

Research on the construction path of Yiwu sponge city during the 14th Five-Year Plan period

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Abstract. During the 13th Five-Year Plan period, Yiwu City has made great achievements in sponge city construction, and won special financial support from Zhejiang Province in 2021. In order to better promote Yiwu sponge city construction through demonstration role, this paper, based on the current situation and problems in Yiwu City, puts forward the construction path of Yiwu sponge city during the 14th Five-Year Plan period according to the national, provincial and municipal construction objectives, discusses the current prominent problems and strategies of water shortage, and looks forward to the effectiveness of sponge city construction, which can provide references for sponge city construction in Yiwu City and even other regions.

Keywords: water shortage; priority construction areas; non-priority construction areas; management and control requirements; water-saving sponge city.

1. Introduction

At the end of the 13th Five-Year Plan, Yiwu City achieved great results in the evaluation of sponge city construction and received special financial support from Zhejiang Province in 2021.

From February to March 2021, Zhejiang Province issued the 14th Five-Year Plan for the Development of Municipal Public Utilities in Zhejiang Province [1] and the 14th Five-Year Plan for Urban Waterlogging Control in Zhejiang Province and the Long-Range Objectives Through the Year 2035 [2], as required “by 2025, more than 55% of the urban built-up area of the city will meet the objective requirements of sponge city construction”.

In June 2022, Jinhua City was successfully selected as the second batch of demonstration cities for systematic and full-field promotion of sponge city construction during the 14th Five-Year Plan period [3], requiring systematic and full-field promotion of sponge city construction (including Yiwu City).

Based on the above background, in order to further promote Yiwu sponge city construction through demonstration role, complete the objectives of sponge city construction issued by the national, provincial and municipal governments, and meet the relevant evaluation work of provincial financial support for sponge city construction, this paper, through the analysis of the current situation of Yiwu sponge city construction, proposes a sponge city construction path that is suitable for Yiwu characteristics and can solve the actual problems, with a view to providing reference for Yiwu sponge city construction.

2. Analysis of the current situation of sponge city construction in Yiwu City

2.1 Achievements of sponge city construction in Yiwu City during the 13th Five-Year Plan period

By the end of the 13th Five-Year Plan, Yiwu City had implemented 290 sponge city construction projects, including 20 building and community projects, 241 park and green space projects, 21 road projects, 3 ecological restoration projects and 5 other projects, completing 21.26 km² of sponge city construction area.

2.2 Problem demand analysis

As an international metropolis, Yiwu has global influence, but like most cities, it also faces problems with water security, water environment, water resources, water ecology and other aspects [4]. Therefore, Yiwu City urgently needs to adjust the way of urban construction through sponge city, and rapidly shift from “engineering water management” to “ecological water management” to achieve green and low-carbon sustainable development of the city [5]. The following analyses the current problems of Yiwu City from the perspective of water security, water resources, water ecology and water environment, etc.

Water safety. Low recurrence interval for urban flooding design: At present, Yiwu City’s recurrence interval for urban flooding design is once every 20 years, which is still far from the standard of once every 30 to 50 years (Yiwu is a large city) required in the Standard for Design of Outdoor Wastewater Engineering (GB 50014-2021).

Low recurrence interval for storm sewer design: At present, Yiwu City’s recurrence interval for storm sewer design in the old town is low (once every 2 years), while the degree of hardening of the underlying surface is high and the proportion of permeable surface area is less than 30%. In the case of short-term rainstorms, the catchment time is short, which may lead to the peak value of surface runoff and the risk of waterlogging.

water resource. Conflict between supply and demand: Yiwu is a severely water-scarce city [6], with average per capita water resources less than 1/3 of the national, and the rapid increase in Yiwu City’s population (according to the Seventh National Census, the city’s permanent population is 1,859,390, an average annual growth of 4.18% [7]), further resulting in a prominent water shortage problem.

