

# Development And Exploration Of The Planning Idea Of Sponge City

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**Abstract.** Ecological civilization construction is the significant foundation for Chinese urban construction transformation, and the sponge city construction is the significant starting of urban construction transformation. The article focused on how to undertake sponge city construction for coastal city and studied several groups of coastal cities. It analyzed urban land characteristics, ecological background and climatic characteristics. Besides, in terms of the problems for sponge city development, it generated standard system for sponge city construction and multi-professional integration development strategy in order to take example by similar projects.

## 1. Introduction

In recent years, China's urbanization process has been developing rapidly, not only in the increase of the number of cities, but also in the expansion of urban scale. Influenced by the idea of urban construction in ancient times, most of the cities located in the plain area developed in the form of concentric circles. After decades of extended land expansion, the urban problems brought by the urban development model are increasingly prominent, including the frequent occurrence of urban waterlogging, the aggravation of runoff pollution, water shortage and other urban water environment problems, such as the Jinan road flood in 2007, the "7.21" heavy rainstorm in Beijing in 2012, and the rainstorm events in Wuhan, Shenzhen, Shanghai and Ningbo in 2013 and 2014. In response to the above water problems, the general office of the state council issued a policy document [2013] no. 23 and [2013] no. 36 issued by the state council, and paid great attention to the construction of urban infrastructure. The comprehensive plan for urban drainage (rainwater) prevention and waterlogging was required to be completed by the end of 2014. Traditional was put forward to pipe canal, pumping stations and treatment plants (station) of the "gray infrastructure" such as "water conservancy engineering" to shallow gully, rain, rain garden ponds, wetland vegetation of the "green infrastructure" such as "ecological water conservancy priority" and "gray infrastructure" combined with the direction of the shift; Traditional municipal, environmental, water conservancy and other departments, "Kowloon river water" to the "Kowloon water", to achieve multi-professional, multi-departmental coordination; Traditionally, the city has been transformed by the city administration of the city, and the "city management" that is divided by the lines of upstream and downstream, to the "watershed management" of the water environment and the natural watershed.

Sponge city refers to the principle that urban construction is based on respect for nature and ecological priority. By combining green and grey infrastructure, the city can be like a sponge, so as to maximize the accumulation, infiltration and purification of rainwater in urban areas under the premise of ensuring urban water security, thus promoting the utilization of urban rainwater resources and



ecological environment protection. The construction of sponge city breaks the tradition of "quick discharge" and "end control" as a single control mode, and constructs a new type of rainwater control and utilization system with "source", "decentralized", "ecological" and "multi-objective" as the guiding ideology, and realizes the whole process control and utilization of urban rainwater from source to terminal, which is one of the important contents of ecological civilization construction in China. Sketch map of planning and design of spongy cities in urban areas, shown in the Fig. 1.



Fig. 1 Sketch map of the planning and design of the sponge City.

## 2. The sponge city planning method.

The construction of sponge city is a complex system, and its construction should start from the source of city planning and integrate sponge city concept into urban planning. The coordination and operation between multiple majors is mainly reflected in the need for multi-disciplinary integration. This needs to break the passive cooperation and limited interaction between urban planning, landscape architecture, road and municipal services, and solve the dilemma of different technical coordination.

### 2.1. Overall planning

Collect and analyze various related materials at the early stage of planning, combine the current research, and conduct thematic study on various elements of the city. For example, urban water environment, ecological protection, industrial development and other research; research on regional ecological environment and economic and social development; Research on ecological cities and smart cities. On the basis of carrying out thematic research, the urban water resources carrying capacity is evaluated, and the development goals and directions of the city are determined according to the natural conditions, and the main functions and properties of the city in the regional development are defined, and the scope of urban planning is determined. Based on the positioning of the city, the principles, strategies and requirements of the development facilities are determined, and the overall control goal of urban rainwater is defined. By urban road, green space, water system, the vertical coordination and related special planning, to carry out the sponge city construction requirements, delimit the urban blue line and green line, determine the sponge urban construction area, guide the low impact development facilities space layout, the control objectives set, etc. Finally, determine the urban land layout and planning structure, etc., for drainage or green architecture of city spatial structure and functional partition, clear the layout of the urban land properties and major facilities, as well as the sponge city planning and control, construction schedule, etc to make demands. River, green space and other ecological systems, infiltration, stagnation, storage and arrangement, and then realize the urban ecological drainage.

