Journal of Architectural Research and Development, 2025, Volume 9, Issue 3
https://ojs.bbwpublisher.com/index.php/JARD
Online ISSN: 2208-3537
Print ISSN: 2208-3529

Research on Urban Waterfront Landscape Design Based on the Concept of River Ecological Restoration—Taking the Section of Chongqing Institute of Engineering on Huaxi River as an Example

Ni Lan*

Chongqing Institute of Engineering, Chongqing 400056, China

Abstract: Since the reform and opening up, the development approach targeting urban economic growth has led to a sharp increase in the proportion of impervious hardened surfaces in cities and significant waste of natural resources. The urgent need for water ecological civilization construction is of great significance to the continuation of human civilization in the long run. This paper focuses on the urban waterfront landscape design of the Chongqing Institute of Engineering section of the Huaxi River in Banan District, emphasizing the concept of "symbiosis". Using site cultural symbols as a medium to connect the campus and the city on both sides of the river, returning the riverbank to the people, restoring the ecological space of the riverfront, enriching the landscape belt, promoting the protection of bird and fish habitats, and stimulating the vitality of the riverbank space; it aims to pave the way for ecological restoration, functional expansion, landscape renewal, and riverfront space activation at the study site.

Keywords: Waterfront landscape design; Symbiosis concept; Ecological design; Chongqing

Online publication: May 30, 2025

1. Introduction

1.1. Project background

Since the reform and opening up, rapid urban economic development has had a significant impact on the ecological environment. The urban development approach, which prioritizes economic growth, has resulted in a drastic increase in the proportion of impervious hardened surfaces and substantial wastage of urban resources. The 18th National Congress report also emphasized the integration of ecological civilization construction into the "five-in-one" structure of socialism with Chinese characteristics. As we all know, water ecological civilization construction is a closely related and integral part of ecological civilization construction. Undertaking water ecological civilization construction is a major strategic issue of high concern for social development. The concept of "ecological civilization" construction presents new requirements and directions for urban waterfront landscape design.

Historically, most cities were built near water bodies, as water is an essential resource for survival, transportation, and daily life, closely linked to social civilization development and residents' daily activities [1]. In the context of vigorously promoting policies such as ecological civilization construction and water environment protection, enhancing urban river environments and optimizing waterfront spaces have become crucial issues in environmental construction. Furthermore, with the continuous improvement of urban residents' quality of life, their demands for health, sports, and nature are increasing, and their multifunctional demands for waterfront spaces are also rising. Traditionally constructed waterfront spaces can no longer meet residents' needs for water-friendly activities. Simultaneously, urban development also poses more complex and diversified functional demands on urban waterfront spaces, such as beautiful natural scenery, the embodiment of urban cultural identity, and open and diversified public spaces [2].

Urban waterfront areas are the birthplace of urban civilization. Chongqing is a city shaped by rivers. How to effectively utilize the resource of Chongqing's public waterfront areas and scientifically transform them into functionally complex, humanized, and ecological spaces is a question worthy of deep consideration and long-term planning [3]. Chongqing is a typical mountainous city bordering a river, and the waterfront area of Jialing River has become a physical carrier of Chongqing's historical development and changes due to its special geographical location, spatial pattern, and spatial functions. This allows the public to glimpse into the development of Chongqing people's daily life, cultural customs, and historical evolution, reflecting the city's spiritual style in a diversified way. At the same time, it has also become an important gateway and carrier for Chongqing to promote inland opening. Currently, due to factors such as historical construction, natural geography, and planning, there are many problems in the development of Chongqing's urban waterfront space, and many scholars in the field of landscape design are also stepping up their research on this topic.

The public waterfront space in Chongqing mostly extends along the water, with mountains as the boundary. It is characterized by a predominance of linear spaces, and the overall space is relatively narrow and long, inevitably spanning multiple administrative districts. Due to its geographical and hydrological factors, it is difficult to avoid issues such as planning difficulties, management difficulties, inconsistent development timing, and development costs. In addition, before the issue of water ecological civilization construction was raised, there were still problems in the early planning of the waterfront space in the center of Chongqing, which led to problems such as lack of use of public waterfront space, severe hardening, and homogenization of functions. These problems are similar, and they are also issues that need to be considered in combination with various factors when designing Section A of the Huaxi River in Chongqing Institute of Engineering.

