Research on the Integration of Bridge Structure and Landscape Art Combined with Two-dimensional Computer Image

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Abstract. With the change of the public's aesthetic concept, people's requirements for the landscape and art of bridges are constantly improving. The connotation of bridge has developed from the original traffic architecture to the carrier of human landscape and historical culture. Therefore, integrating the concept of landscape art into bridge design is an important development direction in the field of bridge design. This paper expounds the connotation of landscape art in bridge design, and enumerates the typical application of the landscape art concept in bridge design. On this basis, this paper analyses the advantages of computer two-dimensional image technology for bridge landscape design, and discusses several aspects that should be improved in future bridge landscape design, which provides new thinking and reference for modern bridge design.

Keywords: Bridge Structure, Landscape Art, Computer Two-dimensional Image

1. Introduction

The bridge is one of the earliest building types of mankind. A perfect bridge is not only the crystallization of the designer’s extraordinary wisdom and creativity, but also the symbol of the times and cultural heritage of the region. In modern society, the significance of bridge construction is not only a way to cross obstacles, it also gives people more spiritual meanings such as crossing and radicalization. Therefore, how to make the bridge present in front of the public with the posture of "beauty" is particularly important. In this context, designers should fully realize the importance of landscape art for bridge design, and only in this way can we create modern bridge buildings that are more in line with people's aesthetic requirements.

2. The influence of landscape art on bridge design
2.1. The connotation of landscape art in bridge design

The bridge landscape art design refers to the harmony between the bridge landscape and the surrounding landscape scale, which includes the respect and integration of the local cultural environment, as well as the reasonable protection of the bridge construction to the natural original environment of the bridge site \(^1\). American landscape architects also give new connotation to the expression of culture and aesthetic characteristics in bridge landscape design, that is to achieve the unity of bridge function, aesthetics and culture. Therefore, the urban bridge built in modern times is far from the purpose of meeting the functional requirements in the past \(^2\). The extraordinary span, strong artistic expression (mainly reflected in the magnificent bridge body) and the extraordinary scale of the bridge all have a significant impact on the city or the earth landscape where the bridge is located.

2.2. Problems in the current bridge landscape design

At present, the bridge design technology has made a great breakthrough, but with the change of the public's aesthetic concept and the increasing requirements of the city for environmental coordination, the shortcomings of the bridge in the landscape art design are more and more obvious.

(1) There are some misunderstandings in the landscape design of bridges. Designers believe that the quality of bridge construction is only related to the structural design of the bridge, which leads them to easily overlook the landscape design work of the bridge.

(2) Designers believe that the bridge landscape design is just an afterthought packaging. They did not give a general consideration to the bridge landscape during the bridge plan design stage, which led to the emergence of "pseudo bridge type". They often just add too much decoration outside the structure, such as simply refitting the beam slab structure into a cable or arch.

(3) In the night lighting of city bridges, more consideration is given to the demand for traffic lighting, which leads to the lack of scrutiny of architectural art by bridges. For example, some urban bridges only seek to illuminate the bridge body, and do not make systematic lighting design according to the characteristics of the bridge type. Therefore, although the bridge is fully illuminated, the final effect of its lighting is to eliminate the space with the distinct bridge structure, which does not reflect the artistic expression of night lighting on the bridge landscape.

3. Integration of the landscape art concept and bridge structure design

3.1. Aesthetic principles in bridge landscape art design

Aesthetic law is the guiding principle in the design of bridge landscape art. Only by strictly following the aesthetic law and flexibly specifying the design scheme according to the actual situation, can we create a more perfect bridge building.

(1) Coordination and unity. Coordination refers to the coordination of bridge shape and environment in living space. Unity refers to the organic unity of all parts of the bridge and the environment.
(2) Symmetry and balance. Symmetry refers to the equivalent combination of various elements such as shape and volume \[^3\]. These elements are not absolute quantitative equivalence relations. All parts should be reasonably matched during design to make the bridge visually give people a regular, solemn and balanced beauty.

(3) Rhythm and rhythm. In terms of the overall composition of the bridge in the environment, each part of the bridge presents its own rhythm. In the design process of the bridge landscape, each part should be combined to make the whole bridge present a sense of rhythm and rhythm.

3.2. Typical bridge design with the concept of landscape art

The design of the bridge landscape is a process that determines how the bridge communicates with space and people through its temperament, posture and expression \[^4\]. For designers, only by paying attention to the integration of bridge landscape and space and elaborating history and culture flexibly, can bridges have vitality.

