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Research on Enhancement of Perception Design of Landscape Pavilion in Tianjin Section of Grand Canal National Cultural Park Based on Cultural Gene

Tan Wei, An Zeyu

School of Fine Arts and Design, Tianjin Normal University, Tianjin, 300387, China

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Abstract: Based on the perspective of cultural genes, a theoretical model of design transformation structure is established using the logical analysis method of cultural genes. The main genes, attached genes, mixed genes, and mutated genes of the Grand Canal culture are extracted and transformed. Then, cultural element extraction, symbol transformation, and color material extraction are used for design deduction. Derive a design strategy for public environmental facilities in the Grand Canal National Cultural Park based on cultural genes. The design practice cases extracted through cultural genes demonstrate the quaint and elegant literati interest, integrating with the surrounding natural and cultural landscapes, enhancing interactive experience and functional perception, and improving the humanistic perception of the Tianjin section of the Grand Canal National Cultural Park.

1. Introduction

In July 2019, the Central Committee for Deepening Reform reviewed and approved the construction plan for the Great Wall, Grand Canal, and Long March National Cultural Park. The meeting emphasized the need to activate the accompanying culture of the Grand Canal through its cultural needs. Culture is the soul of a nation, and extracting cultural genes is an important means of revitalizing and inheriting culture. Public environmental facilities play an important role in improving urban quality and meeting people's daily living needs. They not only play the role of endorsing the city's brand image in public visual and usage, but also undertake multidimensional functions such as service, guidance, decoration, and promotion in the city, reflecting the functional, aesthetic, and cultural attributes of the location. They are an important component of the cultural construction of park cities, providing the public with a better public cultural service experience and endowing them with more diverse tourism functions[1]. Therefore, incorporating cultural gene design into the design of public environmental facilities can not only enhance the connotation and quality of the design, but also promote excellent national culture, enhance people's sense of belonging and identity, and improve cultural perception.

This article aims to take the design strategy of the landscape pavilion for public environmental facilities in the Tianjin section of the Grand Canal National Cultural Park as an example, explore the combination of cultural genes and public environmental facility design, and construct environmental

facility design strategies that highlight regional cultural characteristics from the perspective of cultural gene inheritance. To provide theoretical suggestions and practical references for enriching the construction of the Grand Canal National Cultural Park.

2. The connotation of public environmental facilities in the Grand Canal National Cultural Park

2.1. Concept of Public Environmental Facilities

Public environmental facilities, as tangible carriers of cultural development, carry and embody the cultural genes of the Grand Canal. Public environmental facilities play the role of "urban furniture" in urban development, but their form and function are different from household furniture[2]. Public environmental facilities can create a warmer public cultural space, providing people with a good place to rest and socialize. The establishment of resting public environmental facilities such as pavilions and corridors provides people with shelter from wind and rain, as well as beautifying and promoting culture[3]. The definition of a pavilion in "Yuanye" is as follows: "The pavilion stops." As an important node connecting the route and scenery in the scenic area, a landscape pavilion plays a role in adding color and integrating the scenic area[4]. And it can provide people with a more comfortable multi-level experience during scenic area tours, highlighting the level of civilization and development status of the city[5]. Landscape public environmental facilities can reflect a humanistic value and serve as a carrier of urban culture. Through the extraction and transformation of urban cultural genes, design not only brings convenience to people's lives but also provides conditions for urban development. It is also an important manifestation of urban spirit[6].

2.2. Exploration of Cultural Genes in Public Environmental Facilities

The concept of "cultural genes" can be traced back to the 1950s when Kroeber and Clark Hong first attempted to explore whether there are "cultural genes" similar to biological genes in cultural communication in their book "Culture: Evaluation of Conceptual Definitions". Cultural genes have stability and local representativeness, controlling the expression and inheritance of urban culture. Edward Wilson and Charles Lumesden proposed the theory of "co evolution of genes and culture" [7], which classifies cultural genes into host genes, attachment genes, mixed genes, and mutant genes using typological methods in applied research based on their attributes [8]. From a biological perspective, the host genes determine the properties and external characteristics of an organism. From the perspective of urban cultural inheritance, the main gene belongs to the "maternal" gene that dominates regional culture, and plays a significant role in the regional cultural system, playing a leading role[9]. The attachment gene is the extension and external manifestation of the host gene, which exists depending on the host gene and has significant regional and cultural characteristics [10]. Mixed genes are new gene types formed by the fusion of cultural genes from the same or different regions, which play a role in enriching urban culture[11]. In cultural inheritance, due to the duality of mutated genes, a "survival of the fittest" model should be adopted to maintain benign mutated genes and abandon malignant mutated genes. In the field of public environmental facility design, cultural gene extraction and transformation are used to assist in the selection and determination of shapes, colors, materials, and processes, in order to better spread regional culture.

