Response strategy for drought and flood in sponge city construction risk under the background of climate change

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Abstract. Sponge city construction has been widely carried out in China, but in recent years, extreme precipitation and extreme drought caused by climate change occur frequently, which requires sponge city construction to be able to effectively deal with. Through discussing the low-impact development facilities, the role of plants in the construction of sponge cities, and the construction of urban drainage system, the construction mode of sponge cities under extreme precipitation and extreme drought climate is analysed.

Keywords: Sponge city, Extreme precipitation, Extreme drought.

1. Introduction
In the context of rapid urban development, deteriorating urban water environment, and frequent urban embarrassment, sponge city construction is being carried out nationwide. However, in recent years, global warming has occurred, and extreme rainfall and extreme drought have occurred. Even in the southern part of China, there are rare snowfalls and frosts, and rare hot weather appears in the north. The frequency and intensity of extreme rainfall events have increased in the context of global warming. But there are obvious regional differences. Analysis shows that extreme rainfall in some areas of the southeast and northwest and the middle and lower reaches of the Yangtze River has increased. But in some parts of North China, Northeast China and Southwest China, there is a decreasing trend. There are still differences in the results of different model simulations at this stage. But the overall forecasting conclusions indicate that there is a polarization trend in China's extreme rainfall [1]. It can be seen that the construction of the sponge city focuses on the problems of the existing urban ecological environment. On the other hand, we should consider how sponge city construction adapts to climate change, and resist the corresponding risks.

This paper summarizes the current situation of sponge city construction and climate change trend, analyzes the possible risks in the construction of sponge cities under extreme drought and extreme rainfall, and proposes key points for low-impact development facility selection, plant selection, and construction of large drainage systems, providing reference for the national promotion of sponge city construction.
2. Construction situation of sponge city in China

In recent years, due to the continuous deterioration of urban environmental problems, stink water and lack of water resources, urban water logging occurs frequently. Based on the concept of low-impact development city construction in Europe and the United States, China has gradually started the construction of sponge city. In 2008, Shenzhen Guangming New District introduced foreign low-impact development concepts for urban construction. Subsequently in 2015 and 2016, a total of 30 pilot cities for sponge city construction were selected by the Ministry of Finance, the Ministry of Water Resources, and the Ministry of Housing and Urban-Rural Development. Pilot cities account for most of China, distributed in more than 20 provinces, except for some special provinces and cities in consideration of climate and administrative factors.

For new urban areas, sponge city construction is mainly to change traditional rainwater discharge patterns and support the comprehensive utilization measures of rainwater according to the low impact development concept, and the roof rainwater is purified through green roofs, bioretention facilities, etc., and collected through rainwater buckets in the construction of urban development projects. Also, the rainwater runoff generated by the pavement is collected into the surrounding bioretention zone for percolation and depletion, which is used to replenish groundwater and gradually reach the natural hydrological state before development.

For the urban development and construction area, there are fewer green spaces in the current situation, resulting in the lack of important rainwater infiltration in the city. It is necessary to reduce the impervious area and increase the coverage of green space. Combine the urban green space planning and improve the rainwater utilization system, and the original parks and abandoned land. It is not suitable for urban construction land reconstruction, supplemented by the restored water system to connect, forming an urban ecological environment where green space and water system coexist, gradually repairing water ecology, improving water environment, improving water safety, and conserving water resources.

3. Climate change trend

At present, the global warming trend is becoming more and more serious, and the frequency and intensity of extreme weather events are increasing sharply [2]. Climate change will cause changes in the global hydrological cycle and have a direct impact on rainfall, evaporation, runoff, soil moisture, etc., causing redistribution of water resources in time and space, and changes in total water resources, increasing extremes such as floods and droughts. The frequency and intensity of disasters [3]. Therefore, urban construction needs to consider the urban ecological, environmental and security issues brought about by climate change.

The research shows that the intensity of rainstorm rainfall in China is obvious, and the regions in the southwest, southeast and middle and lower reaches of the Yangtze River generally show an upward trend, while the northeast, northwest, and yellow-huai sea areas show a downward trend [4]. In recent years, different degrees of heavy rainfall have occurred in various cities. In June 2011, heavy rains fell across the country, and more than 20 large and medium-sized cities suffered serious guilt. In July 2012, Beijing suffered heavy rains, causing floods of 1.602 million people. Among them, 77 people were killed in the floods, and the economic losses caused by the disaster amounted to 11.64 billion yuan [5]; in 2013, more than 200 cities were in the city, and in 2014, there were more than 100 cities including Beijing, Shanghai, Guangzhou and other big cities. Guilt, causing varying degrees of economic loss. The rainfall in the southeast coastal areas of China is unevenly distributed by the monsoon climate during the year, and the flood disaster is serious. Most of the land area is affected by flood disasters of different types and hazards, and it is one of the countries with the most serious flood disasters in the world [6].

Meteorological drought refers to the abnormal shortage of water caused by the imbalance between rainfall and evapotranspiration in a climate with long-term no rainfall or abnormally low rainfall in an area [7]. In recent years, the extreme dry weather caused by climate change in China has also appeared frequently. Studies have shown that in the northeast and north China, the frequency of extreme drought has increased significantly in the past 10 years, and it is a frequent and frequent period of extreme
drought with a large range of high intensity in the past 100 years [8]. In the southwestern part of China [9], the southwestern part of the Sichuan Basin, the southern end of the Hengduan Mountains, the southwestern coast of Guangxi and the northern part of Guizhou are the areas where the frequency of extreme drought has increased significantly in the past 50 years.

