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| RESEARCH ARTICLE

The Construction of Sponge Public Space in Child-Friendly Cities - Takes the Waterfront of Macao as the Prospect

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| ABSTRACT
As countries protect the rights of children and safeguard the rights and interests of children through laws, regulations, and policies, for the concept of children from "demand" to "respect rights", the understanding of "child-friendly" urban design planning concept is also deepening and strengthening, many large and medium-sized cities in China are active efforts to explore the construction of "child-friendly" city and community. This paper first analyzes the current situation of the waterfront area of Macao, then analyzes the concept of child-friendly areas through other cases, mainly focusing on the technical and ecological means of functional wetland, and builds the public space of the waterfront area of Macao, to provide suggestions for the construction of the waterfront area of the inner port of Macao.

| KEYWORDS

Child-friendly; sponge city; public space; Macao inland port waterfront; green infrastructure.

| ARTICLE INFORMATION

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1. Introduction

In April 2019, General Secretary Xi Jinping, at the opening ceremony of the second Belt and Road Forum for International Cooperation, put forward the cooperation initiative of "Caring for Children, Sharing Development and Promoting the Realization of the Sustainable Development Goals". In March 2021, "Building a child-friendly city" was officially included in the outline of China's 14th Five-Year Plan, with the strategic goal of "demonstrating 100 child-friendly cities". In October 2021, the National Development and Reform Commission and 23 other departments issued the Guiding Opinions on Promoting the Construction of Child-Friendly Cities, which made comprehensive arrangements for the guiding ideology, basic principles, construction objectives, tasks and measures, and implementation guarantee mechanism for the construction of a child-friendly city with Chinese characteristics. Building a child-friendly city and promoting the healthy growth of children has become a strategic measure to alleviate the pressure of China's aging population and fewer children and improve the level of sustainable urban development and people's happiness.

However, children are often neglected in public policy and even in public health places and built environments (Caroline Brown et al., 2019). The reasons for this are diverse and are related to status and intellectual ability. Children cannot vote or pay taxes, and they are rarely considered able to contribute to policymaking.

Focusing on children can be seen as a valuable entry point for integrated healthy city construction and policy and as the basis of the WHO Healthy Cities Initiative (Caroline Brown et al., 2019). To paraphrase Enrique Penalosa (Mayor of Bogota), if a city is a place where children all feel friendly, it will be a friendly place for everyone.

1.1 Sponge-type child-friendly city

In 1996, UNICEF and UN-Habitat launched the Child-Friendly Cities Initiative (CFCI), which stated that the well-being of children and youth is the ultimate goal of a healthy living, civilized and democratic society, and good government. The ultimate goal is the well-being of children and youth (联合国儿童基金会, 2018). According to the United Nations, a "child-friendly city" is a city, town, community, or any local government system dedicated to protecting the rights of the child under the Convention on Rights without discrimination, acting in the best interests of the child in the affairs involving children; ensuring the child's life, survival, and development rights and respect for the views of the child (Hyojin Nam & Seok In Nam, 2018). In these cities or neighborhoods, children's voices, needs, priorities, and rights are an integral part of local public policy, procedures, and decision-making. Therefore, in essence, a child-friendly city is also a livable city for everyone.

The city goes further and further in the pursuit of efficiency, which obviously ignores the interests of vulnerable groups, especially urban children, while increasingly deviating from the core values of urban planning (丁宇, 2009). The construction of a child-friendly city should be a long-term development goal. Sponge child-friendly city carries the core value of urban planning, reflects the care for the socially vulnerable groups represented by children, and uses sponge construction technology and concepts to build a friendly city.

1.2 Urban public space

With the acceleration of urbanization, on the one hand, the urban population has expanded rapidly in recent years, followed by the problem of urban congestion and the increasing potential space demand of individuals. At the same time, many cities are faced with a series of pressing problems, such as the tension between people and land, environmental deterioration, and the decline of green landscapes (严晶, 2007). On the other hand, with the improvement of the quality of life, people's requirements for urban work, living, and living environments are also constantly improving. With a little attention, we will find that as long as the urban public space field creates a favorite landscape and facilities, people will flock there. As an important medium, the urban public space is the main place for human social interaction and leisure.

By urban public space, we refer to the sum of all forms of external environmental space between buildings in a city, which the public can enter at will. From the narrow streets, markets, and docks of early cities to residential gardens, squares, parks, pedestrian shopping centers, and today's urban open space system, all fall into the category of urban public space. An important feature of urban public space is its publicity, which is created to meet the wishes and needs of most people. In modern urban life, people's requirements for the outdoor environment are becoming higher and higher, and the humanization of landscape design of urban public space has become more and more important. Each urban public space is a space combination composed of several small Spaces, and its humanized design is directly related to the quality and atmosphere of the whole space.