3. Design and Analysis of Rest Public Environmental Facilities in Yangliuqing Grand Canal National Cultural Park

3.1. Research and Analysis of Public Environmental Facilities in Yangliuqing Grand Canal National Cultural Park

The Yangliuqing Grand Canal National Cultural Park in Tianjin covers an area of over 2800 acres, with the regional culture of the northern section of the Grand Canal and the prosperous history of the Ming and Qing dynasties as its core, integrating modern design elements. After investigation, the park has the following problems: Firstly, there is a lack of distinctive long-term rest facilities within the park. Although the existing seats are practical, their design is ordinary and lacks elements that can represent the characteristics of the Grand Canal National Cultural Park. This makes it difficult for tourists to find a comfortable and culturally significant resting place during their travels. The efficiency of information dissemination in the park needs to be improved. The navigation system is incomplete, with only one main map guide and a few introduction signs, making it difficult for tourists to quickly find their destination or learn detailed information about the attractions during the tour. At the same time, the park also lacks promotional facilities for the cultural heritage of the Grand Canal, making it difficult for tourists to deeply understand the profound connotations of this historical and cultural heritage. The design sense of public facilities in the park is lacking. The design of public facilities such as garbage bins and street lights is too conventional, lacking regional color and uniqueness. This makes the overall environment of the park appear monotonous and boring, unable to leave a deep impression on visitors. In view of the problems existing in the design of public facilities in Yangliuqing Ancient Town, such as the superficiality of cultural inheritance, the lack of characteristics and vitality of the times, and the weakening of cultural genes, it is proposed to carry out the design of public environmental facilities by deeply digging the cultural genes of the ancient town, taking farming culture, business travel culture, water transport culture, etc. as the theme, combining architectural texture, arts and crafts, auspicious culture, spiritual folk and other elements, as well as the new China-Chic trend of the new era.

3.2. Principles for the Design of Public Environmental Facilities in Yangliuqing Grand Canal National Cultural Park

According to the research results, the design of public environmental facilities emphasizes not only the integration of traditional and modern elements, but also the coordination with the surrounding environment and the uniqueness and recognition of the design. Classical, regional, and ecological styles are highly valued in their selection. Everyone is looking forward to providing sufficient rest space, night lighting, and charging services. According to research, public environmental facilities are not only convenient facilities, but also important carriers for providing people with a good environment and experience. From this, the design principles of the landscape pavilion in the Grand Canal Cultural Park can be derived as follows: (1) prioritize practicality over decoration. Environmentally sustainable and in line with regional characteristics. (2) Take simplicity as beauty, integrate the architectural features of the Ming and Qing dynasties, and reflect the new China-Chic. (3) Emphasize local suitability, use locally sourced materials, and focus on warm and wood colors as the main colors. Based on the research of public demand and following the design principles of public demand, extract cultural genes.

