

# Progress in the Theory of Sponge City Construction in My Country

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## Abstract

**Through combing the theoretical results and research literature in the field of sponge city construction, it is found that China has made outstanding achievements in the theoretical fields of sponge city special design and technology application. In addition, the financing methods, construction evaluation, policies and regulations, and experience introductions that are closely related to the specific construction of sponge cities are also important objects for practitioners and scholars to discuss. From the review of literature and results, it can be seen that domestic theoretical discussions on sponge city construction basically cover the scope of subjects that can be involved in this field, but they are still weak in local theoretical exploration, effective technology development, and interdisciplinary comprehensive research, and follow-up research is needed. The supplement is perfect.**

## Keywords

**Sponge city; Green space system; Drainage and drainage; Research review.**

## 1. Introduction

According to China.com.cn, 14 provinces (regions and cities) across the country have suffered heavy rains since 2016, and a total of 573 counties have suffered floods. The affected population is nearly 9 million. The affected area of crops exceeds 8 million mu, and the direct economic loss exceeds 13.8 billion [1]. In addition, with the acceleration of my country's urbanization process, a series of environmental and ecological problems continue to arise, such as difficulty in infiltration of rainwater, excessive exploitation of groundwater resources, water pollution and water quality deterioration, and degradation of water system runoff functions. These problems further affect my country Economic growth. In December 2013, General Secretary Xi Jinping clearly pointed out the importance of establishing a sponge city at the Central Urbanization Work Conference. In 2014, the Ministry of Housing and Urban-Rural Development issued the "Technical Guidelines for Sponge City Construction—Notice on the Construction (Trial) of Rainwater Systems for Low-Impact Development". According to the guidelines, "sponge cities" are like sponges, which can absorb, store, infiltrate, purify rainwater, replenish groundwater, and regulate water circulation on the spot or nearby when it encounters rainfall;

it can be stored in drought and water shortage conditions. The water is released and used, so that the water activities in the city conform to the urban form of natural laws. In 2015, the General Office of the Ministry of Housing and Urban-Rural Development issued the "Notice on Sponge City Construction Performance Evaluation and Assessment Measures (Trial)". Driven by the above-mentioned series of government documents, my country has made many explorations in the field of sponge city construction in recent years, and has achieved a lot of results.

## 2. Design Research

### 2.1. Urban Water System

At the beginning of the construction of a sponge city, work in the fields of water system engineering, road transportation, green space landscape, municipal engineering, etc. should be coordinated based on the ecological concept, and a targeted special system plan should be proposed in advance, and it should be combined with the city's overall planning and control details. The planning is coordinated and combined to ensure the scientific, systematic and implementability of sponge city construction.

The urban water system is an important part of the ecology and natural environment of a small urban area. It is also an important receiving body, passage, and storage space for the natural discharge of urban runoff and rainwater, and even urban water discharge. In the future construction of sponge cities and urban water system scheduling and operation, in addition to the existing spillways and drainage channels, the dual functions of landscape corridors and flood discharge and drainage channels in the connecting section of the natural water system should also be considered. In terms of artificial waterways, the original natural topography and topography should be fully utilized, the engineering design should be consistent with the topography of the construction site, and rainwater from the plant should be discharged into the treatment unit nearby. The layout and planning of the water system can be composed of a single or multiple types. In reality, the existing forms include three types: series, parallel and combined. Specifically, it is possible to independently plan and design rainwater channels and wetlands according to the purpose of the effluent, or to choose to use series and parallel forms in accordance with the order of pretreatment, storage and treatment units. If you want to recycle rainwater and water, you can use tandem to realize water recycling; if rainwater and water can be directly discharged, you can use a parallel design water system to facilitate the discharge of water to the nearby natural water system; combined use should be integrated. Consider the reality and the needs of the city.

### 2.2. Municipal Roads

In sponging municipal roads, it is mainly to pave low-impact facilities on both sides of the road to absorb, store, filter, infiltrate, purify rainwater and supplement groundwater [2]. Taking the sponge construction in the Yangtang residential area of Xiamen City as an example, the construction of the sponges on both sides of municipal roads should be capable of inflowing runoff, purifying runoff, slowing down the runoff speed, retaining runoff, infiltrating runoff, discharging runoff, preventing soil erosion and erosion. The function of intercepting pollutants. In terms of the specific content of the municipal road sponge, the vertical design should be optimized and the natural topography should be used to collect rainwater around the municipal road. Ma Yue et al. (2016) pointed out that the sponges on both sides of municipal roads include different types such as sunken green space, grass ditch, and quick seepage well [3]. The existing sponge city construction research mainly focuses on the discussion on the function, form and construction of the municipal road sponge.

### 2.3. Greenbelt System

The construction of the green space system is an important measure to achieve the goals of ecology and landscape greening. At present, the construction of sponge cities mainly tends to cut in from the perspectives of garden design, ecological environment system planning, function and function, etc., to discuss the importance, necessity and construction path of the green space system. In terms of functions, the green space system not only has the functions of water absorption, water storage, water seepage, water purification and drainage required by the sponge city concept, but also has the functions of ecological environment protection and urban beautification. Zheng Kai (2016) pointed out that the working principles of landscape architecture are based on respect and good treatment of nature. Sponge City puts forward higher requirements for the planning and design of landscape architecture [4], which also indicates the importance of gardens and sponge city construction. Combination has become the general trend of urban construction and development in the future. In terms of more micro-specific construction technology, Zhang Guan et al. (2015) pointed out that the choice of vegetation is the key to building an ecosystem, and it is also the entry point for the green system and infrastructure to function, and put forward that it should meet the requirements of flooding time as the premise To choose the specific plant types needed for landscape design [5].