### 2.2. At the level of control detailed planning

According to the geological landform, nature of land, vertical condition and water supply and drainage pipe network, it should be divided into catchment zones. Through the evaluation of the development

intensity of the land block, the development strategy and principle of the land land low influence are determined, the layout of land use is optimized, the nature of the land is subdivided, and the municipal and public facilities are configured for the plot. Then, the rainwater control target and specific index of the plot are determined by the catchment area, and the unit area of the plot is determined to control the volume rate and the lower down green land rate. According to the requirement of rainwater control, the construction control indexes of the plot are determined, such as the plot ratio, green land rate, building density and low impact on the scale and overall layout of the development facilities. Finally, the urban design guidance of the land is proposed, and the relevant provisions are made on the building volume, the building enclosure space and the area of its subsidiary hardening area.

### *2.3. At the level of detailed planning*

Through the field soil properties, vertical elevation, water system, greening and construction situation analysis evaluation. Determine the size and spatial layout of the development facilities, and make reasonable use of the pit water system in the site, and select the suitable low impact development facilities according to the current situation of the site. Finally, the feasibility and economy of low impact development facilities should be analyzed comprehensively. In the development of the city with high intensity, should change the past with relatively single engineering technology to passively response of the city a serious problem of water environment, and on the basis of the city development strength, assessment of construction activities on the surrounding urban land use, such as traffic, water supply and drainage, municipal city land development and traffic control, the combination of rainwater control target. When the local conditions are insufficient, it may be considered to establish a large underground storage facility, or use the low impact development facilities near the site to reduce the surplus urban rainwater. Far away from downtown, development strength, a relatively small area, but at all levels within the designated urban planning land, considering such as roads, green space in urban land to set aside enough land for low impact development facilities.

## **3. Sponge urban planning design case analysis**

Baotou is located in the state of the country, and the two screens are the main eco-security strategic structure, the frontier areas of the northern wind belt and ecological safety barrier, the south of the Yellow River. The ecological barrier on the northern foot of the yinshan mountain is a large area of desertification grassland. The land is barren, the water resource is scarce, the arid wind is large and the cultivated land desertification is serious. The southern Yellow River flows through the baotou section of 220km, which is an important part of the national ecological conservation belt of the Yellow River basin. From the nation's largest cold northern national wetland park, along the Yellow River national wetland park, 82.3% of the total area of the city's wetland, the wetland ecosystem is fragile, make its restore to the steady state period is longer, the cost of protection is higher, the task of construction and the restoration of the wetland. Over the years, the average precipitation was about 300mm, 70% concentrated in June — September, and the evaporation rate was seven times that of precipitation. Available water resources for 11.65 billion m<sup>3</sup>, the distribution of the Yellow River water index is 5.5million m<sup>3</sup>, available water resources within the territory of 6.15 million m<sup>3</sup>, including surface water is 1.03 billion m<sup>3</sup>, groundwater is 5.12 million m<sup>3</sup>. It is the key to solve the problem of water shortage in Baotou by comprehensively examining the current situation of water resources development and utilization in Baotou and integrating the allocation of water resources.

### *3.1. Ecological restoration project*

Sponge of Baotou construction must first consider the national ecological security strategy and guarantee for the construction of national key ecological function areas, implementing ecological restoration project, construction of urban ecological security pattern and urban rainwater management system effectively.