3.3. Cultural Gene Localization of Public Environment Facility Design in Yangliuqing Grand Canal National Cultural Park

According to the classification method of urban cultural genes and referring to Professor Liu Peilin's principles for landscape gene classification, the cultural genes of Yangliuqing region can be matched and classified into four types: main genes, attachment genes, mixed genes, and variant genes[12]. The agricultural culture, which plays a dominant role in urban culture with regional cultural dominance, is the main gene of Yangliuqing, manifested as the 24 solar terms and related festival activities derived from agricultural culture. The main gene also includes folk culture and business travel culture, among which the folk culture is represented by willow youth paintings, stone carvings, kites, and Paper Cuttings. The culture of business travel is represented by the culture of rushing to large camps and the culture of water transportation. Attachment genes have cultural recognizability and are unique to cities along the canal, which can enhance urban culture. Architectural landscapes, natural scenery, and other material types are also representative. Through attachment gene recognition, the landscape features the northern architecture and regional style of Yangliuqing. Mixed genes are cultural genes that are unique to local cultural characteristics and compatible with other regional characteristics, with cultural relevance. The mixed genes of Yangliuqing include auspicious culture that represents people's expectations of harmony, beauty, abundance every year, patriotism, and the spirit of hard work and entrepreneurship. Variant genes are a kind of genes that have a benign and malignant impact on urban culture under the influence of the new environment. They have the characteristics of variation, integrate new elements in the historical evolution, and are reflected in the Yangliuqing cultural genes. Their benign variant genes are the variant genes under the cultural needs of the new era of China-Chic town and cultural town planned in the future of the Grand Canal National Cultural Park.

4. Design Practice of Rest Public Environment Facilities in Yangliuqing Grand Canal National Cultural Park

4.1. Activation of urban characteristics and cultural perception by main genes

The activation of main genes mainly starts from visual images with regional characteristics, combined with urban history, cultural elements, and architectural spatial features. Symbols are all materials that can express ideas and concepts through images[13]. In the process of extracting and transforming the main genes, symbolic techniques from semiotics were used. For example, the design of the extended seats in the landscape pavilion used the element "camel hump" curve shape extracted from the main genes of business and tourism culture as the bottom shape of the chair. The chair surface has a curved groove shape, reflecting the winding and continuous curve characteristics of the Grand Canal. And in front of the long chair, there are three small single chairs with a boat shaped break. The bottom of the single chairs is uniformly decorated with lotus themed elements from Yangliuqing folk New Year paintings, allowing the decorative language to blend with the overall design. The overall design of the pavilion's top is based on the local agricultural culture of Yangliuqing as the main theme, and incorporates cultural elements into the landscape pavilion design of Yangliuqing Grand Canal Cultural Park. Using the traditional agricultural culture concept of 24 solar terms and the principle of solar shadow projection in the gnomon, the top of the pavilion is designed with solar shadow projection function. The gnomon is an ancient instrument that uses the principle of the length of the sun shadow at noon to indicate different scales to express corresponding solar terms and guide agricultural production. It allows solar terms to be more intuitively perceived and interpreted by people, and is the crystallization of the wisdom of ancient Chinese laboring people. In the specific design process, based on the latitude of Tianjin, which is approximately 39.12 °N, the

noon solar altitude angle for the corresponding solar term can be calculated. Based on the functional relationship between object height (h), object shadow length (x), and solar altitude angle (α) (x=h/tan α), corresponding scale calculations were carried out, so that at noon, the corresponding twenty-four solar terms can be accurately displayed at the top of the landscape pavilion according to the projection position of the sun shadow. The top of the landscape pavilion draws inspiration from the traditional roof design of the ancient town, with grooves embedded in a combination of transparent acrylic and white DuPont paper material, exhibiting excellent light transmission and shadow characteristics. There are corresponding solar term scales on its inner side. When the sunlight shines on the roof, the height difference of the herringbone shape at the top of the pavilion will be projected onto the top of the pavilion. With the help of the transparent shadow material and corresponding solar term markings on the top of the pavilion, the current solar term can be intuitively displayed on the inside of the landscape pavilion top. (See Figure 1)