Uneven rainfall distribution: Affected by abnormal weather, rainfall is less and unevenly distributed, showing the characteristics of “large in mountainous areas and small in urban areas”. At the same time, urban and rural public water supply capacity is limited, and the level of water supply guarantee needs to be improved.

Water ecology. Weak water ecological function: Yiwu City’s current volume capture ratio of annual rainfall is only 38%, which is still some distance from the 75%-80% control rate required by the nation, and the ecological shoreline rate is 24%, which should gradually improve the water ecological function.

Water environment. Heavy pollution from initial stormwater runoff: With the rapid development of Yiwu City, hardening continues to intensify. The impact of surface pollution from stormwater runoff on water quality is becoming increasingly serious, especially in the old town. The problem of surface runoff pollution from small shops is still one of the sources of pollution in the city’s inland rivers.

Single project type. During the 13th Five-Year Plan period, Yiwu City completed a total of 290 sponge city construction projects, of which 83.11% were park and green space projects, while other types of projects accounted for a small proportion, and the overall type of sponge city construction project was relatively single.

3. Objectives and implementation paths of sponge city construction in Yiwu City

3.1 Construction objectives

According to the national, provincial and municipal assessment requirements, 55% of Yiwu City’s urban built-up areas will meet the requirements of sponge city construction objectives by 2025. The urban built-up area of Yiwu City in the base year (2020) is 109.4 km², and considering the annual increase in built-up area during the 14th Five-Year Plan period, it is estimated that the urban built-up area will be about 116 km² by 2025. Therefore, to complete more than 55% of the

urban built-up area to meet the requirements of sponge city construction objectives, it is necessary to complete not less than 42.54 km² during the 14th Five-Year Plan period.

3.2 Implementation path

In order to better promote the high-quality and high-level development of Yiwu sponge city construction, walk in the forefront of the province, and strive to become the pioneer city in sponge city construction. Based on the analysis of the current situation, problems and overall objectives, this paper proposes the construction path of Yiwu sponge city.

Delineation of priority construction areas. In accordance with the construction objectives, combined with the sponge city construction areas already completed in the 13th Five-Year Plan, and in accordance with the regulatory plan and other relevant requirements, a total of 11 priority construction areas have been designated, covering an area of 44.72 km², namely Y-JZ-06, Y-JZ-07, Y-SY-02, Y-SY-03, Y-SY-04, Y-GY-02, N-JZ-06, N-JZ-08, N-JZ-11, N-GY-03, BY-06, as shown below.

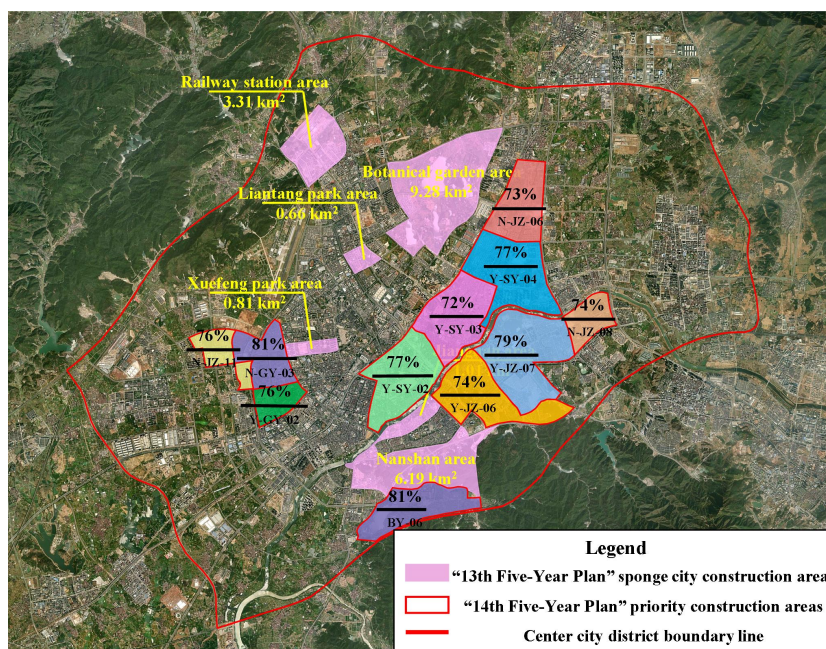


Figure 1. Distribution map of priority construction areas.