2. The research status of public space in sponge child-friendly cities

In 2015, China launched the "sponge city" pilot. Its core goal is to solve the water quality and water problems due to rainfall; according to the government's plan, by 2020, more than 20% of urban built-up areas should naturally store 70% of rainfall, more than 80% of urban built-up areas to achieve this goal (俞孔坚, 2016). After years of construction, it is not difficult to find that China's pilot sponge city construction project is policy-oriented. Through very important research and replication of foreign green technologies, these studies and practices rely too much on the technical level of rainwater management to solve problems rather than based on the social and cultural values of water. Therefore, in the long run, China's rainwater management may not play the desired role and even become an unsustainable "sponge city". At the same time, more and more scholars and planners realize that the construction of cities needs to focus on children, respect children's rights, and encourage their participation. Therefore, it is necessary to make full use of and transform the existing urban environmental land so that children can live in an environment without pollution and have green space. Therefore, the coupling study on the relationship between sponge city construction and child-friendly concepts is of great value to the sustainable development of Chinese cities and communities.

3. Current status of the design examples

Located on the western side of the Macao Peninsula, the Macao Inner Harbour waterfront is the oldest and the first harbour area to be developed in Macao. From the 19th century to the 1930s, its shoreline was gradually reclaimed and expanded to form the present pattern of "two banks of water" from the Old Town of the Inner Harbour to Wan Chai in Zhuhai. (Figure 1).

In China's modern coastal cities opening ports along the river, the waterfront area serves as an important foreign trade port, forming a unique traditional business district along the coast. Now, these once prosperous port areas are facing an urgent need for transformation and upgrading. Among them, how to continuously deal with the frequent flood disasters, continue the traditional wharf culture, and reactivate the vitality of the waterfront area has become an important topic for the activation and renewal of the old waterfront area. The waterfront area and old urban areas of Macao have been affected by flooding for a long

time. In the five-year development plan, the SAR government has taken water control and urban renewal as important livelihood issues in the domestic port (澳门特别行政区政府, 2016), which has also attracted wide attention from society.

The waterfront area has a unique significance in time and space and is the characteristic of each city. In the industry-oriented modern urban period, the industrialization of the waterfront was mainly carried out to meet the needs of urban transportation and storage (王建国 & 吕志鹏, 2001). Due to the adjustment of industrial structure, the transformation of the transportation system, and the transformation of the port and industrial center, the former coastal industrial zone gradually declined. Postmodernism, as a new urban culture, makes the waterfront undergo historic changes in humanity, function, and space. The waterfront was transformed into a public space, a symbol of a post-modern city.

Figure 1 Macau Inner Harbour Waterfront

3.1 Open space in the inland port waterfront and the surrounding area

3.1.1 Waterfront area

The inner port waterfront is a medium-sized waterfront space (杨保军 & 董珂, 2007), forming a relatively closed water area on the water surface with a view facing the coastline of Wanchai. Shiliupu Entertainment City strongly occupies the core plot of the waterfront, and the remaining semi-enclosed space of the waterfront includes 34 docks, where existing ships on the waterway can dock. The industrial role of the port was still there, but the connection between the old port and the water space was cut off. The rigid interface of the waterfront is unable to give full play to the advantages of the waterfront, hindering the view of the landscape, isolating the connection between the public and the water body, and making the public space in the waterfront unattractive and public.

3.1.2 Streets, alleys, front ground and green space

In the dense environment of the inner city, the diversified architectural appearance shows the different architectural standards and styles of China and Portugal (佘美萱 et al., 2011). The streets and alleys composed of the buildings enclosed by the front square together constitute the unique physical interface and the old city texture of the open space of the inner port. The overall terrain is high in the east and low in the west, the streets and lanes are distributed in the mountains, and the local terrain is low, which is an important factor causing the storm surge and flood disaster. The old city includes road, street, street, cross street, inclined street, lane, inclined lane, wai, li, and other eight space forms. As the main street, the new road is only 10 meters wide, and the width of the arcade building on both sides is 2.5 meters. The arcade building along the street has become a comfortable walking place on the street, forming a unique spatial experience. The width-to-height ratio of the traditional street is roughly 1:3, and the surrounding space is even 1:4 or larger, with an obvious narrow sense. The famous fifth day of October Street and Lower Ring Street, together with the main road, form two small-scale ring systems. As a small-scale linear space, streets, alleys, wai, and li are just like the capillaries of the urban organism, forming a unique street layout form of the old city of Macao Inner Port. At the front desk, the irregular small square carries many functions in the unique wavy Portuguese road form, such as rest, sports, interaction,