*3.1.1. Construct urban ecological security pattern.* The northern part of Baotou is desert steppe and wind-erosion desertification zone, and the ecological environment is fragile. The northern region should focus on the implementation of the grassland ecological construction project and strictly limit the overgrazing of grasslands. Implement soil and water conservation comprehensive treatment project, strengthen the comprehensive management of small river basin, restore vegetation and conserve water source. The central region focuses on the implementation of the national natural forest resources protection and the national nature reserve construction project, in order to restore the vegetation of the Great Qingshan Mountain and the Wula Mountain, and actively promote the construction of the comprehensive control project of the small river basin.

Mountains to the south of the city construction, high in the north and Ural Mountain National Nature Reserve, National Wetland of the Yellow River in the south, the most serious damage to natural environment and, is the key area of ecological restoration. Through the implementation of the green project in the south slope of the Mount Daqing, the protection and development of the Yellow River National Wetland Park, the ecological restoration and sponge transformation project of the urban park green space and the vegetable farmland in the edge of town, the ecological pattern of "one heart, two belts, two rings and multi point series" in the construction of urban area. "One heart" contains the nearly 15 thousand mu ecological space of the prairie and Olympic Sports Park in the Tara City of Sai Khan; the "two belts" are the northern Mount Daqing and the southern Yellow River National Wetland Park; the "two rings" are the inner ring of the Jing Bao - Baotou and the round city railway and the outer ring of the north and South bypass roads; the "multi point series" are green spaces and scenic spots in parks which have already been built or are under planning. These ecological green open spaces which have shape of dots, strips and rings form the network through the construction of city river and the landscape road.

*3.1.2. Give play to the role of urban green space sponge.*

Baotou is located in the I area of the total annual runoff control rate zoning map of China, with the control rate of 85-90%, and the new urban area is not less than 60%. This requires the construction of sponge city to seek a more economical and less environmental impact comprehensive way to manage the city's rainwater. From 2016, Baotou will upgrade and upgrade 21 parks and green spaces, including hardened greening and lake district landscape renovation, as well as new parks and green spaces; five scenic spots along the Yellow River National Wetland Park will focus on Xiaobaihe Wetland Scenic Area and South Sea Wetland Scenic Area through wetland restoration and related facilities to improve the development of tourism and cultural industries and improve urban functions. Therefore, these parks, green spaces and scenic spots should be constructed by building a concave green space, planting grass ditch, ecological protection slope, water permeable pavement and other sponge type construction. In the meantime, the rainwater runoff can be provided to the surrounding area as far as possible, so as to provide the surrounding area with rainwater retention and slow-release space, so as to build an economical, effective and small rainwater management way for environmental impact.

*3.2. Water quality improvement works*

*3.2.1. Construct the ecological water system pattern of "two rings and four hearts" in the urban area.*

The construction of urban ecological water system is the need of sustainable development of water shortage cities and the transformation and upgrading of resource-based cities. Therefore, on the basis of the present water system in Baotou urban area, combined with the ecological storage projects such as Xiaobai River, Xiangbeigou Reservoir, Benba Reservoir and Huagetai Reservoir, which have been constructed in Daqingshan Emergency Water Source Project, the ecological water system of "two rings" was constructed by using the high and southeast low terrain conditions in Baotou urban area, and the natural purification function of flowing water was brought into play. In order to promote the construction of the new metropolitan area and the land appreciation after the reconstruction and demolition of the Beiliang shantytown, the feasibility of promoting the construction of the sponge city

in the two areas was considered, and the "two centers" of the new metropolitan area and the empty area of Beiliang were constructed. Through the connection of water system and the construction of water landscape, the spongy city construction of the new area is promoted, and the historical context of "Jiujiang Estuary" is continued in the Beiliang empty area, showing the water culture, and the urban sponge body of "seepage, stagnation, storage, net use, utilization and drainage" is planned and constructed as a whole. To build a tourism industry cluster along the Yellow River in the south, the "two hearts" of Xiaobai River and the South China Sea Scenic area are based on the formation of lakes and wetlands for the construction of sponge cities, the restoration of water ecological landscape, the excavation of the culture along the Yellow River and the historical culture of "flood and drought wharves". Create the landscape along the Yellow River and waterfront to promote the development of the tourism industry, Fig. 2.

