

Vitality Towards Water: Exploring the Construction of Urban Waterfront Public Space

A Case Study of Wuhan's Yangtze River Waterfront Spatial Planning Design

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Abstract

Located in the middle reaches of the Yangtze River, the longest river in Asia, Wuhan is constructed along the river, and its waterfront public space serves as the unique spiritual space that connects citizens with the city. This paper discusses the space construction concept of Wuhan River-beach from multiple aspects, such as understanding developments and evolutions of River-beach, enhancing city and river connection, highlighting local features and implementing supporting planning etc.

Keywords

Waterfront area, space construction, Two Rivers and Four Banks, planning implementation

Water constitutes a key element for the formation and development of a city, for about 70% world population living alongside water. Water not only has a far-reaching impact on a city's economy, transportation and other aspects, but also plays a very significant role in the characterized shaping of urban public space (Xu & Bian, 2015). Since 1980s, there has been numerous global researches on urban waterfront space. In 1988, British scholar Hoyer first comprehensively analyzed the developments and constructions of waterfront space in theory in the book *Waterfront Space Updates* that was chiefly edited by him. In 2002, *Waterfront Landscape Design* chiefly edited by Japan Society of Civil Engineers analyzed the waterfront area planning and management, landscape design idea, water body preservation and waterfront building design from a micro perspective. In recent years, Chinese scholars such as Wang Jianguo and Yan Shuiyu have conducted comprehensive researches on the constructions of waterfront space from the perspective of multi-disciplinary integration of ecology, management, economics and so on (Wang & Lv, 2001).

However, as the public has increasingly higher concerns and demands for waterfront space, except for London, Tokyo, Shanghai and other international metropolis, plenty of urban waterfront space in a city gradually shows its lack of local features. Urban waterfront areas usually are constructed as green space which are lack of vitalities due to the single function and hard to become a unique landmark (Bird, 1963). Taking the waterfront city Wuhan, China, as an example, this paper will further discuss the constructions of public space in the waterfront area based on 'Waterfront Space Planning of the Yangtze River in Wuhan', fully explore the ways to appropriately and reasonably utilize waterfront resources,

optimize the overall coordination capability between waterfront area and urban space and shape the localized characteristics of waterfront space under the premise of ecological priority.

1. City-river development and evolution process in Wuhan

As the longest river in Asia, the Yangtze River Basin covers nearly 1/5 land areas of China. The Yangtze River is known as China's "Mother River". Wuhan is located in the middle reaches of the Yangtze River, which creates a variety of ecosystems, including farmlands, forests, mudflats, wetlands, etc. Thus, the construction of waterfront area keeps playing a very important role in the urban development of Wuhan, which can be divided into three stages, including growing dependent on water, developing opposite to water and resuming waterfront development.

1.1. Growing dependent on water

Situated at the junction of mountainous areas and plains, Wuhan is a city that grows dependent on ancient Grand Yun-meng Lakes that connects to the Yangtze River to the south and Han River to the north and were composed of continuous and interconnected rivers, lakes and marshes (Fig. 1-1). In the Tang and Song dynasties, Grand Yun-meng Lakes ultimately evolved into the vast Jiangnan Plain with abundant natural resources, while Wuhan's urban pattern was then gradually evolved into "Junction of two rivers, Standing of three towns". Wuhan became the only inland river port city developing along both sides of the Yangtze River.



Figure 1-1. Ancient geographical environment of Wuhan. Source: image.baidu.com

As a result, Wuhan's city construction history is closely related with water. During the period from Three Kingdoms to the Tang and Song dynasties, Jiangnan Plain was frequently stricken by floods, while ancient cities and towns were mainly constructed on highlands alongside the rivers and lakes and the military strategic positions were prominent for a city and town. With the development of commerce and trade in the Ming and Qing dynasties, the three towns of Wuhan developed rapidly alongside Yangtze River and Han River relying on convenient water transport. Wuhan kept heightening and strengthening dikes along the rivers while constantly built various docks for transport. Busy ports brought thriving industries and people from the nation. In the late Qing Dynasty, the three towns of Wuhan had been ranked top nationwide in terms of their economic strength and city size, and riverside areas were featured 'Miles of boats parking alongside the ports, Thousands of houses lighting all night long.'

