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Research on Rainwater Management from the Perspective of Sponge City

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Abstract. In recent years, “Watching the sea in the city” has become a portrayal of most cities in China. In order to solve the problem of urban shackles and exploring rainwater management, China advocates the construction of sponge cities. This paper discusses the concept and connotation of sponge city and low impact development, and introduces foreign sponges. According to the actual situation of China, the suggestions and countermeasures for building sponge cities in China are put forward in order to provide reference for rainwater management in China.

1. Introduction

In recent years, most cities in China have experienced serious urban infighting problems. Traffic congestion and road water accumulation are very serious, and the lives and property of the people are threatened. According to the survey data, the current runoff from urban rains in China has increased from 10% before urban development to 55% after development. Obviously, the development and construction of the city has broken the natural circulation of rainwater, due to impervious pavements and building roofs. The gray infrastructure continues to increase, and the natural infiltration of green infrastructure continues to decrease, resulting in the natural circulation of rainwater being blocked. In addition, due to the limited and constant capacity of the drainage pipeline, it is difficult for rainwater to be resolved in a short period of time, resulting in urban stagnation. Faced with this situation, based on China's current water characteristics and water problems, a sustainable rainwater management strategy and richer rainwater treatment methods are needed, and the concept of “sponge city” will follow.

2. Sponge city

2.1. The origin and development of the sponge city

The concept of “sponge city” originated from the industry and academics used to use “sponge” to describe a certain adsorption function of the city. It means that the city can have a good “elasticity” in terms of adapting to environmental changes and coping with natural disasters. “When it rains, it absorbs water, stores water, seeps water, and cleans water. When necessary, it releases and uses the stored water. [1] The core of Sponge City is to prioritize the use of green infrastructure and grey rainwater infrastructure to build a flexible rainwater infrastructure to achieve “seepage, stagnation, storage, storage, use and drainage” of storm water runoff. [2] In December 2014, according to the spirit of the speech of General Secretary Xi Jinping on “Strengthening the construction of sponge



cities” and the requirements of the Central Economic Work Conference, the Ministry of Finance, the Ministry of Housing and Urban-Rural Development, and the Ministry of Water Resources decided to carry out the pilot work of the central government to support the construction of sponge cities. 2015 4 In the month, 16 cities including Qian'an, Baicheng, Zhenjiang, Jiaxing, Chizhou, Xiamen, Pingxiang, Jinan, Hebi, Wuhan, Changde, Nanning, Chongqing, Suining, Gui'an New District and Xixian New District won the first batch of national sponge city construction. Qualification of pilot cities. In October 2015, the General Office of the State Council issued the “Guiding Opinions on Promoting the Construction of Sponge City” to deploy and promote the construction of sponge cities. The “Opinions” clearly stated that the construction of sponge cities minimizes the development of urban ecology. Environmental impact, 70% of rainfall is absorbed and utilized locally. In April 2016, Fuzhou, Zhuhai, Ning , Yuxi, Dalian, Shenzhen, Shanghai, Qingyang, Xining, Sanya, Qingdao, Guyuan, Tianjin, Beijing, Panjin, Hohhot, Yuncheng and other 14 cities ultimately selected for the second batch of pilot cities sponge urban construction.

2.2. Low Impact Development (LID) Concept and Connotation

Low impact development technology (LID) is the core of sponge city construction. In rainwater drainage systems, conventional and ultra-regular storm water runoff storage systems are typically grey drainage facilities, while low impact development rainwater systems are a green infrastructure. Low impact development (LID) has broad and narrow meanings. Early low-impact development (LID) was narrower, emphasizing small-scale decentralization measures, while broad-based low-impact development (LID) needed to take into account green infrastructure such as ponds, wetlands, and floodplains, leaving ecological land area and effectively reducing the impact of surface water runoff on urban operations. [3] However, both the general and the narrow sense, the core essence lies in the source control, that is, the application of the source decentralized small facilities on the site to control the total amount of rainwater runoff and pollutants.

