Creativity and Innovation
2025, VOL. 9, NO. 1, 19-22
DOI: 10.47297/wspciWSP2516-252703.20250901

Urban Waterfront Landscape Design Based on the Carbon Peaking and Carbon Neutrality Goals

Peiyun Bie[1], Hanhan Zhou[1,2]*

[1]College of Tourism and Landscape Architecture, Guilin University of Technology, Guilin 541004, Guangxi, China;

[2]Institute of Guangxi Tourism Industry, Guilin 541004, Guangxi, China

ABSTRACT
In the modern urban construction and development, local governments must take the realization of the carbon peaking and carbon neutrality goal as the application background to take the initiative to strengthen the scientific guidance of the waterfront landscape optimization design, and urge the relevant departments to attach great importance to promoting the carbon peaking and carbon neutrality goals in the waterfront landscape planning and design, so as to optimize and improve the urban ecological living environment, and comprehensively improve the satisfaction and recognition of local people on the overall urban environmental design. This paper will further analyze and discuss the urban waterfront landscape design content under the carbon peaking and carbon neutrality goals, aiming at putting forward specific design strategies.

KEYWORDS
the carbon peaking and carbon neutrality goals; urban waterfront landscape; design innovation

The essence of carbon peaking and carbon neutrality goals refers to the two-stage carbon reduction goal clearly proposed by China. The first stage is to achieve "carbon peaking" before 2030, where carbon emissions no longer increase after reaching their peak. The second stage is to achieve "carbon neutrality" before 2060, where the "carbon emitted" equals the "carbon absorbed". The establishment and implementation of the carbon peaking and carbon neutrality goals can promote the harmonious and healthy development of ecological environment construction and create a good living environment for human beings. Therefore, in the practice of urban waterfront landscape design, local governments should implement the carbon peaking and carbon neutrality goals, optimize, integrate the waterfront ecological resources well, and ensure the sustainable development of urban landscape system construction.

1 Analysis of Urban Waterfront Landscape Design Content under the Carbon Peaking and Carbon Neutrality Goals

1.1 Hydrological Environment Design

In the process of urban waterfront landscape hydrological environment design, designers need to fully consider the topography characteristics of the original site, and optimize and transform the river course in combination with the actual situation, so as to scientifically create the overall relationship between "water and bank" [1]. Designers should reasonably plan and design green infrastructure around the hydrological environment to improve the hydrological environment restoration function, and comprehensively improve the low-carbon design level of waterfront landscape. For example, in the hydrological environment planning and design of the "Isar River" in Munich, Germany, the designers carry out natural ecological restoration operations on the river, and promote the full restoration of the natural appearance of the river through comprehensive measures such as river levee reinforcement, river bank reconstruction, river bed management and water quality improvement, so that the urban waterfront landscape design takes on a new look. Compared with the traditional design model of hard flood control facilities, green infrastructure scientifically planned can effectively widen the natural river bed, and greatly improve the drainage capacity, so as to avoid flooding in the rain season. Meanwhile, it can provide leisure space for pedestrians. It is thus clear that in the optimal design of modern urban waterfront landscape, designers should reasonably adopt the "imitation of nature" design method to promote the optimization of the beautiful waterfront landscape with natural characteristics on the basis of improving the flood control and drainage capacity of the river.

1.2 Ecological Environment Engineering Design

Under the carbon peaking and carbon neutrality goals, urban waterfront landscape design must pay attention to strengthening the planning and design of the surrounding ecological environment. Designers should effectively implement the low-carbon and environmental protection design concept of energy saving and emission reduction, give

priority to the application of green and low-carbon materials, and effectively enhance the sustainable value of waterfront landscape design, rather than blindly pursue the external beauty of waterfront landscape design. For example, in the "zero-carbon park" in Fujian Province of China, designers on the one hand use a large number of carbon-sequestration plants in the planning and layout of the park, which have the excellent oxygen release function, can maintain the natural fresh air around the park, and provide better play experience for pedestrians. On the other hand, the designers also creatively adopt the interactive device of renewable energy, which can successfully offset the large amount of carbon emissions generated during the construction of the park, thus achieving the "zero carbon" " development goal of the ecological environment engineering construction and design [2]. In the process of design and construction of the park, the designers also take into account the ground infiltration, recycling and purification of natural rainwater, so the ecological sponge project is scientifically adopted. In another word, through reasonable setting and application of rainwater pond gardens, ecological stone canals, artificial wetlands and so on, the problems of water pollution and waterlogging in the area are effectively solved, and the full absorption of carbon dioxide is promoted.

