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Analysis of Urban Stormwater Management Based on the "Sponge City" Strategy-Stormwater Landscape Park

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ABSTRACT

Due to the increasing trend of urbanization and climate change in China, the domestic rainfall has reached a level that is difficult to digest. From the current situation of major cities in China, most cities are threatened by surface water flooding. Landscape design can play a crucial role in solving this problem - rainwater landscape parks can be integrated with ecological facilities of different scales, and then used as green sponges to purify and store the flooded surface water in the city, and applied to protect the local environment, fill groundwater, residents' leisure and aesthetic experience.

KEYWORDS

Sponge City; Rainwater Park; Rainwater utilization; Natural infiltration.

1. INTRODUCTION

With the increasing demand for modern urban rainwater management, the concept of sponge cities has gradually become popular. As a result, rainwater landscape parks have emerged - to solve the increasingly serious problem of rainwater in contemporary times, modern means can be used to reasonably utilize rainwater and also solve problems such as urban waterlogging during the rainy season.

Sponge city is a comprehensive utilization of buildings, roads, green spaces, and water systems through strengthening urban planning, construction, and management, achieving the collection, storage, and release of natural rainwater. In the rainwater park, the main goal is to provide scientific technology to effectively control rainwater runoff, achieve natural accumulation, natural infiltration, and natural purification. Therefore, the rainwater storage and utilization system of Xiaoyue River in Beijing must be based on ecology and rely on natural rainwater circulation, give full play to the positive accumulation effect of low-lying wetlands on rainfall, especially rainstorm, and give full play to vegetation, soil, etc.

Under the infiltration of rainwater, wetlands and water bodies can fully utilize their natural purification effects on water quality, striving to achieve the natural circulation of urban water bodies.

The sustainable development of Rainwater Park is a reflection on traditional park planning and design. It is a rational planning and design chosen by designers to overcome a series of environmental, economic, and social problems, particularly against resource waste, environmental pollution, and ecological destruction, and to establish a harmonious balance between these relationships. The aim is to present a rational economic operation, rich social functions, and good environmental protection, as well as their interdependent and mutually reinforcing development relationships. The planning and design of Xiaoyuehe Rainwater Park should follow the principles of sustainable utilization of environment, resources, and economy, as well as a scientific and reasonable park management system.

It should not only consider aspects such as planning, design, and construction, but also management, operation, and maintenance, in order to truly achieve the sustainable development of the rainwater park in Beijing.

The construction of a rainwater park is a complex artificial and natural composite system project, which should adhere to the balanced development of social, economic, and ecological benefits. Ecological benefits should be prioritized, social benefits should be the core, and economic benefits should be the auxiliary. A basic development model that coordinates the ecological and economic aspects of the rainwater park should be constructed, forming a well functioning ecological and economic system for urban rainwater parks, and truly achieving the sustainable development goals of rainwater park planning and design.

The perfect combination of artistic and scientific elements in rainwater parks is the ultimate goal pursued in planning and design. Artistic rainwater parks allow people to experience their different landscape charm, making them feel more happy in the rainwater park environment. More importantly, based on the artistic beauty of rainwater park planning and design, innovative rainwater elements are created into a unique scientific landscape environment, so that people can not only professionally understand and recognize the importance and basic principles of the natural rainwater storage system created by landscape water elements to human beings in the process of appreciating artistic charm, but also make the rainwater park more aesthetically pleasing with both scientific and artistic dual landscape values.

2. CONTEMPORARY URBAN RAINWATER MANAGEMENT-CURRENT STATUS AND PROBLEMS OF RAINWATER LANDSCAPE PARKS

2.1. Shortcomings in the Design of Rainwater Landscape Parks

2.1.1. In terms of park planning.

The number of parks is insufficient, the distribution of parks is uneven, and the planning and control around the parks are ineffective, resulting in the lack of an urban park system. Some cities have more large comprehensive parks, but there is a shortage of community parks and amusement parks. Some cities have a large number of parks, but their distribution is uneven, their functions are single, and they lack distinctive features and themes. Some cities do not pay attention to the control of buildings and structures around parks, resulting in a lack of landscape and significant impact from the surrounding environment. There are also a few cities where planning and control are inadequate, and the planned park land cannot be landed.