Management and control requirements for priority construction areas. In view of the current situation, the implementation path of sponge city construction is determined according to local conditions, and different construction ideas are adopted in the old town and new urban areas: New urban area is objective-oriented, overall planning and strengthened management, implementation of the “sponge +” model, and the concept of sponge city is integrated into the whole process of urban planning and construction management; The old town is problem-oriented, coordinates and promotes the construction of drainage and waterlogging prevention facilities, adopts measures such as “infiltration, stagnation, storage, purification, utilization, and drainage”, makes up for the shortcomings of facilities, and implements the “+ sponge” model to promote the accumulation, infiltration and utilization of rainwater.

For the 11 priority construction areas, indicators such as the volume capture ratio of annual rainfall (%) for each area are determined according to the regulatory plan and other relevant requirements, as shown in the table below. New, renovated and expanded projects in priority construction areas strictly follow the requirements of project planning conditions and sponge city planning to implement sponge city construction objectives.

Table 1. The objectives of priority construction areas construction.

Major categories	Middle categories	Priority construction areas	Area (km ²)	Volume capture ratio of annual rainfall (%)
Built	Residential	Y-JZ-06	5.39	74
		Y-JZ-07	7.28	79
	Commercial	Y-SY-02	5.16	77
		Y-SY-03	4.98	72
		Y-SY-04	5.59	77
	Industrial	Y-GY-02	1.67	76
Proposed	Residential	N-JZ-06	3.86	73
		N-JZ-08	2.00	74
		N-JZ-11	2.07	76
		N-GY-03	3.04	81
Spare		BY-06	3.68	81
Total			44.72	-

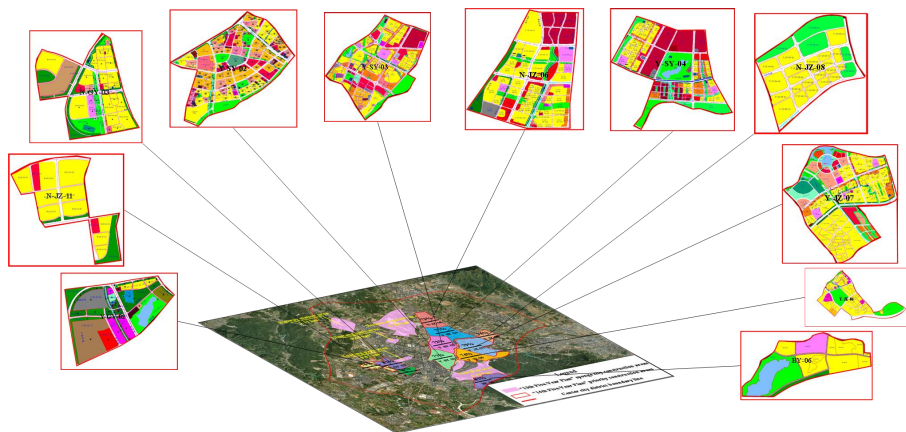


Figure 2. Distribution map of the regulatory plan in priority construction areas.

Management and control requirements for non-priority construction areas. In order to facilitate the management and implementation of sponge city construction, for construction projects within the scope of regulatory plan adjustment or non-priority construction, sponge city planning and design indicators can be determined according to different types of construction project, mainly divided into four categories: building and community projects, municipal road projects, green field and square projects, and urban river system projects, with corresponding control objectives as shown in the table below.

Table 2. Management and control requirements for non-priority construction areas.

Project classification	Land types	Volume capture ratio of annual rainfall (%)
Building and community projects	R1、R2	75
	R3	55
	A	75
	B	70
	M1, M2, W1, W2	70
Municipal road projects	S1, S3, S4	55
Green field and square project	G1, G2, G3	85
Urban river system projects	E1	Enhance flood control capacity

Note: The land types classification reference Code for classification of urban land use and planning standards of development land (GB 50137-2011).