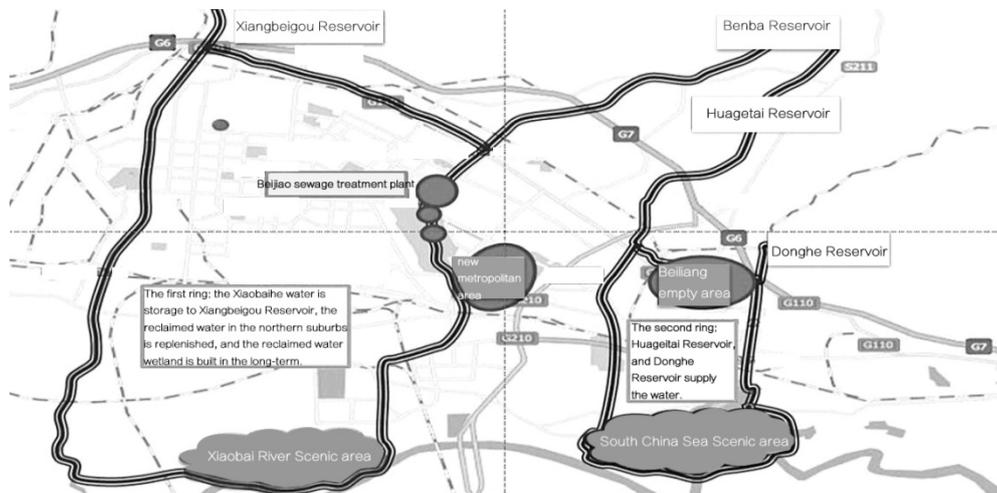


Fig. 2 Overall ecological water schematic diagram of Baotou.

### 3.2.2 Build gray infrastructure and green infrastructure.

Combination of drainage system in the drainage pipe network planning and construction, rain sewage diversion helpful for collection, storage, processing and utilization of rainwater, prevent floods, increase the available water resources in cities, as well as to reduce the urban non-point source pollution. Therefore, Baotou must first implement rainwater and sewage diversion for the Jiuyuan and Donghe districts that have not achieved rain and sewage diversion. Second, we must focus on the source pollution control and discharge after the end treatment water quality standards, in order to improve the treatment process of the sewage treatment plant. At the same time, through the construction of pervious paving, sponge-type green land and wetland, the source of the drainage is purified and the discharge quality is improved. The Beijiao Wastewater Treatment Plant has a reclaimed water supply facility. The reclaimed water is used for the majority of the secondary power plant industrial water and built-up areas, but it is located in the central area of the city. At present, there are many drainage trunks laid between the Beijiao Wastewater Treatment Plant and the Wanshui Spring Wastewater Treatment Plant. Therefore, the sewage treatment function can be incorporated into the capacity expansion of the Wanshuiquan Wastewater Treatment Plant on the south side, and the reclaimed water supply facilities will be retained in conjunction with the Olympics. The construction of the second phase of the park and the restoration of grassland water in the middle of Saihan Tara City will build the largest green infrastructure combined with artificial and natural wetlands in the 47 western regions, purifying the water and recharging the landscape and green water.

#### 4. Conclusion

In the construction of urban management, the most important thing is to ensure the sustainable development of the city, while the sustainable development of the city is reflected in the improvement of industrial competitiveness, ensuring the quality of life, resisting the urban construction of disasters, reducing the environmental burden and living symbiosis with nature. In the sustainable development of cities, on the one hand, it should be based on the previous experience of flood management, on the other hand, actively introduce new technologies and methods from abroad, and carry out the training to promote the management of rain flood management talents, and promote the construction of sponge cities in China.

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