2.1.2. In terms of park construction.

The park scheme design did not fully implement the national park design standards, resulting in unreasonable park zoning, functional deficiencies, and failure to implement various indicators. Some park design schemes do not take into account local history, culture, and folk customs, resulting in unclear characteristics, lack of prominent themes, and even the phenomenon of "one park for every thousand". Some park design schemes excessively pursue luxury, choosing large trees and non-native tree species without considering the use of native tree species and suitable plants. Some design schemes do not conduct on-site soil testing and do not propose improvement plans for soil that is not suitable for planting, resulting in low plant survival rates and declining plant growth year by year. Some design schemes do not fully implement the concept of sponge city, and the application of sponge measures is insufficient, resulting in the initial rainwater not being purified, and the park unable to achieve the functions of "water absorption, storage, seepage, and purification".

2.2. Shortcomings in the Design of Rainwater Landscape Parks

2.2.1. Strictly review the design proposal.

The park design scheme is the key to the success or failure of park construction. For park design schemes, if it is a comprehensive park, not only should a detailed construction plan be prepared, but also a detailed control plan should be prepared. To improve the level and quality of park design, on the one hand, we need to do a good job in the preliminary preparation work, and on the other hand, we need to do a good job in the later review of the design plan.

2.2.2. Track and supervise the quality of engineering projects.

To ensure the quality of park construction, local governments should introduce regulations on park construction quality supervision, clarify quality supervision procedures, and include park construction projects in the scope of local government construction project quality supervision. The construction unit should strengthen process supervision and implement a strict completion acceptance system. If the project quality does not meet the quality acceptance standards, it cannot be put into use. Especially for trees, full crown seedlings should be implemented to prevent dead seedlings. The park management department should take the initiative, actively intervene in guidance and services, and cooperate with the construction unit to ensure the quality of the project.

3. CREATING A DIVERSE RAINWATER LANDSCAPE PARK

3.1. Three sections of Rainwater Landscape Park

3.1.1. Ecological Wetland Plate

Firstly, the protection and utilization of wetland plants. By utilizing existing wetland plants, floating plants, and emergent plants, a triple ecological space is constructed from the site to the wetland and then to the riverbank. The riverbank space is visible and accessible, while land plants are occasionally maintained as necessary. The wetland space is difficult to access, ensuring a good habitat for aquatic plants. The river can be crossed by boats, but they are not allowed to stay on the shore to avoid human interference with the original ecological function of the revetment. The second is a typical demonstration of natural regulation. Ecological wetlands, as a template for natural rainwater regulation, should be regarded as an important regulation function in rainwater parks. Although their regulation effect is limited and the regulation process is difficult to directly display, it should be emphasized through explanations and signage systems. The third is the typical landscape of Rainwater Park. In the planning and design of the plan, ecological wetlands account for more than 50% of the riverbank line, becoming a typical landscape of the park, and integrating the original ecological awareness and image into the planning and design of both banks.

3.1.2. The planning of the waterfront terraced field section

Intends to preserve a portion of the terraced fields on the southeast side of the site, optimize the mechanism, and tidy up the field ridges, showcasing its lively and ecological pastoral landscape to visitors through modern landscape design techniques, providing an interactive space for understanding nature, parent-child interaction, and experiencing labor. In terms of plant landscape construction, taking into account the climate characteristics of Beijing, annual crops such as peas, rapeseed, and wheat can be planted in spring. It is recommended that the growth cycle be within three months and harvested in late summer; Crop vegetables such as cabbage and Chinese cabbage in late summer, and harvest them in late autumn. Create a rich and diverse interactive field landscape through the seasonal changes of different crops and seasons.

