

Sponge City Renewal Strategy of the Old Urban Areas Under the Background of Systematic and Full-Field Promotion

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Abstract. The construction of the old urban areas is closely related to urban development. Problems are common in old urban areas in China, such as water logging, lack of green space and poor space environment. Sponge city construction is an effective measure to adapt to the rapid urban development and solve a series of problems in the old urban areas. The renewal and transformation of sponge cities in old town is problem-oriented and people-centered. It proposes sponge city renewal strategies such as “systematic” pattern, “acupuncture” implant and “demand-oriented” design to alleviate urban water logging from the source, reduce urban runoff pollution load and improve urban ecological environment. At the same time, green facilities complement gray facilities are in line with the requirements of the national dual-carbon target which effectively controls the “urban disease” of the old urban areas through sponge city.

Keywords. Systematic and full-field promotion of sponge city construction, old urban areas, renewal strategy of city

1. Introduction

China's sponge city construction has experienced three stages: preliminary exploration, pilot exploration and rapid development. From 2014 to 2022, a total of 30 pilot cities and 45 demonstration cities have been determined. During the construction of pilot cities, more than 38,000 sponge city construction projects of various kinds have been built in 2020, more than 20% of the built-up areas of all provinces and cities meet the requirements of sponge city construction.

By the year 2021, on the basis of summarizing the experience in pilot construction, the three ministries, Ministry of Finance, Ministry of Housing and Urban-Rural Development, Ministry of Water Resources jointly issued the “Notice on carrying out a Systematization whole domain promotion demonstration work of Sponge City construction” (Finance office construction [2021] 35th document), our country sponge city construction has entered the systematization whole-domain promotion stage. On the whole, 80% of the urban built-up area will meet the requirements of sponge city construction. In the practice of sponge city construction, the concept of sponge construction in newly built areas is relatively mature and the control mechanism is relatively perfect, but the old urban areas with high density, small space, old facilities

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and high hardening are more difficult to implement.

In the previous round of sponge city construction focused on the construction of new districts, so in order to realize China's systematized whole-domain sponge city construction, the old urban areas will become the area that cannot be ignored. Domestic scholars have carried out the research on the reconstruction background, design strategy, implementation path, government management and other aspects of the sponge city reconstruction in the old urban areas [1-3]. Li et al [4] summarized the multiple co-construction modes of the government, society, grass-roots managers of street communities, village collective and citizen under the systematic sponge city construction and transformation the district, and explored the technical methods and implementation paths of micro-renewal. Dong et al. [5] took "system construction and regional governance" as the construction idea, and comprehensively realized the overall governance goal of the old urban areas by integrating the source emission reduction project, the process transmission control project and the end. regulation, storage and governance and other system projects. Zhang [6] analyzed the reconstruction dilemma of the old urban areas from the perspective of public sector management, and proposed suggestions and countermeasures for the reconstruction and development of the old urban areas based on the concept of sponge city, so as to optimize the level of urban governance. The relevant researches of sponge city reconstruction in China mainly focus on the source and process projects such as the reconstruction of the old urban network, the elimination of water points, old residential areas, roads, etc. [7-10], which realize the absorption and retention of local rainwater, but the continuous effect and systematization are not prominent. This paper takes the problem as the guidance, constructs the systematization whole area old city sponge city renewal mode Angle to study the reconstruction strategy and path.

2. The Predicament of Sponge City Reconstruction in Old Urban Areas

2.1. System Construction Neglection

The sponge city reconstruction of the old urban areas involves different specialties such as architecture, planning, municipal affairs, landscape architecture, transportation, etc. The existing problems need to be solved by all departments in coordination. Due to the lack of recognition, the lack of a large drainage system, urban vertical connection, and over all consideration with the current water resources, water ecology and other issues, there is a phenomenon of "remedial measures" which is only available for Specific case.

2.2. Limited Reconstruction Space

The old urban areas themselves have problems in the layout of historical space with high development intensity, green land rate and hardened ground ratio. Meanwhile, due to the continuous addition of new functions in the later use, underground pipeline facilities are constantly superimposed, and residents' living habits are constantly solidified. As shown in Figure 1, there are problems such as limited sites, occupied green space and complex underground pipelines. As a result, the selection, layout and design of sponge facilities are greatly restricted.



Figure 1. Current situation diagram of road, afforestation and community space in the old and old urban areas.

2.3. Insufficient Demand Research

In the process of sponge city reconstruction in the old urban areas, the project effect and construction index are taken as the target, while the current situation and background conditions of the old urban areas are ignored. Sponge measures are blindly added in order to pursue good visual effects. At the same time, due to insufficient public opinion research, residents' needs have not been understood, the actual effect is not obvious, in the process of transformation and transformation, received the residents "boycott" and "ridicule".

