Water-sensitive Urban Design Based on the Perspective of "Sponge City"

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Abstract: At the end of the 20th century, highly urbanized areas began to explore water-sensitive urban design. In recent years, with the gradual expansion of China's urban scale, a large number of people enter the city to settle down, the pressure on urban roads is also increasing, and the limited ability of rainwater infiltration on roads leads to serious water logging in the city when it comes to the rainy season. Sponge city not only solves the problem of urban flooding, but also makes full use of rainwater resources, and will further alleviate the problem of water shortage. This paper takes the design perspective of "sponge city" in water-sensitive urban design as a starting point, explains the origin, connotation, multi-scale construction method and practice of the concept of "sponge city", and combines the Potsdamer Platz in Germany and the Vertical Forest Architecture Case in Italy, to understand the design of sunken green space in sponge city system and the architectural design of vertical garden style in resilient city.
***Keywords*:** sponge city, water-sensitive, urban design

1. Introduction

The biggest innovation of sponge city and ordinary city in water ecology is that, unlike the traditional pipeline and pumping station and other "grey" facilities to carry out drainage, but the use of green belts, grass-planted ditches and other road facilities for rainwater infiltration and filtration, reducing the pressure of the rainwater pipeline or directly replacing the rainwater drainage, and at the same time, the rainwater will be collected and treated. The rainwater will be collected and utilized by the residents after treatment. In this way, on the one hand, it can solve the problem of urban flooding discharge, and on the other hand, it can alleviate the problem of insufficient water supply caused by water scarcity, which is two birds with one stone.

2. Introduction of sponge city concept

Sponge city, as the name suggests, the city as a huge sponge. When the city enters the rainy season when rain and floods may occur, the "sponge" will be absorbed into the rainwater storage system through a variety of surface with the role of infiltration, and further rainwater purification and treatment. When the need to use these rainwater, "sponge" will be collected rainwater "extrusion", purified rainwater can be used for watering landscaping, clean roads, pipe fountains, etc., after a deep treatment of rainwater, and even can be supplied to the residents of living water. "Sponge city" combines "seepage, stagnation, storage, purification, use, discharge" and other processes, the entire water use process organically combined, not only to achieve the comprehensive utilization of rainwater, but also to achieve the purpose of water conservation and emission reduction. The practical application of sponge city can efficiently solve the problem of waterlogging in the city during the rainy season, which fundamentally solves the problem of waterlogging on the roads in the city due to days of heavy rainfall and affects the traveling of the citizens[1]. To a certain extent, the recycling of water. In the water shortage in China, it has a very far-reaching significance.

3. Multi-scale construction method and practice of sponge city system

3.1 Constructing sunken green space infrastructure, the case of Potsdamer Platz in Germany

Sunken green space collects rainfall runoff from the surrounding area, utilizes the role of vegetation, soil and microorganisms to purify a small portion of the flow of rainfall runoff, and rainfall exceeding the capacity of the green space for water storage and infiltration is discharged to the rainwater pipeline through the rainwater outlet. Sunken green space not only plays a role in reducing runoff and alleviating urban flooding, but also increases the water content of the soil and supplements the amount of underground water resources. At the same time, runoff carries pollutants such as nitrogen and phosphorus, which can be transformed into plant nutrients and promote plant growth[2].

The water landscape of Potsdamer Platz in Germany consists of three parts: the water landscape with fountains in front of the Sony Center building; the triangular artificial lake in front of the DaimlerChrysler headquarters building; and the stepped water flow in front of the Berlin Film Festival's "Cinema Palace", which is connected to the artificial lake and pumps at the top and bottom of the water flow. The landscape of Potsdamer Platz, which purifies rainwater, is completed by this three-part water system. When the artificial water system design skillfully combines the original hustle and bustle of the crowded city with the quiet and harmonious nature, it not only purifies the rainwater, but also purifies the body and mind of the people in the city life[3].

3.2 Vertical garden architecture in a resilient city, Italian vertical forest architecture cases

Introducing the design concept of resilient city is a very popular concept in the international arena. When the external water environment changes, the use of reverse osmosis and other technologies to realize the multiple reuse of water resources, to achieve the elastic development of water resources in urban construction, and to maintain the good functioning of the urban water supply system, as a kind of modern scientific and technological innovation for solving the problem of water shortage in the city. Combined with the concept of garden design, the vertical garden building is formed by applying water and rainwater in the building[4].

The Italian Vertical Forest Architecture project aims to purify the air of the city, recycle rainwater resources, and filter sunlight by creating a suitable microclimate through a vegetative barrier that helps generate humidity and oxygen, absorb carbon dioxide and particles, and block radiation and noise pollution in an environmentally sustainable manner. The vertical forest will also use recycled rainwater to water the trees and sustain their growth, and combine wind and solar energy to increase the building's energy self-sufficiency. This is an anti-sprawl measure that helps control and reduce urban sprawl and promotes the formation of urban ecosystems[5].

In summary, based on the function of urban open space in the ecological construction level, the construction process of urban open space should be designed with more sunken green space, permeable pavement, underground cisterns, etc. On the one hand, it can realize the collection and utilization of rainwater, and on the other hand, it can realize the collection and utilization of rainwater. On the one hand, it can realize the collection and reuse of rainwater, and on the other hand, it can also play the role of sharing part of the water when the drainage pressure of the municipal drainage network is too large. In the built-up area of the city, the layout of the sponge city system to point, line-based, combined with urban renewal, the use of less land to focus on solving the problem, for the urban planning area, the layout of the sponge city system can be more comprehensive and diversified. As advocated in the sponge city layout, the urban open space should be in consideration of the needs of the city's comprehensive development layout at the same time, in the form of "point-like", "belt-like", etc., arranged in the city. So that it not only plays an ecological function, but also meets the practical needs of residents[6]. At the same time, in the choice of urban open space layout, not only should follow the needs of urban planning and development, but also consider the views of social experts, scholars and residents. When designing specific urban open space layout, the original ecological environment should be understood in detail, and the local natural ecological landscape should be restored or even reproduced to the maximum extent in the construction process and the later stage. Due to the uniqueness of the geographical location of the city, its internal urban open space construction mode can not be easily borrowed, should be in the understanding of the city's own climate zone and the evolution of the local ecological environment, to develop a set of urban development characteristics and ecological construction needs of the layout of the form.

4. Conclusion

With reference to the theoretical research and practical experience on low impact development of rainwater system in various countries, combined with China's national conditions, the reasonable construction of sponge city system has become an important factor to ensure the balanced development of urban construction and natural hydrology. At the same time, we should also pay close attention to the relationship between our urban green space system and sponge city system. Under the influence of sponge city system, the urban green space system not only meets the city's ecological protection, cultural education, environmental beautification and other basic functions, while playing a greater potential to effectively improve the urban water conservancy facilities to deal with urban rainfall and flooding problems.

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