Located in the hilly area on the south bank of the Yangtze River, Ba'nan District is the birthplace of Ba culture. Chongqing's Lijiatuo ferry was once an important transportation hub for people in Ba'nan to travel to other places, carrying a unique historical mission. With the opening of the Second Chongqing Yangtze River Bridge, the ferry history of Lijiatuo flowed away with the rolling river, and the bustling dock gradually became silent. This is also the earliest dock culture in Chongqing.

1.2. Design purpose

In recent years, the rapid development of the times has brought many environmental and ecological problems. As a mountainous city, Chongqing has also brought new challenges and requirements to urban waterfront landscape design.

The Huaxi River flows through the Northeastern edge of Chongqing Institute of Engineering, connecting the school with the opposite bank with its unique water system, and connecting the North and South. At the same time, it is also a first-level tributary of Ba'nan District, covering a wide area and closely related to people's production

and life. This study selects the section of the Huaxi River in Chongqing Institute of Engineering, Ba'nan District, Chongqing as the research object. Based on a brief overview of the development history and research conclusions of waterfront city landscape design at home and abroad, it conducts theoretical and practical research and application on hot topics in the three major sections of ecological design, symbiotic design, and sustainable design from the perspective of waterfront landscape design research in mountainous cities in Chongqing. The aim is to improve problems such as the single spatial function of the Huaxi River section in Chongqing Institute of Engineering, poor habitat in the riparian zone, large sediment deposition, and lack of connection with the opposite bank.

1.3. Design significance

When conducting research on the section of the Huaxi River in Chongqing Institute of Engineering, it is necessary to integrate various factors such as economy, society, ecology, and culture into the consideration system. This has positive significance for strengthening the connection between the two banks of the Huaxi River and the development of urban water environment protection work.

2. Research status at home and abroad

2.1. Domestic research status

Research on urban waterfront landscape design in China has been conducted methodically for many years. Zhang Tingwei is known as the earliest expert in China to study urban waterfront design. In his book "Design and Development of Urban Waterfront", he introduced numerous examples of foreign waterfront development [4]. The motivations and basic principles for the development of urban waterfront areas were proposed. Since then, more and more scholars have begun to pay attention to waterfront space research, and some influential academic achievements have emerged. Yu *et al.*, taking the landscape design on both sides of the Sanzaojiang River in Cixi City, Zhejiang Province, as an example, elaborated on the ideas and methods of landscape design in urban waterfront areas. They proposed a multi-objective landscape design viewpoint aimed at coordinating the relationship between humans and nature. Chen proposed that culture, space, ecology, and carrier are the four elements of waterfront landscape planning and design.

Chinese scholars' research on waterfront space mainly has the following characteristics: Firstly, they attach importance to the study of landscape entity design, focusing on the study of landscape elements such as embankments, water areas, waterfront buildings, landscape sketches, and city skylines. Among them, there is more research on embankments, involving embankment design principles and schemes, emphasizing ecology, safety, visual beautification, waterfront recreation, and systematization principles. Secondly, they pay attention to the study of planning and design methods at the technical level [5]. Among them, there is more research on datum lines, namely, water system landscape axes, visual corridors, traffic corridor axes, and vertical shorelines, emphasizing the sharing, three-dimensional design, and multi-functional utilization of shorelines. Zhang *et al.* believe that the datum line can serve as the basic framework for organizing the spatial order of waterfront planning. Thirdly, they attach importance to comprehensive development and management research in waterfront areas, mainly emphasizing the improvement of ecological functions and the exertion of economic benefits. In addition, some people have proposed a multi-objective landscape design concept that coordinates the relationship between humans and nature [6].

2.2. Foreign research status

Research on urban waterfront space began in the late 19th century. For example, Howard proposed the "Garden

City" theory in 1898, which used canal water as a protective buffer zone around the core area of the city, combined with green belts to form a riverside green space. The first research paper on urban waterfront areas was published in 1969 by Canadian geographer Forward. The article mainly compared the land use situation of several urban waterfront areas. Since then, some scholars have begun to study the development and construction of waterfront areas from an economic value perspective. In the late 1960s, besides geography, related disciplines such as landscape ecology and urban planning also began to pay attention to waterfront research. The ecological concept was highly respected, and the idea of landscape ecological design developed rapidly in Europe, achieving significant results.