3. Sponge City Renewal Strategy

The sponge city renewal of old urban areas focuses on building systematic plans to solve practical problems based on demand. Study the systematic path of construction system and old city reconstruction, comprehensive renovation and integration, implement sponge city measures through the "Acupuncture-acupuncture style, demand" strategy, implement the comprehensive transformation of "+ sponge", and strengthen residents' perception of sponge city construction.

3.1. Systematized Pattern

Sponge cities in old urban areas, combined with urban renewal and development, adhere to the systematic thinking to promote regional water logging control, rainwater utilization, water pollution, environmental improvement and other construction; Adhere to the construction idea of systematization and itemized governance. Overall planning of the current spatial resources of the old urban areas, using the natural "sponge texture" restoring the background ecological pattern of natural storage space such as rivers, lakes and grasses, combining buildings with residential areas, parks and green spaces, urban roads and squares, forming a "systematic" sponge city reconstruction pattern.

3.2. Acupuncture-Acupuncture Style Implantation

Based on the overall structure of the drainage system, the control zones should be determined according to regional catchment zones, vertical elevation, current conditions and other factors. According to the control zone, the sponge city transformation space is sorted out, sponge facilities are implanted in the "acupuncture

style” way, and small and micro public spaces in the old urban areas are activated with the help of street corner green spaces, parking spaces, green spaces beside houses, activity venues, etc., and rainwater retention space, runoff channel and facility layout are rationally planned, so as to realize the interaction effect between public space and sponge city and jointly improve the urban environment

3.3. Demand-Oriented Design

In the systematic scheme, the systematic governance concept of “source, process and end” is combined with field research, discussion of neighborhood committees and residents’ representatives, questionnaire survey, etc., and a “co-creation group” composed of residents, government and designers is established. Adhering to the principle of “people’s city is built by people, and people’s city is for people”, the will and needs of residents are fully communicated. And consider the old urban areas for the elderly and children friendly needs, with the sponge city upgrading project, the construction of water logging elimination, environmental improvement, people satisfied with the “old city”.

4. Comprehensive Transformation and Application of Sponge City in the Old Urban Areas

4.1. Basic Information

As shown in Figure 2, the Sponge City upgrading and renovation area in the central city of Zhangguizhuang covers 1.32 square kilometers, which is surrounded by the main road of the city. It is a centralized living area with high building density and strong popularity. Through field investigation and model simulation, the following problems exist in the area:



Figure 2. Project scope diagram.

4.1.1. Vertical Analysis

As shown in Figure 3, the region is flat as a whole, and the ground elevation is 2.25-3.17 meters with a maximum difference of 0.08 meters. The elevation of the land parcel is 2.49-3.17 meters, and the elevation of the road is 2.25-3.00 meters. The whole land parcel is higher than the surrounding road. However, due to the low construction standard of storm water pipe network and the subsidence of some plots, there are two water logging points in the region.



Figure 3. Vertical analysis diagram of the project.

4.1.2. Analysis of Underlying Surface

As shown in Figure 4, the roof of urban buildings is mostly flat roof without large equipment, and the roof rainwater as a whole adopts the form of external drainage, most of which is directly dispersed to the ground, part of which is cut off in mid-air, and the rainwater directly falls to the ground when it rains. The green space inside the building and residential area is small, mainly for rows of tree pools, a few residential areas have a certain green space, but there is a large area of loess bare land; The roads in the area are less green, and the trees on both sides are basically bare soil. Park square greening is better, but the green space is higher than the road surface, not combined with the drainage system, did not play the role of absorbing the surrounding rainwater. Community and road pavement on both sides of the road uneven or serious damage, to the surrounding situation travel, fitness and other activities caused a greater impact; The pavement around the water system is hard, and the rain can't be purified when it rains as shown in Figure 4.



Figure 4. Current situation of the underlying surface of the project.

4.2. Renovation Scheme

4.2.1. Systematic Construction Ideas

Through several field surveys and field surveys, as well as terrain measurement within the basin, the current underlying surface, vertical elevation and drainage network (including pipeline type, inspection well and water outlet) shall be found out, the background conditions of the project shall be sorted out, and data such as climatic rainfall, hydrology and water conservancy, and the current rainstorm intensity formula shall be analyzed. The problem-oriented and the core goal shall be to eliminate the existing water logging points in the region. Carry out the status assessment, scheme comparison and effect confirmation, combined with municipal roads, parks and squares, buildings and residential areas and other projects to arrange the source emission reduction project, optimize the pipe network layout to improve the process transmission control, increase the pollution interception, regulation and storage and other end regulation and storage management projects, in the process of construction, carry out the “acupuncture and acupuncture and moxibustion type, demand” sponge city upgrading. Form a systematic spatial pattern of sponge city combining “point, line and surface”, and improve the transformation effect of sponge city from the aspect of source- process- end. The idea of Sponge city systematic transformation in the old urban area is shown in Figure 5.