(1) The Shanghai Disneyland landscape pedestrian overpass is a space curved beam the unilateral suspension landscape bridge, which is located on both sides of the central lake of Resort Park and consists of two East and West overpasses across the Laker landscape. The design of the suspension landscape bridge is unique in that each bridge is a single-sided suspension bridge, which is composed of the main and auxiliary bridges. This kind of design is ingenious, and the bridge body is like a crescent moon reflected in the lake, which perfectly matches the romantic colour of Disney. Figure 1 shows the physical object of Shanghai Disneyland landscape pedestrian overpass.

![Figure 1. The Shanghai Disneyland landscape pedestrian overpass](image)

(2) The Hua-shan bridge has a high demand for design scheme, which not only requires to realize the unity of function, beauty and culture to the maximum extent, but also makes it a regional cultural focus and image window. The arch tower cable-stayed bridge is adopted in the bridge, and the curve of the arch tower comes from the refining of the sail shape. Viewed from the facade, the arch tower is slightly off to one side, and the overall shape is dynamic, just like a sailboat driving on the lake.

(3) Yanpingba Yangtze River Bridge is a landmark building in Yibin City. Both sides of the bridge site are urban new areas hidden in the mountains. Its landscape design needs to integrate the environment to become a good place to view and a landscape landmark. A new cable-stayed bridge is built between the two mountains, which perfectly connects the mountain boundary between the two sides, which is separated by the Yangtze River. Through this form, a compound landscape subject of
"water, bank, bridge, mountain and city" has been formed.

4. The development trend of bridge landscape art design in the computer age

4.1. The application of computer two-dimensional image in bridge landscape design

The diversified design requirements make computer-aided design technology more widely used in landscape design, and gradually become the mainstream way of landscape design. Compared with the past manual drawing method, the computer two-dimensional image technology represented by CAD can not only save the design time, but also preview the effect and modify it in time [5]. In this way, people do not need to worry about frequent changes caused by drawing mistakes when designing complex and varied bridge landscape. As the bridge shape reflects the rationality of the building structure, the shape should distinguish the main and secondary stress structures, including the main bridge and approach bridge, the main hole and secondary hole, the main structure and auxiliary facilities, etc. The designer needs to carefully consider the relationship between the proportion and the scale after meeting the use function, so as to maintain the aesthetic feeling of the overall structure of the bridge. Therefore, the advantages of computer two-dimensional image technology in bridge landscape design are highlighted. Figure 2 shows the CAD plan of Qingma Bridge.

![Figure 2. The CAD plan of Qingma bridge](image)

4.2. Key points of deep integration of bridge structure design and landscape art

(1) The landscape effect of the bridge is usually placed in various "symbolic meanings", so the bridge must be able to properly and fully express it [6]. In bridge design, pure innovation and change may make the bridge the most popular thing, but at the same time, it will be eliminated very quickly. Because this kind of design often lacks the consideration of historical accumulation, it is difficult to resist the changes of the times. For the permanence of the bridge, the design scheme must have the rich cultural connotation to make the design more convincing.

(2) Designers must pay attention to the construction of bridge details. Bridge details include many elements, such as street lights, railings, pedestrian channels, ground materials, signs and markings, bridge nameplates, night lights, stairs, etc. The bridge details can show the intention of the bridge aesthetic designer, increase its readability and integrity, and the fine auxiliary facilities design will make the bridge more artistic beauty of details. Therefore, auxiliary facilities are not independent parts of the bridge, which can make the bridge obtain more overall aesthetic feeling. Detail design can not only affect the bridge design, but also explore the advantages and disadvantages of the bridge when the design is completed. At the same time, it is a method to improve the space environment and the
surrounding environment of the bridge itself.

(3) In order to make the visual balance, in the case of more horizontal lines in the design, reasonable layout of vertical line modeling will make the visual effect have a clear rhythm. In the bridge with the main characteristics of being straight and upward, the appearance of horizontal lines will make the overall effect more peaceful and calm. Both of the two methods can make the whole bridge reach a balance, which is helpful to express the "emotion and spirit" in the bridge modeling design.

5. Conclusion

Modern bridges are no longer purely for the purpose of meeting the traffic function. The design aesthetics, creative thinking and innovation ability of bridges have attracted more and more attention. The construction of the bridge should not only pay attention to the construction technology of the bridge itself, but also pay attention to the form aesthetic design and the coordinated design of the surrounding bridge landscape. Therefore, in the contemporary bridge design, designers should flexibly use computer two-dimensional image technology to fully integrate the concept of landscape art. Only in this way can we endow the bridge with the overall aesthetic feeling in art and make the bridge a model of contemporary architecture.

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