Looking at foreign research results, it is rare to apply symbiosis theory to the study of urban landscape planning and design, especially for urban waterfront landscapes. The depth and breadth of research are also very limited. Most of them explore the symbiotic relationship between landscapes through partial or case study methods, lacking deep exploration and systematic research on the symbiotic mechanism between landscapes. However, the idea of symbiosis has already been reflected intentionally or unintentionally in landscape research and practice.

2.3. Current status of the site

The Huaxi River section adjacent to Chongqing Engineering College borders Nanwenquan, boasting rich landscape resources, high vegetation coverage, and a beautiful environment. It is surrounded by roads, with developed traffic and convenient access. A first-level tributary of the Yangtze River flows through the surface, providing relatively abundant water resources.

The external terrain of the base is relatively flat, with multiple gentle and steep slopes inside, creating a certain height difference. The site has abundant vegetation and a relatively open view, providing basic conditions for urban waterside landscape design. The open vistas also offer advantages for urban waterside recreation, enhancing the scope of viewing. However, long-standing water ecological issues in the Huaxi River have led to a homogenous ecological environment, lacking distinctive waterside landscape features and diversity in functional areas.

3. Principles of urban waterside landscape design

3.1. Ecological principle

The design of urban waterside landscapes should fully respect the natural ecological environment, recognizing the ecological value of waterside areas and the role of landscape in ecological restoration. It is important to integrate ecological landscape elements with the surrounding environment to create continuous natural scenic corridors and improve water quality. For Section A of the Huaxi River at Chongqing Engineering College, the landscape design should aim to enhance the ecological function and visual quality of the riverfront while preserving the site's original natural and cultural features.

3.2. Flood control principle

The geographical location of the urban waterside landscape determines its special role. As an interlaced zone between terrestrial and river ecosystems, waterside landscape planning not only needs to meet basic functions such as leisure and entertainment for citizens but also, most importantly, must be designed to have certain flood control capabilities. Simultaneously, the adaptability of vegetation in the four seasons landscape belt to different natural disasters, such as floods and droughts, should be considered.

3.3. Landscape diversity principle

In the selection of vegetation for waterside spatial landscapes, it is essential to collect and analyze data on native aquatic plant species. Drawing on successful examples of waterside space transformation in mountainous cities can help ensure that plant configurations adhere to principles of aesthetics, cost-effectiveness, and practicality. When facing high-pressure environments, such as the impact of seasonal floodplain fluctuations on vegetation, flood disasters, natural erosion, and other situations, scientifically and rationally allocate plant species to endow them with sufficient stress-bearing capacity and satisfy the principles of landscape ecology. Creating diverse vegetative landscape belts that simulate natural riverbanks can provide habitats for wildlife, help regulate the urban heat island effect, and contribute to improving the overall quality of the urban living environment.

3.4. Cultural continuity principle

Combine natural landscape protection with the preservation of human cultural landscapes, injecting vitality into urban riverside landscapes, preserving the continuation of historical contexts, and shaping new cityscapes. In the design, respect the diversity of different regional cultures, utilize cultural resources creatively, and form unique waterside landscape features with regional characteristics.

4. Design analysis

4.1. Foundation in vegetation, focus on people

The design concept aims to achieve harmonious coexistence between people, the natural environment, and the cultural environment through a symbiotic approach. This urban waterfront landscape design, guided by the principles of ecological and cultural symbiosis, abandons the traditional method of using buildings to separate the campus from the city environment. Instead, it weakens the barrier function of buildings, connects the campus with the city across the river, and creates a functionally diverse, green, and ecological “sequential symbiosis” waterfront landscape that is loved by the masses.

4.2. Original landscape of mountains and waters, priority to ecology

Guided by national ecological civilization construction and responding to the demands of the broader society for waterfront landscapes, the key to the ecological restoration design of the Huaxi River is to refer to the provincial strategy of “Two Rivers and Four Banks”. The idea of symbiosis, which originated in biology and is one of the fruits of interdisciplinary research, has been applied to urban waterfront landscape design after undergoing long-term development and evolution. As an important component of urban public shared space, waterfront landscapes drive the development of urban economy, society, and culture. Applying the symbiotic idea to urban waterfront landscape design has positive significance for addressing issues such as the fragility of urban ecological chains and human encroachment on animal habitats.