3. Foreign experience in sponge city construction

3.1. Best management practices in the United States

The primary focus of Best Management Practices (BMP) was the reduction and control of non-point source pollution sources. In 1987, the United States amended the Federal Clean Water Act, promulgated the Amendment to the Clean Water Act, and formulated provisions for the control of non-point source pollution sources to incorporate the control requirements for storm water runoff pollution into the national pollution discharge permit system. The Federal Water Pollution Control Act Amendment (FWPCA), passed in 1997, incorporated the BMP concept into the legislative hierarchy for the first time. In 2003, the BMP target was expanded to include integrated rainwater management decision-making systems covering storm water control, soil erosion control and non-point source pollution reduction, and more emphasis on ecological design and non-engineering management measures combined with natural ecology. [4]

3.2. Japan's sound water recycling system

Based on the Environmental Basic Law enacted in 1992 and the Environmental Basic Plan formulated in 1994, Japan has made clear the importance of improving the water cycle system from the environmental protection level. In 1998, Japan held a “liaison meeting for relevant departments to construct and improve the water cycle system” to coordinate the work of relevant departments. In 2000, when the "Environmental Basic Plan" was revised, Japan emphasized the establishment of a sound water cycle system based on the basin. The administrative agencies under the jurisdiction of the prefectures, counties, and other offices in the basin should conduct an assessment of the current situation of the water cycle system in the basin. Water cycle plan. In 2003, Japan completed the “implementation plan for the construction of a complete water cycle system”, clearly pointing out the problems and solutions of the water cycle system. [5] Since July 1, 2014, the Basic Law of the

Japanese Water Cycle has entered into force. Its main purpose is to adopt measures to promote the water cycle, restore and maintain a sound water circulation system, develop a sound economic society, and enhance the stability of national life.

3.3. Australian water sensitive urban design

Australia proposed Water Sensitive Urban Design (WSUD) in the late 1990s. WSUD is a rainwater management model and method proposed for the problems caused by the traditional drainage system. The core viewpoint is to present the importance of rainwater management from the perspective of urban planning and facility design, and to regard the urban water cycle as a whole. Tap water, sewage, and rainwater drainage are considered and managed as a component of the urban water cycle. [6]

3.4. Green infrastructure construction in Europe and America

Since the 1990s, the concept of green infrastructure has expanded in Europe and the United States. Although the meaning of green infrastructure construction in different countries and fields is not the same, in a broad sense, it refers to the effective use of green space, wetlands and rainwater storage and infiltration facilities. Specifically, in urban development and land use, we are committed to the construction of infrastructure such as rainwater storage and infiltration facilities, low-lying land, and constructed wetlands, using functions such as disaster prevention and water purification in vegetation in the natural environment. [7]

4. Suggested countermeasures for sponge city construction

The distribution of urban areas in China is large, and the natural conditions vary greatly. The planning, construction and management systems of cities have their own characteristics. The construction of sponge cities in China is still in its infancy, and there are still many problems and deficiencies. Therefore, we learn from foreign rainwater management technologies. And experience, the following recommendations and countermeasures are proposed for the construction of sponge cities in China:

4.1. Introduce foreign advanced concepts and technologies according to local conditions

When introducing concepts and technologies such as BMP, LID, and WSUD and sound water recycling systems into the country, it is necessary to pay attention to appropriate adjustments. The sponge city construction plan suitable for the region should be found according to local rainfall, urban residential density and population density. When the program is implemented, it should be scientifically planned, actively promoted, adapted to local conditions, and truly conform to the reality of China.

4.2. Pay Attention to the Cultivation of Comprehensive Subject Talents

Since the construction of the sponge city involves multi-sectoral and multidisciplinary, it requires the cooperation of various national departments and local departments. In terms of personnel training and appointment, China can set up relevant professional courses in the University for the Knowledge of sponge city construction, so that a group of young people with higher education can understand and learn more about sponge city construction. In addition, the selection and appointment of talents in some institutions of higher learning have continuously added vitality to the construction of the sponge city.

