Innovative Methods for Restoration and Digital Landscape Design of Abandoned Railway Ruins

LI Xiao¹, a, ZHU Yanrong¹, b

¹Art school, Jiangsu University, Zhenjiang, Jiangsu, China

Abstract. The purpose of this paper is to investigate the abandoned railway ruins, intervene in the innovative methods of digital landscape design, and explore various possibilities of historical restoration of abandoned railway under the background of digital acquisition, protection, restoration and dissemination through four stages. This paper analyzes the fusion path between the historical restoration of railway site and the digital landscape design, which provides a reference for the construction of the digital protection system of railway industrial historical and cultural heritage.

1 Introduction

As the memory landscape of urban development, abandoned railway sites still contain great derivative value and utilization potential. How to systematically and scientifically excavate and utilize abandoned railway sites with unique connotation but scattered distribution? And some on the verge of extinction or destruction of the important sites of abandoned railways for rescue repair? Using digital technology, multimedia information technology, geographic information system and Internet for digital protection is another innovative method for the historical restoration, protection and dissemination of abandoned railway sites.

2 Status and Problems

2.1 Status of research

Railway wasteland belongs to the industrial wasteland of transportation facilities. According to the definition of industrial wasteland, combined with the characteristics of railways, railway wasteland can be defined as: once undertook industrial production and transportation tasks, and later due to industrial transformation or planning changes and the railway land that has been abandoned ¹. From a global perspective, the rapid development of transportation in developed countries such as the United States, Japan, France, etc., has taken into account the space environmental problems caused by the abandonment of urban railways earlier, and different countries have given different treatment methods (Table 1). It provides directions for the restoration and reuse of abandoned railway land in my country.

| Table 1. Treatment of Railway Waste Land in Selected Developed Countries |
|--------------------------|-----------------|----------------------------------|
| Digital technology | Function | Practical application |
| Digital surface model (DSM) | a surface elevation model containing the height of surface buildings, bridges and trees, etc. Based on DEM, it further covers the elevation of surface information other than ground. | It is suitable for bridge, culvert and other cultural heritage of abandoned section of Zhenjiang Huning Railway. |
| Photogrammetry | A three-dimensional object with a distance of not more than 300 m is used for photogrammetry, including contour map, elevation map and plan. | It is suitable for the cultural heritage of the abandoned section of Zhenjiang Huning Railway. |
| 3D laser scanning | Using 3D ground laser scanner, we can work in any complex field environment, and collect the 3D data of the entity directly into the computer, and reconstruct the 3D model of the target and all kinds of data such as line, surface, body, space and so on. | It is suitable for the cultural heritage of bridge, culvert and tunnel in the abandoned section of Zhenjiang Huning Railway. |
| GIS spatial data | refers to the realization of access to spatial data in GIS (geographic information systems), including information about the spatial location, distribution, morphology, formation and evolution of geographical objects. | It is suitable for the cultural heritage of bridge, culvert and tunnel in the abandoned section of Zhenjiang Huning Railway. |

¹295318845@qq.com
b970355653@qq.com

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (http://creativecommons.org/licenses/by/4.0/).
In the 1990s, China began to study the related fields of abandoned railway, most of which are based on the simultaneous research methods of theoretical and practical projects. Among them, the theoretical viewpoints on the spatial planning of abandoned railways are mainly divided into two categories: (1) to change railway ruins into urban roads. (2) to excavate and activate the value of abandoned railways with urban rail transit as the main part. Compared with the former, the latter research is less, starting late.

The earliest similar practice project in China was in 1998, when Dong Sheng abandoned branch line of Taiwan Dong Feng Railway was transformed into a landmark line which integrates sightseeing and sports. Subsequently, Hua Lian Railway Park, China Railway Museum, Hangzhou Jiang Shu Railway site Park, Beijing-Zhang Railway site Park and a series of excellent railway site parks followed.

