Application of traditional water conservancy wisdom in the landscape of Suzhou Grand Canal

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Abstract. China has a long history of shipping and an extremely rich cultural heritage of the Grand Canal, traditional water conservancy is an important part of it. As a section of the Beijing-Hangzhou Grand Canal, the Suzhou Grand Canal has a profound impact on the historical development of Suzhou. In the context of the revitalization and activation of the historical heritage of the Grand Canal, this paper follows the superior planning of the Suzhou High-tech Zone Planning Branch, takes the nodes along the Suzhou Grand Canal from Hengtang to Fengqiao as the base of creation to sort out the Suzhou Canal culture and traditional water conservancy’s technology. The purpose of this article is, from the perspective of the application of water conservancy facilities in the design of modern waterfront landscapes, to explore the possibility and reference of the combination of historical and cultural heritage rejuvenation with contemporary urban life, traditional wisdom reuse and contemporary landscape design.

1. Introduction
As the main transportation means of ancient China, the Beijing-Hangzhou Grand Canal has a vital impact on economic and social development. In 2014, it was included in the World Cultural Heritage List. In 2017, after inspecting Tongzhou, General Secretary Xi Jinping made important instructions on deepening the historical and cultural resources centered on the Grand Canal and protecting the ecological environment of the Grand Canal. Under the background of this era, the revival and activation of the historical heritage of the Beijing-Hangzhou Grand Canal is the general trend. The Suzhou Municipal Planning Bureau High-tech Zone Planning Branch seized the strategic opportunity of the Grand Canal Cultural Renaissance and organized and revised the Urban Design along the Grand Canal of the Hengtang-Fengqiao Section of Suzhou High-tech Zone, which further improved and upgraded the urban planning of the core areas along the Grand Canal, and strive to create the Grand Canal Scenic Belt in Suzhou High-tech Zone.

2. The wisdom of traditional water conservancy projects--Take Dujiangyan as an example
Controlling floods and ensuring water conservancy was not only the foundation of the feudal society’s agricultural economy, but also an important condition for maintaining social and political stability. The rulers of all ages attached great importance to water conservancy construction. In the long process of development, traditional Chinese water conservancy has the characteristics of early formation, complete variety, large scale and diverse types [1]. Among the many traditional water conservancy
projects in ancient times, the “Dujiangyan” (Figure 1), which was presided over by Li Bing and his sons during the Qin Dynasty, is the most famous water conservancy and is called “the originator of world water culture”. It cleverly utilizes the special hydrological and topographical features of the Lancang River exit, and sets up three main projects: Yuzui (divided water dike), Feishayan (spillway), and Baopingkou (inlet). The Lancang River flows through Yuzui and is divided into the inner and outer rivers with 40% and 60% current, respectively, thus achieving the purpose of automatic diversion of the river. At the same time, the sandstone in the river is divided into concave and convex banks, most of which are automatically discharged from the outer river and less into the inner river. The rest of sandstone is then returned to the outer river by Feishayan. Finally, the river water is controlled by Baopingkou and then enters the Chengdu Plain. Flood change into water, and the water function is still functioning normally for two thousand years. It is a model of harmony between man and nature, man and water. The Lancang River forms a radial water network from the northwest to the southeast, which lays the foundation for the fan-shaped natural and cultural landscape pattern of the country of Tianfu. Dujiangyan is the starting point of the Tianfu fan. The Dujiangyan Water Culture Square (Figure 2), which was completed in 2002, is the core or “shuikou” of Dujiangyan City. The planning and design starts with the local natural culture, the status quo of the place and the lifestyle of the local people. The modern landscape is used as the design type, and the landscape design is understood as the process of interpreting the spirit of the region and the place [2, 3]. Water is the dominant landscape element, and its design is inspired by the Dujiangyan monuments, reflecting the ancient and profound water culture of the area. The stone culture, architectural culture and planting culture generated around the treatment and utilization of water make the city square closely related to the local texture, which contains profound cultural connotations, a rebirth of the ancient water conservancy project. Through the medium of landscape, visitors further recognize and inherit the water and wisdom of their ancestors, and the heritage is protected by “activation”.