4.3. Formulate and improve the guiding policy

“Sponge City” means comprehensive planning, which has certain conflicts with the previous urban construction management system. In the past, all departments and departments have allocated a separate system to dismantle the original complete ecosystem. The water is headed by the water conservancy department, the urban green space is headed by the urban construction department, and the soil is headed by the environmental protection department. This has made it difficult to solve the ecosystem problem. The sponge city should take into account the relationship between water and soil,

vegetation and biology, and build a complete water ecosystem. It should formulate relevant sponge city guidance policies to promote the sound development of the industry. Conduct comprehensive and reasonable analysis and planning of the overall urban planning before the start of construction; strictly observe the specific construction details in the implementation of specific projects, and conduct the acceptance and evaluation of the results through the government assessment after the completion of the project.

4.4. Renewing ideas and mobilizing the enthusiasm of all parties

In the past, the reduction of sudden rain and flood losses was mainly caused by rivers and drainage networks. Facing the acceleration of urbanization and climate change, this traditional practice has little effect, so it is necessary to find more and closer cooperation methods. Drawing on the urban rainwater management direction of urban planning and urban design presented by WSUD, combined with the comprehensive rainwater management planning of the entire basin, the role of local owners in the decision-making of storm water management schemes is emphasized, and the enthusiasm of the owners is fully mobilized.

4.5. Improve the construction of urban rainwater management information

The development of urban water supply and drainage industry has changed from construction to maintenance management, and rainwater management has reached a new era. In the future, it is necessary not only to collect information on various measures and facilities for urban storm water management, but also to collect facilities and observations from other industries, to integrate existing plans and established information systems, to fill in gaps, and to improve the city. The construction of rainwater management information will store, analyze and maximize the use of various types of information to provide over-planned rainfall and emergency response plans to mitigate the losses caused by emergencies.

5. Conclusion

The most important thing in urban storm water management is to ensure the sustainable development of the city, and the sustainable development of the city is reflected in the improvement of industrial competitiveness, ensuring high-quality life, disaster-resistant urban construction, reducing environmental load and symbiosis with nature. . In the sustainable development of the city, on the one hand, it should be based on the previous experience of rainwater management, on the other hand, actively introduce new foreign technologies and methods, implement the work of cultivating and promoting storm water management talents, and promote the construction of sponge cities in China.

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References

- [1] Wu Danjie, Zhan Shengze, Li Youhua, Tu Manzhong, Zheng Jianyang, Guo Yingyuan, Peng Haiyang. Emerging Trends and Practice of Sponge Cities with Chinese Characteristics [J]. China Soft Science, 2016 (01): 79-97.
- [2] Yu Kongjian, Li Dihua, Yuan Hong, Fu Wei, Qiao Qing, Wang Sisi. Theory and Practice of "Sponge City" [J]. Urban Planning, 2015, 39 (06): 26-36.
- [3] Technical Guide for Sponge City Construction of the Ministry of Housing and Urban-Rural Development - Construction of Low Impact Development Rainwater System (Trial). 2014
- [4] Shanbei. Recipe for solving the problem of "see the sea from the city": Understanding Technical Guide for Sponge City Construction [J]. China Construction, 2015 (1): 22-25. (in Chinese)
- [5] LIAW Chaohsien, JIANG Yuquan. Urban water environment and rain water utilization plan [J]. Taiwan Environment and Land, 2014, 2 (2): 50-59. (in Chinese)
- [6] Liao Chaoxuan, Gao Aiguo, Huang Enhao. Enlightenment of Foreign Rainwater Management

- on the Construction of Sponge City in China [J]. *Water Resources Protection*, 2016, 32 (01): 42-45+50.
- [7] National Research Council. *Urban stormwater management in the United States* [M] New York: The National Academics Press, 2009.