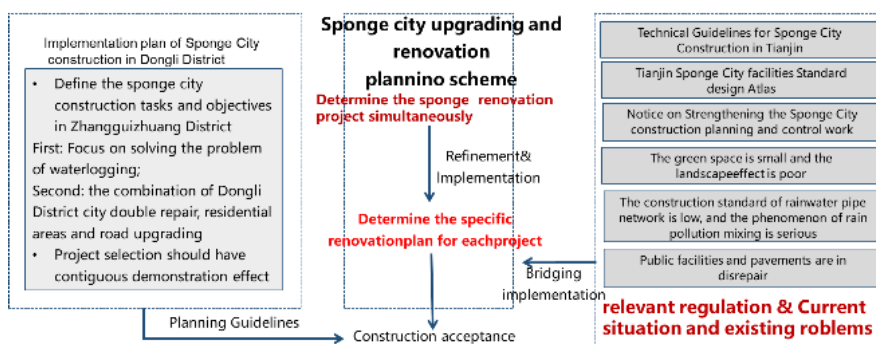


Figure 5. Technical route of systematic reconstruction of the project.

4.2.2. Water Logging Control Project

There are two water logging points in the central city of Zhangguizhuang among which Tianshui Liyuan water logging point renovation and sponge lifting project: based on the current pipe network and environmental analysis, and in accordance with the principles of ecologist, sponge lifting and convenience for the people, the rainwater pipes and community environment are upgraded and reformed. The existing rainwater and sewage confluence pipe will continue to be used as sewage pipe, and the new d300-d600 pipe will be used as rainwater pipe. Repair the seriously aged rain fall pipe (UPVC, Del00), and add pebbles at the junction of rain fall pipe and green space to slow down the erosion of rain water on green space and reduce soil and water loss in green space. Make full use of the existing green space and transform it into a concave green space, rain garden and dry stream by means of “acupuncture style” implantation. Through opening holes in the road, rainwater from the surrounding road will be merged into it to absorb the initial rainwater and control the initial pollution of runoff. Through the investigation of residents’ needs, the abandoned public areas should be upgraded and renovated, and the permeable rubber runway should be set up, as well as the recreation facilities for children and the elderly should be added. On the basis of retaining the original number of parking spaces, reasonable planning of outdoor space layout of the community, using ecological parking spaces to increase the ground permeability as shown in Figure 6.

Fushanli water points renovation and sponge lifting project: the overall optimization of the community rainwater pipe network, strengthen the drainage capacity of the community, clear rainwater path. Rationally plan the rainwater storage space on the roof, and use the linear drainage ditch to centrally transfer the roof rainwater to the reconstructed concave green space beside the house, so as to reduce the pressure of the internal pipe network. According to the residents’ wishes, 12 finished rainwater flowerbeds and 18 finished rainwater barrels were set up “according to the needles” on the premise of not affecting parking, so as to realize the collection and utilization of roof rainwater and carry out the pilot demonstration of rainwater utilization in the community. The transformation effect is shown in Figure 6.



Figure 6. Comparison before and after renovation.

added, so as to form a multi-level vegetation community with the combination of grass, irrigation and grass.

There are many living streets in the old urban areas. Combined with the living characteristics and needs of residents, sponge city renewal focuses on the initial rainwater pollution control, the rainwater reduction of sidewalks and slow roads, and the unimpeded rainwater paths of vehicle roads. Sponge measures such as pavement water paving, grass planting ditch, concave green space and pollution interception hanging basket are set up.

4.2.4. Reconstruction Effect

Through the sponge transformation of the current water accumulation points, road pipe network, old residential areas and green space square in the central city of Zhangguizhuang, the water accumulation problem in the region can be effectively solved, and the sponge construction goal of “no water accumulation in light rain and no water logging in heavy rain” in the old city can be realized. After the evaluation of the sponge city model, the annual total runoff control rate is 55%. The sponge concept is used to upgrade the current road, which is conducive to controlling the initial rainwater pollution improving the urban appearance, and improving the landscape quality of the central city. Rationally control rainwater runoff and use rainwater resources. collect and utilize about 4000 cubic meters of rainwater annually, used for afforestation irrigation to save operating costs, but also to provide residents with healthy living conditions; Restoring ecological space, fully protecting river, lake system and green space, maintaining the continuity of ecological space, and maintaining good ecological functions of the city.

5. Conclusion

Sponge city renewal is a complex and systematic project involving architecture, landscape, municipal and other professions and departments. The sponge city reconstruction of old urban areas focuses on solving problems, integrating the treatment of water accumulation points, low-impact transformation at the source, area renewal and other approaches. We need to start with the concept of systematic management of the source and process of rainwater. By applying engineering and technical measures such as “seepage, stagnation, storage, purification, use and discharge” according to local conditions, we promoted the construction of sponge city in the old urban areas with online monitoring as the effect evaluation method. Finally, a low impact transformation model that is green, livable, and economically reasonable was implemented in urban renewal.

Acknowledgement

Fund Project. Research on Sponge City Reconstruction Model of Old Urban Areas under the Background of “Systematic and Comprehensive Construction”, Youth Fund Project of China Academy of Building Research (20212001331030001).

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