![Figure 1. Dujiangyan historic site plan (Image source: http://www.pep.com.cn/skzhyd/czls/js/tbjx/xjcxxa/7s/201008/20100827_810691.htm)](image1)

![Figure 2. Dujiangyan water culture square (Image source: http://www.cila.cn/news/43876.html)](image2)

In the history of a thousand years after the opening of the Grand Canal, it took on the heavy responsibility of north-south commodity exchange, and has made great contributions to the country's political stability and economic development. Today, it is still the largest and busiest segments of the Grand Canal in China. For instance, Yandai is a water conservancy facility invented to regulate the water level drop of the river, stabilize the water volume of the canal, and ensure ship passage. It is constructed of earth and stone or grass and wood materials. In the upper and lower reaches of the river, the gentle slopes are made of stone, and simple machinery is placed on both sides. Animal force is
used to pull the ship through. It is an inchoate ship lifting equipment, but it is too labor-intensive, the ship wears seriously, and the delay time passes. In order to improve the shortcomings of Yandai, people invented Doumen, which uses a wooden door that can be freely opened and closed to block water. It is a single-door ship lock and has been widely used on the Grand Canal during the Northern Song Dynasty (960 to 1126). In order to further improve canal capacity, a compound ship lock and at Ou Gate were constructed. The layout and application of the compound ship lock are the same as those of the modern ship lock. The Ou Gate is a water-saving ship lock, using a water tank next to the gate or a specially opened pool for water storage and drainage [4-6].

3. Thoughts on the waterfront landscape design of Suzhou Grand Canal

3.1. Location analysis

The Grand Canal Scenic Area of Suzhou High-tech Zone is located in the north from Hanshan Bridge and south to Youxin Elevated, with a total length of 11 km. The target site is located at the intersection of Canal Road and Dengwei Road, adjacent to the Jinshan Bridge, facing the Canal Park across the river, with the Hanshan Temple and Fengqiao Scenic Area in the northeast and the commercial center in the south (Figure 3). The site covers an area of about 1.3 hectares. The riverside landscape does not fully explore the historical and cultural values of the Grand Canal and lacks space features. In addition, the flood control of the high embankment breaks the living habits of the Suzhou people. The Grand Canal is a far-sighted view for the citizens, but you can't get involved (Figure 4).

Therefore, the design faces two major challenges: 1) How to use the traditional water conservancy wisdom to deal with flood, how to deal with the relationship between the canal water conservancy facilities and the site, to establish an ecological landscape that allows flooding to form a harmonious unity with the surrounding environment? 2) How to enhance the cultural connotations of the waterfront landscape of the Grand Canal, integrate the public service functions of recreation and cultural heritage, strengthen the citizens' cultural identity and heritage protection awareness, and provide citizens with an open space to experience the traditional canal life?

3.2. Design concept

3.2.1. "Living heritage protection" The protection of living heritage originates from the protection of the living value of the heritage. The original use of historical buildings in the West is currently an internationally recognized method of heritage protection. The so-called "living state" mainly means that the heritage not only has the attributes of "heritage", but also the testimony of history and culture,
and still has its original functions, and continues to play a role in modern society [7]. The 5,000-year-old civilization has left many cultural relics and wisdom. Modern people can only inherit the splendid history and culture through the records in the books, the static display in the museum or the three-dimensional image. The protection of living heritage is a kind of protective thinking that is different from the “museum” protection by modern means such as texts, audio and video presentations.

The Grand Canal, as a water conservancy project that cooperates with man and nature, is a concentrated expression of the collective wisdom creative spirit and hard work of the ancient people. This dynamic and river section has made positive contributions to economic and social development and has basically maintained its originality. Some routes continue to function as shipping routes, water conservancy and ecological storage. It is an important living heritage in China and the basis and source of inspiration for water conservancy landscape design. However, at present, the design of water conservancy landscapes in China is mostly the landscape, ecological treatment of water conservancy facilities and the design of garden-style water conservancy scenic spots, ignoring the links of landscapes to historical and cultural heritage. Therefore, landscape design should follow the "protection of living heritage ", carry out exploratory research from the perspective of the application of water conservancy facilities to retain their functions. Traditional wisdom can be translated to serve the modern human life through continuous dynamic adaptation, and continues to play its role in effective combination with contemporary landscape design [8].

3.2.2. Use water "power" to use it

The multi-purpose wetland of Furong bam’s lake bay, Hanfeng Lake, Kaizhou District, Chongqing City, built in 2018, draws on traditional water conservancy projects such as Dujiangyan and Lingqu in China's farming era, and the ecological wisdom related to the concept of water control, water use in the ecosystem, using natural forces to maintain river stability and river ecosystem integrity, design and build a multi-functional wetland ecosystem system with a layered structure adaptable to seasonal water level changes[9-11]. Traditional wisdom may have certain limitations in the context of the rapid development of social economy and science and technology, but its adaptation to the physical environment and the pursuit of harmony between humans and land coincide with the principles of contemporary ecological conservation. It can be concluded that the design needs to learn from and continue the traditional wisdom, and to innovate and improve, and constantly explore ways to coordinate human development and ecological reconstruction.