3.1.3. The planning of the viewing platform section

Proposes to set up a viewing platform in the northwest of the base. The viewing platform will mostly use hard revetments to meet the group activities of tourists, and is suitable for various popular science education, cultural promotion, and commemorative ceremonies. The viewing platform or square is an indispensable part of Xiaoyue River Park, serving as the park entrance, distribution square, and geographical indication. It is also an important scenic spot to showcase the beautiful coastline and natural landscape of Xiaoyue River. It cannot be denied that the use of hard revetments will to some extent interfere with the ecological foundation of Xiaoyuehe Park. Therefore, in the rainwater park, the hard revetment type viewing platform only accounts for one-fifth of the shoreline. New permeable bricks that meet the functions of sponge cities are used for paving, and the permeable brick section landscape is displayed to visitors, achieving the core functions of technology popularization, publicity, and education.

3.2. Key Points for Functional Plant Configuration of Rainwater Landscape Park Infrastructure

3.2.1. Exploration of Ecological Water Conservancy Function of Urban Landscape Green Space

The establishment of a complete ecological civilization system is an important measure proposed at the Third Plenary Session of the 18th Central Committee to build an ecological civilization. In this context, the goal of urban green space construction is not only to meet the leisure and entertainment functions of citizens, but also to play an increasingly important role in urban landscape construction and ecological system restoration. Traditional urban green spaces often have a higher vertical organization than park road paving and urban municipal roads, and rainwater is directly discharged into the sewer system, ignoring the role of green spaces in rainwater organization and management. In China, the effectiveness of rainwater management in green spaces is gradually being valued. It not only endows green spaces with rainwater management functions, but also combines different entertainment facilities and landscape facilities to form welfare landscape infrastructure with multiple values, functions, and comprehensive attributes, maximizing the landscape and ecological benefits of green spaces and promoting the transformation of urban green space development. The plants mentioned here are aquatic water-resistant plants that play an important role in purifying and filtering in the system. They serve as the backbone to support the landscape structure and the functional structure of rainwater collection and purification. Therefore, they are called functional plants of urban rainwater landscape infrastructure.

3.2.2. Plant configuration principles

In urban rainwater management landscape infrastructure, species and communities are the main components of the rainwater collection and purification ecosystem. The selection of species and the configuration of communities need to be determined based on the three different environments and system processes mentioned above, in order to achieve optimal efficiency in rainwater pollution treatment, stability of the ecosystem, and landscape effects. Aquatic moisture resistant species have different habitat requirements, such as tolerance to water and drought, light, and pollutants. When configuring communities, species also interact with each other, including resource competition and the release of chemicals. Therefore, when configuring plants, it is necessary to comprehensively consider the biological characteristics of each species. The aesthetic role of urban rainwater management landscape infrastructure can be directly felt and experienced by people. Therefore, while achieving ecological effects, its landscape role should also be taken into account, such as color, plant type, texture, as well as the size and staggered relationship of plant patches, which will affect its landscape effect.

4. CONCLUSION

The sponge city theory combines ecological governance solutions with engineering technology solutions, integrating artificial design with natural theory. The planning and construction of urban rainwater parks are the concrete practice of this theory. With the development of ecological science and materials science, the construction of rainwater parks at home and abroad is gradually being promoted, and the system of rainwater storage and utilization is being improved. Technical issues will no longer be the biggest constraint on the promotion and construction of rainwater parks. The value that should be maintained in the planning process of parks will be limited. Therefore, in the maintenance stage of the rainwater park, it is the responsibility of all gardeners to make the rainwater park "popular and visible". We believe that in the future construction of rainwater parks, rainwater parks should not only be a technology or a method, but also a modern technological culture that can be promoted, applied, and inherited by humans.

Urban rainwater management landscape infrastructure is an important means for cities to conserve water sources, increase groundwater levels, prevent urban waterlogging, and promote the recycling and reuse of rainwater resources. Aquatic wetland plants, as the main body for adsorbing and filtering pollutants, are an important ecological landscape integration strategy. Therefore, in the design of urban rainwater management landscape infrastructure, not only should attention be paid to the selection and matching of plants, but also comfortable use space and good plant landscape should be provided for visitors on the basis of meeting ecological requirements. Therefore, the humanization of urban rainwater management landscape infrastructure design is a necessary aspect, enabling it to achieve comprehensive construction of landscape, functionality, and ecology.

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