exhibition, and trade, with local textures. In the high-density environment of the old city, public spaces such as streets and fronts are precious and scarce. There are only a few green Spaces that can really improve the comfort of public space and create a pleasant microclimate. Except for the White Pigeon Nest Park, there is almost no complete green space. According to statistics, the per capita green area of Macao is only 2 square meters, and the green space for public activities is insufficient.

4. Suggestions for the design of the Macao inland port waterfront area

4.1 Greening and the Environment

An important requirement for Macao residents is to make full use of the reconstruction opportunities of the inland port waterfront area, carry out reasonable greening, expand the nodes of public space, and create a comfortable and convenient waterfront area (刘滨谊, 2007). Compared with the traditional greening mode in the waterfront area, the greening mode of "small space, multiple configuration and three-dimensional" can better adapt to the spatial limitation of urban space and also meet the control and positioning of small-scale and small systems. According to the overall function orientation and design requirements of Binhai New Area, the overall layout of small space, small and medium-scale conventional green space, linear green corridor, and special space greening is put forward. In the whole continuous waterfront open space, the ground green space is the main, and the linear corridor should be combined with the layout of the slow traffic system to play the series organization function of the space. Special greening of a specific space. In the local small space and the side of the old city, the method of filling up can be adopted for greening in part of the reconstructed areas, and residents are encouraged to rationally use the space for small areas of point greening so as to create a public and comfortable small environment, rather than a single large space.

4.2 Build the green infrastructure in the waterfront area

In the 1990s, McHarg's design was combined with the theory of nature to further develop new technologies in the field of landscape and stormwater management, namely the Low-Impact Development Model (Low Impact Development, LID), which has become the main technical solution for contemporary urban flood control and prevention. Its principle is in different site conditions and underground conditions, the use of biological stranded facilities, rainwater filtration systems, vegetation depression/rainwater wetlands, rainwater collection devices, sustainable drainage systems, stranded pools, vegetation grass ditches, seepage ditch, green roofs, permeable pavement technology to collect, guide, retain, permeate and purify rainwater. To reduce the frequency of rainwater runoff and rainwater pipe overflow, eliminate water accumulation and pollution, etc. Statistically, LID can reduce rainwater runoff by 30% to 99% and delay the peak runoff by 5 to 20 minutes, thus reducing the pressure on the municipal drainage network (Zhang Yuan et al., 2014). At present, the concept of green infrastructure combined with human settlement environment, ecological protection, and green technology has become a hot research topic at home and abroad in recent years, but the relevant theory and practice in China are still in the preliminary exploration stage (李开然, 2009).

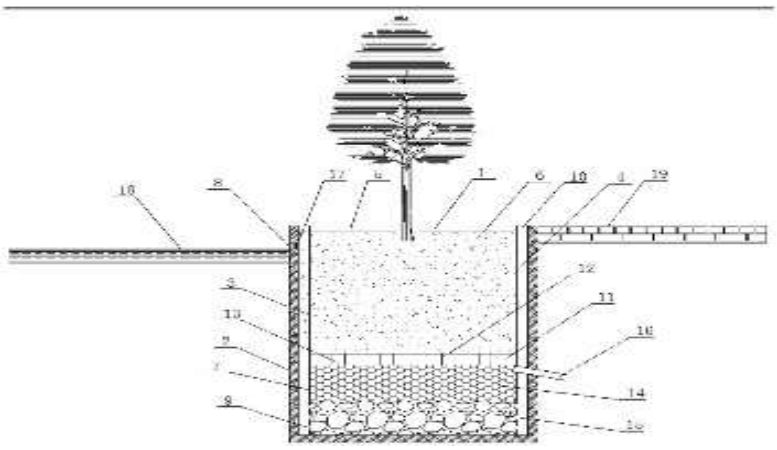

Figure 2. Ecological tree pool
Source: cnipa

4.3 Create child-friendly space in combination with green infrastructure

4.3.1 The concept of green infrastructure permeable pavement + ecological tree pool

An ecological tree pool is installed along the waterfront. Studies have shown that one of the main factors restricting children's independent activities is street traffic safety (Lia Karsten & Willem van Vliet, 2006). According to the UK SUDS project, narrow roads

are converted into permeable roads through traffic restrictions, and when it rains, rain flows into the cracks of the permeable road and directly into the ecological tree pool installed on the waterfront (Figure 2). The permeable pavement is designed to match the level of the existing site, and the permeable part of the pavement (gravel, gravel, and 50 mm synthetic material) has a depth of 180 mm, which can not only penetrate rainwater but also accommodate heavy emergency and maintenance vehicles in an emergency.