1.3 Biological System Design

Biological system design is an important part of urban waterfront landscape planning and design, which can better maintain the biodiversity and water cleanliness in the waterfront area and avoid damaging the ecosystem. Therefore, designers need to reasonably add natural plant communities in the waterfront landscape design, improve the carbon sequestration level of the waterfront landscape, and achieve the goal of building a "natural carbon pool", so as to successfully offset the greenhouse effect in the air [3]. For example, the waterfront landscape "Living Water Park" designed and created in Chengdu, Sichuan Province of China, as the world's first urban comprehensive environmental education park and the world's first water-themed urban ecological environmental protection park, is mainly composed of artificial wetland biological water purification system, "simulated natural forest community" and environmental protection education hall and other parts. This urban waterfront landscape has an advanced and perfect biological system. Designers purify and balance the water quality with a rich variety of aquatic plants, which promotes the organic combination of water environment management and biodiversity maintenance and protection. The designers carry out the optimization and transformation design for the biological environment of the water body in the region, and reasonably integrate diversified biological communities on the basis of maintaining the original ecological balance of the water body, so as to increase the carbon content of the water environment.

2 Urban Waterfront Landscape Design Strategy under the Carbon Peaking and Carbon Neutrality Goals: Taking the Chaoyangxi Wetland Park as an Example

Chaoyangxi River Wetland Park is located in the upper reaches of Chaoyangxi River near the intersection of Beihu and Anwu road in Nanning, China. It is a comprehensive regulation project of the Chaoyangxi basin by the local government. The regulation work starts from improving river banks, beautifying the landscape, and preventing floods and waterlogging, and finally forms an urban waterfront landscape structure system with the integration of "low carbon, vitality and diversity".

2.1 Reduce Space Energy Consumption and Improve Resource Utilization

In the planning and design of Chaoyangxi Wetland Park, the design team focuses on energy conservation and emission reduction. The first is to reduce the space energy consumption. According to the requirements of relevant flood control elevation, designers optimize and design the three-component waterfront space system of "shoal, stack and garden embankment" [4]. The first layer is the waterfront mudflat ecological space, and the natural grassy slope, pebble shoal and waterfront wetland zone are integrated into the surrounding parts, which enhances the spatial hierarchy of the shoal design.

The second layer is the waterfront recreational space, which can meet the leisure and entertainment needs of the audience to the greatest extent. In this part, the designers reasonably set up activity platforms, viewing walkways and leisure platforms along the line.

The third layer is the activity and viewing space. The designers rationally plan and design the basic service facilities, greenway activity venues and garden squares along the area, and form a professional and perfect regulation and storage system of rainwater and flood.

The second is to enhance the carbon sink level of water environment. The design team improves the recycling and utilization rate of natural rainwater to the greatest extent by planning and designing green service facilities such as rain garden, natural storage tank and biological retention ditch in the park. For example, the design and construction of rain

gardens can effectively reduce the impact of slope runoff in the park on the slope, avoid a large amount of soil loss, and also play a good role in water purification and balance. The terraced and platform landscape in the park also effectively broadens the whole natural sunshine area, which can not only reduce space energy consumption, but also greatly improve the utilization of natural resources. The final one is to flexibly use the local material resources. In the design and construction of this urban waterfront landscape, the design team mainly adopts local green and low-carbon materials, such as common local natural pebble, bluestone, wood, etc. Through the comprehensive use of these green and low-carbon materials, it can not only achieve the high-efficiency development goal of waterfront landscape civil construction materials, but also help the local city to create a low-carbon and environmentally friendly natural garden landscape.

2.2 Improve Basic Service Facilities and Strengthen the Audience's Participation Experience

In the early stage of planning and design of Chaoyangxi Wetland Park, the design team arranges professionals to conduct in-depth research and analysis in the market, and fully grasp the actual situation of the site and the experience needs of the surrounding audience. To this end, in the landscape design of the waterfront park, the design team effectively implements the "people-oriented" design concept, and scientifically plans and designs the basic service facilities such as civic square, youth playground, elderly recreation square and children playground according to the relevant needs of the target audience and the distribution of the local communities. It can meet the needs of people of all ages and both sexes for healthy exercise, leisure and play, and inject great vitality into the city area[5]. In addition, the design of Chaoyangxi Wetland Park also clearly put forward the idea of "suitable for aging". In each location of the park, the designers reasonably set up activity venues that are convenient for the elderly to travel and live, which minimize the steps, add the low-carbon materials with good elasticity, safety and non-slip, and set up railings, so as to give the elderly groups meticulous care, and effectively guarantee their travel safety.