4.3. Reducing homogenization, creating functionally diverse waterfront spaces

By combining ecological waterfront landscapes with ecological knowledge, the design aims to create a city waterfront landscape that is “appreciated, learned, and shared” by all. The three major landscape themes of “ecological symbiosis, ecological tourism, and ecological science popularization” are designed to meet the functional needs of ecological display, ecological environment experience, and ecological knowledge popularization, creating a popular and enjoyable city waterfront landscape.

5. Conclusion

Water is the source of life, and humanity's affinity for water bodies stems from ancient historical contexts. Cities are born near water, and many of the world's megacities follow this pattern. As cities modernize rapidly and economies grow at a high speed, people are presented with both development opportunities and conflicts arising from environmental degradation. The concept of "ecological civilization" proposed at the 18th National Congress of the Communist Party of China underscores the urgency of resolving these conflicts. Finding a delicate balance to manage these conflicting forces is a challenge that designers must strive to address.

This article conducts an in-depth study and analysis of urban waterfront landscape design within the strategic context of "ecological civilization." By examining modern trends in urban waterfront landscape development and analyzing the current status and historical progression of such landscapes both domestically and internationally, it proposes specific strategies tailored to the site conditions of the Huaxi River section of Chongqing Engineering College. These strategies incorporate three key design elements: "mountains, water flow, and emerging fog."

To summarize, a lucrative environment is a valuable asset, just like mountains of gold and silver. This design, based on the concept of "sequence and symbiosis," explores the urban waterfront of the Huaxi River section at Chongqing Engineering College. Guided by the national vision of "ecological civilization" and informed by the historical context of mountainous cities, it takes into account local topography, hydrological features, and other natural conditions. With a thorough understanding of the site's current state, the design incorporates historical elements, makes scientific and rational use of natural conditions, and incorporates humanistic care.

Guided by the national ecological civilization construction and responding to the public's demand for waterfront landscapes, the key to the ecological restoration design of the Huaxi River lies in referencing the provincial "Two Rivers and Four Banks" strategy.

Through preliminary analysis, customer research, data collection, and case study review of the Huaxi River basin at Chongqing Engineering College, the goal is to create an urban waterfront that is "enjoyed, learned from, and shared by all." This reflects the unique landscape characteristics of the Huaxi River section, enriches the functionality of the waterfront space, contributes to ecological waterfront design, and realizes the protection and utilization of water resources in this area.

The study on the Huaxi River section of Chongqing Engineering College proposes a comprehensive waterfront landscape strategy that integrates aesthetic, cultural, and technological values. It also explores the current development status of waterfront landscape design in mountainous cities.

Funding

Chongqing Institute of Engineering School-level Project: Research on Urban Waterfront Landscape Design Based on the Concept of River Ecological Restoration - Taking the Section of Chongqing Institute of Engineering on Huaxi River as an Example (Project No.: 2022xskz02)

Disclosure statement

The author declares no conflict of interest.

References

[1] Fan W, Ao L, Zhang S, 2020, Study on Pollution Status and Countermeasures of Small Watershed in Mountainous Cities – Taking Huaxi River in Ba'nan District of Chongqing as an Example. Journal of Anhui Agricultural Sciences,

48(6): 55–58+63.

[2] Zhang H, 2019, Study on Population Dynamics of Cylindrospermopsis and Its Correlation with Environmental Factors in Huaxi River, thesis, Southwest University, Chongqing.

[3] Yang Z, Cao Y, 2018, Urban Design of Important Sections at the Bridgehead of Baijusi on Huaxi River in Ba'nan District, Chongqing. Urbanism and Architecture, 2018(21): 78–80.

[4] Dai K, Xiang G, Hu F, et al., 2017, Correlation Between Landscape Pattern Change and Soil Erosion in Huaxi River Basin. Subtropical Soil and Water Conservation, 29(4): 11–17+36.

[5] Zhou F, Hu X, 2017, Evaluation of Eutrophication Level in Huaxi River, Ba'nan District, Chongqing. Environmental Engineering, 35(9): 141–144.

[6] Li X, 2014, Research on Yu Kongjian's Ecological Landscape Design, thesis, Shanxi Agricultural University, Taiyuan.