Compared with the activation and renewal of abandoned railways at home and abroad, scholars in European countries tend to keep all the facilities, or add some design techniques of earth art to carry out innovative transformation, advocating relative art, flexibility, nature and fun. Chinese scholars are more inclined to transform it into railway industry museum and railway culture park, the form is relatively single, but more functional. As a researcher, it is necessary to provide the country with more novel, interesting, valuable, ecological restoration and utilization ideas, and provide multiple suggestions for transformation and utilization.

2.2 Problems and difficulties

Combined with the current research situation and case practice at home and abroad, it is found that the consciousness of landscape renewal of railway wasteland in China is constantly strengthened, but because of the trend of blindly learning from foreign cases in the early stage of exploration, there are also planning problems and design difficulties.

Specific issues are as follows:

- Lack of integration with urban spatial planning\[3\]. The abandoned railway has a negative effect on the overall layout of the city. In landscape reconstruction and reuse, it should not be limited to the railway wasteland as a closed, independent linear greening space, but should consider more innovative ways of integrating the abandoned railway landscape with the urban comprehensive space to weaken its heterogeneity.

- Despite human experience and the simplicity of cultural communication. Under the background of the rapid development of digital science and technology, blindly adopting the landscape techniques and Propagation mode commonly used in modern gardens can no longer meet the current people's experience needs.

- Failed to construct a detailed database of abandoned railway sites and the evaluation standard of railway site value. Each abandoned railway site has different historical time, destruction degree and cultural value. At present, every city or region in China mainly repairs the site landscape of a single railway section, and lacks further integrity, scientific and accurate analysis and evaluation.

In view of the above problems, it is found that the difficulties in landscape restoration of abandoned railway sites in the future are as follows: (1) The data collection of the abandoned railway sites is relatively complicated, requiring scientific and technical input and the participation of professional research teams. (2) The data storage of cultural information related to railway sites requires a permanent and comprehensive approach. (3) The digital display experience is difficult to control.\[3\] (4) The scientific establishment of value evaluation standards.

According to the above difficulties and the application level of digital technology, this paper intends to introduce digital landscape design into the historical restoration of abandoned railway sites.

3 Research area overview

3.1 General Situation of Zhenjiang Old-Shanghai-Nanjing Railway

As the important place for water transportation in the Jiangnan region, Zhenjiang has always been an important transportation and commercial hub in the country\[2\]. In the 34th year of Guangxu in the Qing Dynasty (1908), the Shanghai-Nanjing Railway was opened to traffic and passed through Zhenjiang. Zhenjiang Station was listed as a major station. It was customarily called Zhenjiang West Railway Station during the Republic of China. When the main line was laid on the Shanghai-Nanjing line that year, the branch was led out from Zhenjiang West Railway Station and extended to the riverside of the small wharf. Branch line was laid, a riverside cargo station was set up, and a wharf was set up for rail and water cargo. It is the only transportation hub in the lower reaches of the Yangtze River where railways and ports are directly reloaded. In 1978, after the Shanghai-Nanjing double line was completed, the railway station was moved to the current Zhenjiang Station. The site where the Baogai Mountain Tunnel was located was changed to a branch line, and its transportation function gradually declined. It eventually passed through the main urban area of Zhenjiang and affected the development of the city. In 2004, it was shut down and became an abandoned railway (Figure 1). At present, the Zhenjiang Old-Shanghai-Nanjing Railway still leaves behind the Baogai Mountain tunnel, bunker, construction site site, office building site and other relics.
It is a new batch of municipal insurance in 2014. Three sites have been listed as Zhenjiang’s outstanding historical buildings. Zhenjiang's economic, tourism, and cultural development have brought tremendous value.

3.2 Types of Zhenjiang Old Shanghai-Nanjing Railway Landscape Heritage

The basic research based on landscape morphology can divide the Zhenjiang old-Shanghai-Nanjing railway landscape heritage into tangible cultural heritage and intangible cultural heritage. Therefore, this article focuses on the characteristics of material form. According to the field investigation and summary of Zhenjiang Old-Shanghai-Nanjing Railway, its material heritage landscape can be divided into line heritage landscape, station heritage landscape and background environmental landscape, which are further subdivided (Figure 2).