4. Discussion of sponge city construction paths in Yiwu City

4.1 Sponge city construction area

During the 14th Five-Year Plan period, Yiwu City is expected to complete 11 priority construction areas, covering an area of 44.72 km². Taking into account the 21.26 km² of sponge city construction already completed during the 13th Five-Year Plan period, by the end of the 14th Five-Year Plan, it is expected that 65.98 km² of sponge city construction will be completed, accounting for the estimated area of Yiwu City's urban built-up area (116 km²) 56.87% in 2025, meeting the 55% assessment requirement.

4.2 Water shortage problem

Yiwu is a typical water-scarce city, with less rainfall and uneven distribution, even in rainy and typhoon seasons. In view of the serious water shortage problem in Yiwu City, among the priority construction areas, further combine the original parks and wetlands, such as Xiuhu Park, Jimingshan Park, Futian Wetland Park, etc., and use its rainwater storage function to collect rainwater in the surrounding communities. Rainwater collected can be used for green space, road watering and toilet water in parks and surrounding communities, thus providing strong support for building a resource-saving, environment-friendly society and an ecologically civilized city.

For priority construction areas with serious water shortages, various indicators are strictly controlled in accordance with planning, focusing on the purification and utilization of rainwater. New public building and municipal infrastructure projects in priority construction areas are required to install rainwater infiltration, purification, collection and utilization facilities to make full use of rainwater resources, such as watering roads and greening. Establish rainwater reuse facilities for each household in the residential community, rainwater can be used for low-quality water such as toilet flushing, and consider implementing certain subsidy policies [8], according to the volume of rainwater recycling per household to be subsidized, to encourage the construction of rainwater storage and reuse facilities [9], to create a water-saving sponge city with Yiwu characteristics.

4.3 Construction of smart platform

The sponge city smart platform will mainly monitor rainfall, sponge facilities, drainage facilities, river systems, rainwater recycling facilities, etc. At the same time, sponge city plates will be integrated into the existing comprehensive control platforms (such as "smart water conservancy", "smart drainage", etc.) to network and intercommunication, forming a comprehensive platform for urban flood prevention, water environment enhancement and urban construction, to further promote Yiwu sponge city construction.

4.4 Establishment of long-term mechanisms

The construction of sponge city is a comprehensive systematic project, involving multi-department, multi-specialty, multi-type, etc. Yiwu City actively promotes the long-term mechanism for sponge city construction, the work organization mechanism is gradually improved, standards and norms are gradually improved, and policies are successively formulated, including work management, evaluation and assessment, planning and construction, operation and maintenance, and system innovation [10], to comprehensively guarantee the construction and implementation of sponge city.

5. Conclusion

Yiwu sponge city construction needs to construct priority construction areas, forming the water-saving sponge city with Yiwu characteristics. Through the construction of "small sponge body", and gradually form priority construction areas of sponge city, and finally converge priority construction areas to create Yiwu sponge city construction.

In response to the current problems in Yiwu City, the city is gradually shifting from the “traditional model” to the “sponge model” by adjusting its development model to better achieve sustainable development. Specially for the serious shortage of water resources, by constructing priority construction areas, further alleviating the problem of water shortage, using rainwater recycling facilities, and giving certain subsidies. On the one hand, the current serious water shortage problem can be greatly alleviated. On the other hand, the construction of sponge city can be further promoted, so that citizens can truly feel the visible benefits of sponge city, reduce the cost of daily tap water, and make the concept of “sponge city” gradually deeply rooted in the hearts of the people.

The promotion of sponge city will enable Yiwu City to construct the “natural storage, natural infiltration, natural purification” of the city, create a more resilient, more liveable, more ecological World Commodity Capital, and provide more Yiwu elements and experience for the construction of ecological civilization in the province and the whole country.

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