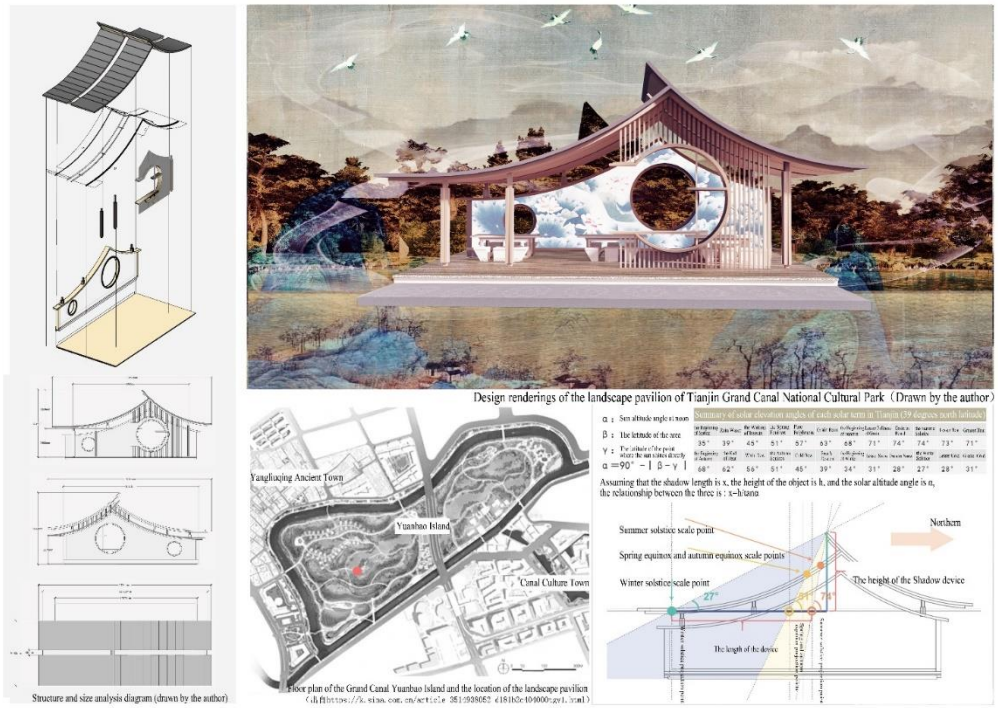

Figure 1: Renderings of public environmental facilities in the Grand Canal National Cultural Park

4.2. Cleverly utilizing attached genes to enhance interactive experience and functional perception

Deeply explore the local attachment genes of Yangliuqing, based on the courtyard walls and roofs of the ancient town, transform through streamlined design, and innovate the main shape design of the landscape pavilion. The landscape pavilion is located in a shallow water area of a spacious public activity space, where people gather and provide comprehensive services. Drawing on the essence of the roof design of Yangliuqing Courtyard, using deconstruction and fusion design techniques, it is cleverly integrated into the top design of the landscape pavilion. In terms of styling, the main technique is the interplay of curves and straight lines, showcasing a unique and harmonious form of design. The main body of the landscape pavilion is composed of a projectable background wall and a half wall design with a sloping front facade, mainly to meet the functional requirements of sun and rain protection and cultural display. Drawing inspiration from local architectural colors, with a focus on warm and neutral tones, complemented by wood colors to harmonize with the environment. The top is made of black material combined with solar panels, reflecting the charm of modern technology

and energy support. The white walls echo the inner lake surface of the Grand Canal National Cultural Park, presenting a fresh and elegant atmosphere. The frame of the landscape pavilion is made of anti-corrosion wood and bamboo steel materials, which are sturdy, durable, and have a sustainable design concept. The entire design incorporates the regional color characteristics of the local cultural genes, using modern color matching techniques that are more in line with modern aesthetics.