2.3 Increase the Amount of Greenery in the Waterfront Landscape and Give Priority to High-carbon Sink Varieties

The area where the Chaoyangxi Wetland Park is located belongs to the subtropical monsoon season, with abundant rainfall and sunshine throughout the year, which is suitable for planting various subtropical green plants. In order to increase the amount of greenery in the waterfront landscape and meet the needs of local residents for tree shade during physical activities, the designers add various local evergreen broad-leaved species in the landscape design of the waterfront park to maximize the coverage rate of green plants. The biggest application advantages of local evergreen broad-leaved species are low cost, good regional and strong stress resistance, which is more conducive to stabilizing the ecological community structure in this region. At the early stage of the planning and design of Chaoyangxi Wetland Park, the design team carries out scientific sorting and marking of the advantageous green plants in the park, and largely retains the local species such as palm forest, ficus forest and bamboo forest, which can greatly reduce the various losses of energy costs caused by the later transplantation of trees. In order to further increase the amount of greenery in the waterside landscape and create a unique green landscape work, the designers also optimize and select local varieties with high carbon sink in the later stage, such as *Dracontomelon duperreanum*, *Ficus concinna*, *Bischofia javanica*, etc., which have a faster growth rate and strong carbon sink capacity. In addition, the design team also integrates the characteristic flower, forest and grass bank into the landscape design of the waterfront park. For example, in the design and presentation of the wetland section of the fir forest in Chaoyangxi Wetland Park, the designers rationally use natural trees such as the *Taxodium distichum* and metasequoia to form the effect of the wetland fir forest. By combining the rain gardens with different water depths and area shapes in the park, the designers flexibly use a variety of wetland aquatic plants, mainly including reed, black algae, calamus, *Cyperus alternifolius*, hornwort and lotus, etc. The combination of these wetland aquatic plants can not only promote the improvement of water purification capacity, but also increase the carbon storage of the park wetland environment, and create a more suitable living environment for the biome.

3 Conclusion

To sum up, under the carbon peaking and carbon neutrality goals, urban waterfront landscape design should attach great importance to energy conservation and emission reduction, and designers should implement the design concept of low carbon and environmental protection, combine the actual situation of the site and the fundamental needs of contemporary people, optimize and use scenic resources, and integrate the community with low-carbon landscape, ecological wetland and humanistic activities, so as to create a healthy and comfortable waterfront landscape for the audience.

Funding

The Basic Scientific Research Ability Improvement Project of Young and Middle-aged Teachers in Guangxi Universities in 2024: "Research on the Correlation between Garden Plant Biodiversity and Landscape Design" (Project Number: 2024KY0258); The Basic Scientific Research Ability Improvement Project of Young and Middle-aged Teachers in Guangxi Universities in 2024: "Research on the Protection and Inheritance of Geographical Name Culture in Lijiang River Basin from the Perspective of Heritage Resource Theory" (Project Number: 2024KY0257); 2024 Professional Core Course in Guilin University of Technology: "Plant Landscape Planning and Design".

About the Author

Peiyun Bie (2004.04-), Female, Han, Shijiazhuang, Hebei; Undergraduate, College of Tourism and Landscape Architecture, Guilin University of Technology, Research Field: Landscape Architecture Planning and Design.

*Corresponding Author: Hanhan Zhou (1990.06-), Female, Han, Guilin, Guangxi Zhuang Autonomous Region, Master; Lecturer, College of Tourism and Landscape Architecture, Guilin University of Technology, Institute of Guangxi Tourism Industry, Research Field: Landscape Architecture Planning, Design and Theory.

References

[1] Liu Gang, Hou Hongxu, Jin Jiao, et al. Research on Urban Waterfront Landscape Design based on the Carbon Peaking and Carbon Neutrality Goals: Taking the Landscape Design of Jinghe Wetland in Xi'an as an Example[J]. Architecture and Culture,2023(9):239-241.

[2] Xu Jing, Tang Lin, Wang Yuxiang. Research on Urban Waterfront Landscape Design under the Carbon Peaking and Carbon Neutrality Goals: Taking the Chaoyang River Wetland Park as an Example[J]. South China Agriculture, 2023,17(20):26-28.

[3] Li Rubo, Zhu Dandan, Xiao Jing. Exploration of Landscape Design for Urban Mountainous Waterfront Parks under the Carbon Peaking and Carbon Neutrality Goals: A Case Study of Shuangfeng Waterfront Park in Zigong City[J]. Design of Hydroelectric Power Station, 2023, 39(1): 65-67.

[4] Wang Yanling. Research on the Design Strategy of Urban Waterfront Space Quality Improvement under the Low-carbon Background: A Case Study of Landscape Improvement Project (Phase I) of Riverside Districts in Nan'an City[J]. Housing and Real Estate,2024(18):92-94.

[5] Dong Jie. Multi-dimensional Exploration of Urban Waterfront Space Landscape Design[J]. Flower Plant and Penjing,2024(3):86-87.