Suzhou is located in the humid subtropical monsoon climate zone of North Asia. It is humid and rainy, and the rainy season is often disturbed by floods. Therefore, a cement levee was built along the river bank in the site to cope with the flood with return period of 100 years, but it cut off the connection between people and water, soil and water, as well as plants and water. The restoration design can draw on the ancient method of “managing floods into available resources”, allowing people to live in harmony with nature and water, and use flood as a resource that can be combined with ecological protection, cultural protection and recreation functions to connect cities[12]. The green and blue patches provide a variety of services for the city. That is to say, the use of water "power" for the benefit of the site and the whole city.

4. Design plan

4.1. Ou gate

Chang'an Gate (Figure 5) is one of the three major conservancy in ancient Jiangnan area, and has complex structure of the Ou Gate. It employs three gates and two reservoirs to achieve water diversion, water storage and recycling [13]. The plan takes into account the two-meter height difference between the waterfront boundary of the site and the water surface of the canal. Plan simulate the water function of “Ou Gate” (Figure 6), combined with the modern landscape design method, designed a double-layered ship lock to guide the canal water to a site two meters above the water surface. Two reservoirs (Shang Ou and Xia Ou) and two steering wheels for visitors to experience operation are provided next to the gate to assist the ship lock to adjust the water level. The specific operation steps are as follows:
When the ship passes the first ship lock, the tourists can transfer the water in the second canal to the first water storage tank by rotating the steering wheel on the shore until the water level of the waterway is flat, the first ship lock is lowered and the ship smoothly enters the second water channel. In the second step, the water in the first reservoir is re-introduced into the second canal, and the water in the third channel is transferred to the second reservoir, so that the water level of the two canals is flat and the ship can enter the third. The water in the second reservoir is then returned to the third canal, completing the entire process of overcoming the span of the height difference. The water in the second reservoir is then returned to the third channel, completing the entire process of overcoming the span of the height difference (Figure 7, Figure 8). The steering wheels set on the site is not only the hub for maneuvering the water level and the ship lock, but also the link that promotes the interaction between people and landscapes, people and traditional water conservancy facilities, and promotes the combination of traditional wisdom and modern life.

**Figure 5.** Changan Gate floor. (Image: Jiali Zheng, Zeming Lou. Investigation and excavation of Chang'an Gate Site in Jiangnan Canal [J]. Cultural Relics of the East, 2013(03):26-33+4.)

**Figure 6.** Ou Gate principle demonstrations.

**Figure 7.** Schematic diagram.
4.2. Terraced flood control embankment

Drawing on the idea of utilizing the power of nature in traditional water conservancy projects, the scheme aims at restoring the natural regulation of the river bank and the function of responding to floods also ensuring the flood control safety of the site. Therefore, the hard high embankment in the site was transformed into a terraced flood control embankment (Figure 9). The terraced flood control embankment consisted of 3 to 4 stone cages combined with terraced terrain, which was distributed in a stepped manner. The highest level stone cage retaining wall can cope with the 100-year flood. Combining the stone cage with the terraced field as the retaining wall of the terraced field can not only improve flood control, but also incorporates it into the walking path of the walkway system with different heights suitable for flooding, and it is also possible to form a groove for planting plants with the upper stone cage. The rising water level of the canal in the rainy season can leave fertile sediment in the grooves, providing sufficient nutrients for all kinds of native vegetation, making the river bank a vibrant natural landscape. On the other hand, multi-level planting belts can intercept surface runoff and non-point source pollution from the sites, purify pollutants in river water and excess nutrients. As a transitional area between the whole site and the canal, the terraced flood control levee can simultaneously function as a resting space, flood control and ecological restoration, and realize the solution and utilization of flood.

5. Conclusions

First, the scheme restores the material connection between the land and the river by repairing the hard river embankment, and uses the seasonal changes of the flood to provide the plant with material for growth, thereby achieving the purpose of purifying the river water and reconstructing the waterfront ecosystem, and enhancing the ecological adaptability of the landscape. Secondly, it draws inspiration from local traditional culture, historical legacy and customs, connects the context of the venue, inherited historical and cultural heritage, strengthens people's cultural identity, and awareness of the cultural landscape heritage. Finally, through the interaction of landscapes, the venue and people's activities are organically combined to create a space for experience and socialization, and realize the social participation of the landscape. The scheme attempts to create an ecologically functional landscape that adapts to floods, a memorial place that cherishes historical culture, and a public space where citizens interact with waterfront. It allows exploring the effective combination of historical with cultural heritage revival and contemporary urban life, as well as traditional wisdom with contemporary landscape design.

Traditional wisdom is the result of the ancient working people's perception of nature. For thousands of years, this wisdom has effectively maintained production and life in the feudal society. Modern landscape design needs to screen, transform, change and strengthen traditional wisdom according to its specific needs. Compared with the static understanding and passive acceptance in museums and in books, landscape design can show the elements of traditional wisdom applied in a more interactive way, through daily use in modern life.
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