4.3. Mixing genes to optimize element composition and spiritual perception

To activate cultural perception, we need to start by deepening our understanding of multiple elements such as cities and historical culture. On the basis of complete functionality, the design should incorporate elements of regional cultural characteristics to meet the experiential needs of tourists for the historical and cultural heritage of the scenic area. Yangliuqing and its surrounding areas carry rich auspicious culture and spiritual folk genes, and these elements are integrated with local folk meanings in the design. Using the theory of situational experience to design landscape pavilions, the design of landscape pavilions is full of spiritual perception and can bring profound situational experiences to tourists [14]. This case selected the most regionally influential craft art Yangliu Youth Painting from the mixed genes as the design theme, integrating auspicious culture and spiritual customs to meet contemporary people's pursuit and desire for a better life. In the design process of the Shanshui Pavilion, elements such as willow tree youth paintings and interactive projection technology are integrated to provide visitors with a unique cultural experience and perception. The top of the pavilion's background wall is equipped with a laser projection device, which projects the unique folk New Year painting culture, architectural culture, auspicious culture, etc. of the area onto it in the form of dynamic images. This not only visually showcases the profound cultural heritage of the Tianjin section of the Grand Canal National Cultural Park, but also immerses tourists in an immersive experience. Using laser projection technology, dynamic scenes of Yangliuqing paintings are projected onto the background wall of the facility at night according to the corresponding seasons, seasonal terms, or traditional festivals. Interactive technology is used to capture tourists' interactive actions in real time, enhancing the expression and interactivity of the facility's regional cultural characteristics, and endowing it with deeper cultural connotations and artistic value. This enhances the display effect of local intangible cultural heritage, strengthens the expression of local cultural genes and characteristics, and creates an immersive travel experience for tourists, making them feel as if they are in a painting and experiencing the unique charm of Chinese culture. The level of spiritual perception still needs to be further improved, and facility design needs to be optimized. The bottom of the pavilion is decorated with imitation wooden strips symbolizing the waves of the Grand Canal, which, together with the lotus pattern on the bottom of the small armchair, create a painting of "lotus growing step by step". In terms of color, the main color is natural wood, which blends with the green brick walls of the block and echoes the ink landscape. It not only showcases the culture of the Dayun River, but also evokes people's imagination of the historical poem of smoke, willows, and blue waves. Design and transform the attached genes, highlight the architectural culture of the ancient town, stimulate users' perception of the history and culture of the landscape pavilion, and strengthen its cultural attributes.

4.4. Mutated genes highlight the integration of traditional culture and contemporary culture

Cultural genetic variation is similar to biological genetic variation, with both benign and malignant aspects. Benign mutations preserve the excellent parts of the original cultural genes, absorb foreign cultures to form new cultural genes, and promote positive cultural development. In the design process, taking the user's spiritual perception connotation as the starting point, analyze the user's psychological, emotional and other needs, follow the design concept of emotionalization and humanization, fully

consider the user's multiple needs from use to experience. In terms of material selection and color matching, the seat base adopts wood carving technology, and the surface is treated with anti-corrosion and sprayed with transparent paint, which complements the local architectural color and texture. The built-in charging device on the seat surface is convenient for users to charge, meeting the fast-paced and convenient needs of contemporary people. On the premise of maintaining the stability of cultural subject gene attributes, it is possible to better meet the spiritual needs of contemporary people through the translation and transformation of cultural genes in the era. By combining modern design with functional requirements, functional requirements that meet the needs of the times have been extracted, achieving a benign transformation and development of traditional cultural genes, better adapting to contemporary society and meeting cultural needs in the new era. It showcases the charm of traditional culture from multiple aspects of design and incorporates modern technological elements such as interaction and wireless charging of mobile phones, making it more in line with the needs of modern people. This modern transformation and development of traditional cultural genes can help inherit and promote Chinese traditional culture, while also meeting the increasing demand for public environmental facilities in the new era. The landscape design of the Tianjin section of the Grand Canal National Cultural Park triggers people's reflection on the spiritual connotation and emotional memory of the city, enhances users' spiritual perception of the landscape, and showcases its unique regional cultural atmosphere.

5. Conclusion

This article aims to achieve the cultural inheritance and dissemination of the Grand Canal Cultural Park in the field of public environmental facility design through gene extraction and design transformation in the public environmental facility design of the Tianjin section of the Grand Canal National Cultural Park. By locating urban culture, extracting representative design elements from urban cultural genes, and combining design elements such as public environmental facility functions, styles, and materials, it is transformed into a public environmental facility design that reflects the urban cultural genes. In the design process of public environmental facilities and landscape exhibition halls, cultural genes are extracted and transformed, and regional culture is integrated to become a propaganda medium and material cultural carrier for inheriting and disseminating regional culture. Reflecting cultural genes in the design of landscape pavilions in terms of form, color, craftsmanship, and materials can better enhance regional identity, inherit and develop regional culture. There are many factors that contribute to the cultural inheritance of the Grand Canal National Cultural Park. This study only explores the extraction and transformation of cultural genes from public environmental facilities in the construction of the Grand Canal Cultural Park. In the future, other perspectives can be used to study the cultural inheritance and development of the Grand Canal National Cultural Park.

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