4. Plants and low impact development facilities

Low-impact development facilities such as sunken green spaces, bioretention zones, and rain gardens commonly used in the construction of sponge cities have the function of retaining and storing rainwater runoff. Therefore, the choice of plants in these facilities usually requires water and moisture resistance. At the same time, plants are required to have a purifying function for rainwater runoff, degrading or eliminating pollutants in stormwater runoff. For example, through photosynthesis, nitrogen, phosphorus and other substances in rainwater runoff are converted into their own fertilizers; adsorption of heavy metal materials and enrichment, reduce soil pollution; through the respiration of plant roots, the formation of aerobic and anoxic microbial ecological environment around the roots of the soil, forming conditions conducive to the removal of pollutants.

However, with the frequent occurrence of extreme arid climates, it has become a trend to select plants that have wetness, purification, and drought resistance. At the same time, the number of dry days has a certain impact on the operation of low-impact development facilities. For example, the operating efficiency of rainwater gardens is affected by the water content in the previous period, while the water content in the early stage is mainly affected by the number of dry days. The longer the early drought stage, the more water the plants consume, and the lower the water content in the medium, the more water can be stored in the next rain. The better the water volume reduction effect of the rain garden, the change of the water volume reduction effect of the rain garden is no longer obvious after 7 days [10], but the long drought time will affect the survival rate of the plants.

5. Urban drainage system

Extreme rainfall is likely to cause different levels of guilt. The main reason is that the urban drainage system is not perfect. Most cities use gray drainage system. The urban pipe network replaces the natural drainage ditch and river channel, and the runoff is quickly collected through the pipe network. Drain to the downstream drainage system or receiving water.

The construction of urban drainage pipe network tends to expand and radiate around the central area of the city. In the old urban area and even around the village, the newly developed land quickly encloses the city in a demarcated space environment. As the planned construction area continues to increase, the hard-underlying surface of the city increases and the catchment area expands accordingly. However, the drainage concept still relies on the pipe network to collect the runoff into the river channel, and does not consider the discharge channel exceeding the standard rainwater. In the case of insufficient drainage capacity of the site, a large amount of stagnant water will be generated in the area where the terrain is low, and the internal hemorrhoids will be formed.

Some problems in the urban drainage system also need to be resolved. On the one hand, according to the survey data, nearly 80% of the rainwater drainage pipes in Beijing have sediments. About half of the rainwater drainage pipes have sediments that account for 10% to 50% of the pipe diameter, and the thickness of sediments in individual pipes even accounts for more than 65% of the pipe diameter directly affects the function of the urban drainage system [11]. On the other hand, the scale of the city continues to expand, the road network continues to expand [12], the underground space is increasingly complex, and the urban underground space construction includes many basic urban service pipelines such as rainwater, sewage, tap water, and communications, and most urban centers contain In urban villages, the situation is complicated, and the relevant departments of urban management have not formed a complete map, and the improvement of urban drainage system is becoming more and more difficult.
6. Conclusion
Under the background of the concept of new urban construction in the sponge city, for extreme rainfall and extreme drought, urban construction needs to take certain measures to deal with the corresponding risks, mainly reflected in the following two aspects:

6.1. Plant selection
On the basis of the plants commonly used for urban landscape landscaping, it should consider its water-wet resistance, purification function and drought-tolerant characteristics. Relevant research should explore the characteristics of plants in depth and provide more choices for urban landscape greening.

6.2. Construction of urban drainage system
Protect the city's original water system. The traditional urban drainage system construction concept should be changed, and the urban water system should be rationally planned and utilized. When the rainfall is too large and the catchment area is overwhelmed, the water flow in the catchment area needs to be transported to the main rivers of the urban rivers, downstream wetlands, etc. The water storage space is reserved in the safe zone, and the urban water system is supplemented after the rainy season to promote the ecological function of the urban water body.

Increase connectivity between water systems. Many urban waters belong to seasonal rivers or wetlands. In the early seasons with little rainfall, they are often disconnected from the main rivers. In urban construction, these ecologically-reserved natural reserves are mostly occupied by construction land, and the rain and flood space. The reduction or disappearance of the venting channel, in turn, exacerbates the occurrence of guilt. For the water system in the city, it is necessary to enhance its connectivity, take some restoration measures to the small tributaries that have been abandoned in the development process, strengthen communication with the nearby main river, help the diversion of the water flow, and reduce the pressure on flood discharge. Guarantee the city from guilt.

Improve the urban drainage system. In the construction of the sponge city, in order to protect the city from internal collapse, the small drainage system still needs to play a large role in runoff discharge. Therefore, the small drainage system combined with the above-ground and underground drainage channels formed by the above-ground gullies and pipes and canals is an important planning and construction idea for connecting micro-drainage and large drainage systems, linking the above-ground and underground facilities with micro-drainage. Together with the large drainage system, it constitutes a perfect and mature urban drainage system.

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