### 2.4. Drainage and Flood Prevention

In terms of drainage and waterlogging prevention, comprehensive consideration should be given to the topography, water system patterns, drainage systems and water conservancy projects in cities and large areas in order to plan and build a scientific and effective drainage and waterlogging prevention system. Specifically, in terms of natural drainage and flood prevention channels, downstream dam sluices should be strengthened to improve their overall ability to discharge floods and prevent tides and drains; for upstream channels, new channels, drainage and flood prevention sluices and drainage outlets should be opened manually. , In order to enhance the upstream diversion capacity. In addition, carrying out ecological restoration and treatment projects, strengthening water and soil conservation in river basins, increasing wetland construction, and improving the overall storage capacity of the region are also important contents of drainage and waterlogging prevention projects. Wang Qiang et al. (2015) analyzed the rainwater system of Beijing's Yongding River Cultural New District and pointed out that the construction of a rainwater drainage pumping station with a flow rate of about 12m<sup>3</sup>/s and a 4-hour emptying capacity in the southernmost rainwater storage area in the area is helpful for alleviating Beijing's Yongding River. The waterlogging problem in the new cultural area plays an important role [6]. By combing the existing results and research literature, we can know that the research in the field of drainage and waterlogging prevention mainly tends to be carried out in terms of overall planning, design ideas, and technical routes.

### 2.5. Green Roof

The green roof is an important sponge city construction technology through rational design and planting plants on the top of the building to collect rainwater and achieve the purpose of beautifying the environment and improving water quality. For the green roof, the existing research mainly focuses on the discussion of its function and construction method. First of all, green roofs are the most convenient way to collect rainwater, which is suitable for factories, office buildings, residential areas, schools and other buildings. The green roof can directly collect and store rainwater with the help of rain buckets or cisterns. The collected rainwater can replace non-potable water for washing cars, sprinkling roads, flushing toilets, etc. Secondly, the green roof technology can effectively reduce surface runoff and alleviate runoff velocity, thereby reducing soil erosion caused by surface runoff. Third, green roofs also play an important role in beautifying the environment, improving water quality, and providing a rich growth environment for native plants [7].

## 2.6. Permeable Paving

Permeable paving is of great significance to the improvement of urban landscape water permeability, can promote the infiltration efficiency of part of the surface of the rainwater, and has an important role in the reduction of surface water accumulation and the replenishment of groundwater. Permeable paving has a wide range of applications and is suitable for squares, parking lots, roads with small traffic and load (non-motorized roads of municipal roads), sidewalks, etc. Different permeable paving methods need to be selected for different construction objects. The hardened ground with less load in the small area can be pavement with pure water, while the roads of motor vehicles and fire trucks should be pavement with stronger materials such as permeable bricks and permeable concrete; roads in the park should be paved with permeable concrete pavement. The branch road is mainly permeable brick/permeable gravel pavement. The selection of all materials aims at guiding rainwater to replenish groundwater through the surface layer; the square uses prefabricated permeable concrete with imitation stone specifications and texture to ensure the load-bearing of the institutional layer. It also has the function of water permeability. In addition, you can consider choosing loose gravel and pebbles as paving materials for unusually-used ground, and spreading grass seeds on the paving surface to form a strong green skin, so as to give full play to the effect of permeable paving.

## 3. Conclusion

Based on the content division of the "Technical Guidelines for Sponge City Construction", combined with the basic modules and directions of sponge city academic research, this article combs the literature on my country's sponge city construction research results, and finds that my country's special design, technical application and other sponge cities. Many advanced achievements have been made in the macro and micro areas of construction, which provide useful guidance and experience for the further construction of sponge cities in my country. Although my country has made a lot of research results in the study of sponge city construction, due to many factors, there are still some research deficiencies.

Strengthen theoretical research and provide guidance for specific applications. Because of the late start of sponge city construction, my country's guiding theories and ideas for sponge city construction are mostly imported from foreign developed countries. Therefore, there has been a ambiguity in pursuit of construction and application, while ignoring the construction of guiding theories and ideological systems that ground the foundation. Therefore, it is an important aspect of my country's sponge city construction research field to carry out indigenous basic theoretical research on sponge cities based on my country's special circumstances.

Continue to develop technology to enhance the function of sponge city. Taking the construction of the first batch of 16 sponge cities in my country as an example, Tan Shukui and others investigated the progress of the construction of sponge cities in my country, and found that nearly half of these 16 cities did not match the needs of the cities, and they were not very good. To solve the problem of urban drainage and drainage, to a certain extent, it can reflect the defects in the technology of my country's sponge city construction, which needs to be further improved by implementers and researchers or develop more effective application technologies. In addition, many pilot cities in my country are still confused in the construction process, and I don't know where to start. Therefore, continuing to improve the technology and provide guidance for builders to promote the construction of sponge cities is still the content that needs to be discussed in the future.

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