According to this technology, public spaces around the waterfront, buildings, or permeable pavement around campus playgrounds are connected to underground downpipes to direct rainwater to the ecological tree pool. The ecological tree pool provides more than 55 cubic meters of storage, which does not include the amount of rainwater in the permeable pavement and retained in the ecological tree pool, as the trees in the tree pool will further control the rainwater runoff. The purpose of planting these trees was to limit stormwater runoff below 1L / s, which was significantly lower than the 5L / s runoff normally used for common plots, and to allow more rainwater to remain in the field for longer periods. Use of intelligent drain outlets to minimize the risk of siltation. Tree pools not only increase biodiversity by planting a variety of trees and herbs but also create a green open space where residents and children can meet, play, and explore nature.

4.3.2 Rainwater Garden of Green

Infrastructure Concept by installing rainwater gardens on the waterfront. Rainwater gardens are inspired by the observation of nature, where shallow depressions in natural woodlands are filled with rain during heavy rains and then slowly discharged into the ground for a day or two (Viviana Pappalardo & Daniele La Rosa, 2020). In the same way, runoff is captured high on the roof of the building around the waterfront and joins in between through elevated stands, then flows down the "sculpture" ropes to carry water out of the building and eventually into the rain garden on the waterfront. The rain garden requires only annual weeding and fertilization to keep the soil healthy and porous, thus allowing the rain to be quickly absorbed by it.

4.4 Advantages of incorporating green infrastructure into Macao's Inner Harbour Waterfront area

The advantages of green infrastructure, and urban and child-friendly concepts of including green infrastructure in the waterfront of Macao are interrelated. Green infrastructure can be a small green system designed for urban stormwater management that can create more green space for cities to reduce floods (刘海龙, 杨锐, 贾海峰, 等, 2015); the coupling of green infrastructure system and child-friendly concepts can guide us to use land more effectively, use resources more efficiently and educate future citizens to understand and care about our environment.

4.4.1 Building green infrastructure on the waterfront of Macao will contribute to the formation of a child-friendly urban space network.

Green infrastructure can be used for the construction of large open spaces in cities, as well as for the renovation of small plots of land in communities and campuses. For a long time, many cities in China have simply equated the construction of child-friendly urban public spaces with the construction of large-scale projects related to children. The very representative one is the construction of children's parks, museums, children's palaces in urban centers, or the construction of various large-scale theme parks (such as Disneyland). In fact, the service radius of such projects is too large for children to allow them to participate in games anytime and anywhere. In addition, the project is huge, and the construction period is tight, which cannot guarantee the right of children to participate in the design and construction. Many people do not know, but the children know that the children's amusement facilities in certain places have risen. Compared to these large child projects, children prefer natural landscape sites, providing them with green space and stopping to observe wildlife habitats. While promoting the construction of sponge cities, China is also promoting the construction of child-friendly cities. It may be a good choice to include more sponge city pilot projects in the child-friendly project network. Building green infrastructure will make it a more diversified, child-friendly space and reflect humanistic care.

4.4.2 Maximize the ecosystem service benefits from the urban green space.

The waterfront area of Macao will be built into a demonstration area of sponge city, and the urban environment will be continuously "softened" by increasing the greening area of roads, paving permeable pavement, and promoting rainwater gardens. At present, there are still few landscape projects with "sponge city" and green infrastructure as the core at the micro level. In recent years, with global climate change and increasing rainfall intensity, we can use existing roads, squares, school playgrounds, etc. Rainwater is managed by multiple objectives of increasing green space and permeable pavement (increasing infiltration), tree planting (rainwater storage), and rainwater storage and reuse; we can also increase the cost of construction operation and maintenance by modifying the relevant regulations, use publicity and education to strengthen the public, and improve the rainwater of private courtyards or public houses by modifying the relevant regulations of residential areas.