4 The Innovation of Digital Landscape Design of Abandoned Railway Cultural Heritage

4.1 Digital Landscape Design Innovation for Cultural Heritage

For the cultural heritage, especially the digital protection of the heritage of abandoned railway sites studied in this paper, the following three aspects need to be realized: first, digital protection. Using computer information technology to realize digital restoration and preservation of abandoned railway history, culture and landscape environment, so as to achieve the purpose of protection; second, digital presupposition. By 3 dmax, Sketch up, BIM and other software technology to achieve the preset scene of site planning; third, digital dissemination. Diversified display and dissemination of the digital achievements of the abandoned railway site landscape; fourth, digital detection. Scientific use of modern testing equipment for the heritage of abandoned railway sites for real-time detection and tracking. Compared with the traditional methods above, digital technology has more advantages, such as the long-term preservation of data, the timeliness of information, visual recognition and so on.

According to the characteristics of cultural heritage landscape, digital technology route (figure 3) is used to explore and study. In view of the fact that the restoration of cultural and historical heritage sites is a complicated interdisciplinary system, the relevant information will be digitally collected and processed, such as historical background, cultural foundation, landscape elements, architectural remains, audio and video image data, etc., followed by classification, compression, storage, retrieval and data type analysis[4]. Finally, we use network and virtual reality technology to realize the development of interactive experience platform, as well as the display, dissemination and sharing of cultural knowledge.
4.2 Digital system for abandoned railway cultural heritage

Based on the above analysis of cultural heritage landscape digitization and Zhenjiang Shanghai-Nanjing Railway cultural heritage, this paper puts forward the function and realization of the digital system of landscape heritage in the abandoned section of the railway:

- Through multimedia technology, processing the sound, text, picture, video and other information related to the heritage of the site to realize the digital storage and display of the railway cultural landscape heritage.
- Through data collection and processing, establish the railway cultural landscape related research data database and query interface, and provide storage, recall and retrieval functions.
- The use of three-dimensional digital and interactive systems to establish a variety of interactive methods, and has a tour guide explanation system, to achieve the intelligent tour guide function of the ruins scenic area.
- Repair and restore broken or destroyed historical buildings and cultural relics to enhance the sight-seeing and historical authenticity of the railway landscape.

4.3 Data processing and information database development

Data processing optimization can be divided into two-dimensional data optimization processing and three-dimensional data optimization processing. According to the above methods, the two-and-three-dimensional data can be classified, sorted, archived and analyzed by text editing, video editing, image processing, three-dimensional modeling and other technologies. In order to realize the effective display and dissemination of the information of the Shanghai-Nanjing railway site in Zhenjiang, the core contents of the railway site are extracted, classified and stored based on digital technology. Through analysis and research, five kinds of material database including text database, picture database, video database, audio database, action database and model database are established, and the database and display way are integrated or cross-applied. In addition, it is necessary to compare and analyze various cultural landscape elements on the basis of establishing the virtual reality environment of the railway site, and combine these data with historical data to establish an evaluation system. Among them, the evaluation criteria can be divided into pre-planning site classification standard, integration standard in planning, implementation standard of post-planning scheme and construction evaluation standard to provide evaluation basis for cultural landscape and heritage protection.

5 Summary

This paper mainly discusses the fusion method of historical restoration of railway sites and digital landscape design, and constructs the digital protection system of Zhenjiang old Huning railway heritage cultural landscape through the in-depth analysis of the historical restoration and digital landscape design of abandoned railway sites. Taking the Railway ruins as an example, this paper expounds in detail the role of digital technology in the restoration of railway sites from three aspects: digital method of data acquisition, establishment of data processing and information database, design and development of virtual interactive experience system, and provides ideas for digital restoration and protection of landscape design of railway heritage types.

References

2. Zhu Ning. A Study on Regional Renewal of Old City Railway Station from the Perspective of Production Southeast University, 2018, 41-43.