4.4.3 Conclusion

Under the current top-down mechanism in China, there are limitations to solving these problems by changing the level of planning, so the construction of a "sponge city" can provide an opportunity for China to realize the open community democracy led by the

government, capital injection by social groups, and coordinated participation and management by residents. Most residents and real estate developers in China have not yet realized that green infrastructure will increase property value, so demonstration projects need to raise their awareness and encourage the government, developers, and residents to jointly renovate existing living conditions to promote the construction of a "sponge city" system.

5 Conclusion

The proposal of Sponge City is based more on the technical level to solve the problem of urban rainwater management. In addition to the basic value of urban planning, combining the social and cultural values of water and taking the public needs of citizens into account can better play the role of urban planning. Urban planners and designers should grasp the core goal of urban planning, based on child-friendly and sponge city construction technology, to build a sponge child-friendly city. This paper to the port of Macao waterfront space planning problem as a starting point, combing the relationship between the basic value and technical means, starting from the status quo, the study how sponge child-friendly city concept combined with the status quo, and put forward to green infrastructure child-friendly public space, casting, hope to provide new ideas for urban construction.

6 Study Limitations and Future Research

The shortcomings of this paper include the following: 1) The research scope of this paper is relatively macroscopic, without in-depth analyses and evaluations of specific green infrastructure projects, and the cost-effectiveness of implementation and other factors still need to use quantitative data and models to support and validate the results of the study. 2) The research perspective of this paper is relatively limited, mainly from the point of view of urban planning and design, and does not take into account the impact and role of the social, economic, political, cultural, and other dimensions of the child-friendly city and sponge city. 3) The research perspective of this paper is limited, mainly from the perspective of urban planning and design, and does not fully consider the influence and role of child-friendly cities and sponge cities in the social, economic, political, cultural and other dimensions.

Future research efforts should focus on the following: 1) Deepen the research on green infrastructure projects, evaluate and optimize them from technical, economic, environmental, and social perspectives, and improve their effectiveness and efficiency in sponge-type child-friendly cities. 2) Enrich the research methodology and adopt multiple data sources and analysis tools to enhance the objectivity and scientificity of the research. 3) Expand the research perspectives to explore the impacts and effects of child-friendly cities and spongy cities from multidisciplinary and multilevel perspectives. Expanding research perspectives, exploring the theory and practice of child-friendly cities and sponge cities from multidisciplinary and multilevel perspectives, and constructing a comprehensive and systematic research framework.

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References

[1] Caroline B, Ariane D L, Deborah M, Tim G, Marcus G, Hannah W, & Samuel W (2019). Special issue: Child-friendly cities. Cities & Health, 3(1–2), 1–7. https://doi.org/10.1080/23748834.2019.1682836
[2] Hyojin N & Seok I N. (2018). Child-friendly city policies in the Republic of Korea. Children and Youth Services Review, 94, 545–556. https://doi.org/10.1016/j.childyouth.2018.08.033
[3] Lia K & Willem V V. (2006). Children in the City: Reclaiming the Street.
[4] Viviana P & Daniele L R. (2020). Policies for sustainable drainage systems in urban contexts within performance-based planning approaches. Sustainable Cities and Society, 52, 101830. https://doi.org/10.1016/j.scs.2019.101830
[5] 丁宇. (2009). 儿童空间利益与城市规划基本价值研究. 城市规划学刊, z1, 177–181.
[6] 严晶. (2007). 浅论城市公共空间. 苏州大学学报(哲学社会科学版), 1, 119–120. https://doi.org/10.19563/j.cnki.sdzs.2007.01.031
[7] 佘美萱, 李敏, & 梁敏如. (2011). 澳门园林建筑与装饰小品特色研究. 中国园林, 27(11), 52–56.
[8] 俞孔坚. (2016). 海绵城市: 理论与实践. 中国建筑工业出版社.
[9] 刘海龙 , 杨锐 , 贾海峰 , 等. (2015). 国际城市雨洪管理与景观水文学术前沿: 多维解读与解决策略. 清华大学出版社.
[10] 刘滨谊. (2007). 城市滨水区发展的景观化思路与实践. 建筑学报, 7, 11–14.
[11] _ (2009). 绿色基础设施:概念,理论及实践. 中国园林, 25(10), 88–90.
[12] 杨保军 & 董珂. (2007). 滨水地区城市设计探讨. 建筑学报, 7, 7–10.
[13] _ (2016). 澳门特别行政区五年发展规划(2016—2020年). 澳门特别行政区政府.
[14] _ (2001). 世界城市滨水区**开**发建设的历史进程及其经验. 城市规划, 7, 41–46.
[15] _ (2018). 构建儿童友好型城市和社区手册. 联合国儿童基金会.