1.2. Developing opposite to water

After the founding of People's Republic of China, the modernization urban construction has been under planned development across China. Owing to the central location and a good foundation of megacity, Wuhan was prioritized to development with the help of all nation in every major national strategic plan. For example, Wuhan was incorporated into the layout planning of 156 major projects and the very first Yangtze River Bridge in China was sited and built in Wuhan. The city then started to expanded from three parts and developed back to the river. With the embankment and waterbody reclamation construction of Yangtze River and Han River, artificial elements were added to the water by human activities and city constructions. Industries and agriculture all became to the large-scale industrialization mode comparing to old small spots mode. The city size expanded as a circle in a direction perpendicular to the Yangtze River (Fig. 1-2). The spatial form of riverside areas was dualistic, namely the city area was guarded by multi-stage dike system while peripheral rural areas still kept their natural bank line characteristics with point renovations for industry expansion to satisfy the low-cost development demands of industry and ports. Besides meeting the port and dock needs, space outside the dikes was built with many large-scale industrial municipal facilities. The options of waterfront activities for citizens in Wuhan were mainly country visiting activities and touring sporadic flood control sites.

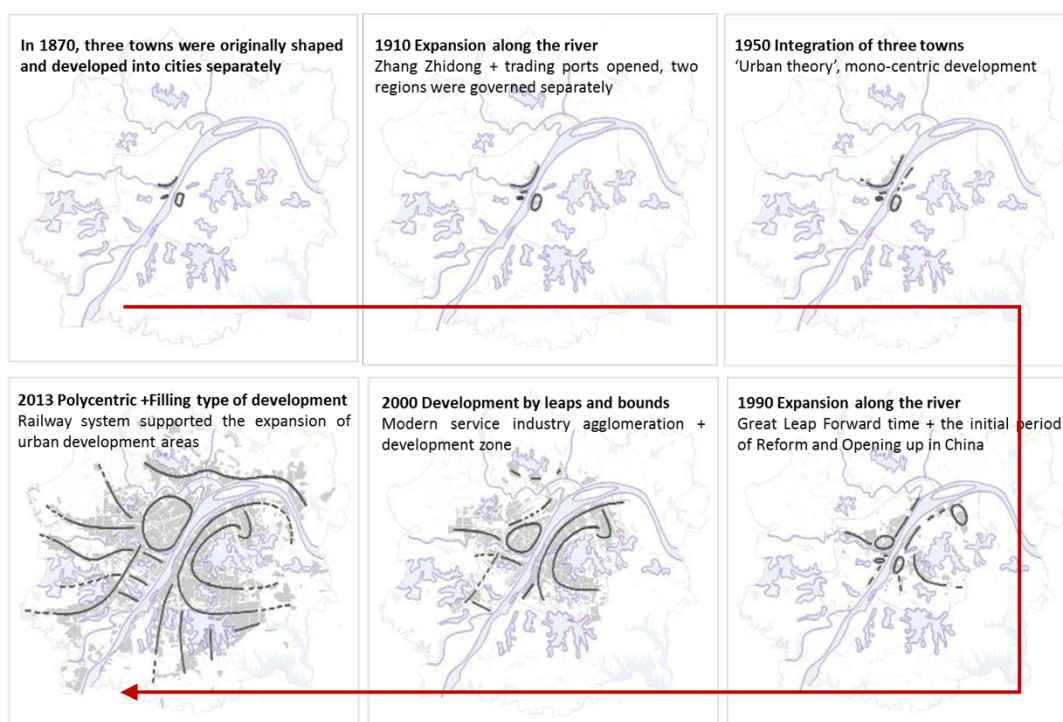


Figure 1-2. Waterfront development history of Wuhan. Source: Plotted by Authors.

1.3 Resuming waterfront development

In 1998, the Yangtze River experienced the catastrophic flood once in 100 years. As a megacity in the middle reaches of Yangtze River, Wuhan's city safety not only concerned the safety of millions of citizens, but also became a test of whether China's Reform and Opening-up policy was capable of high-quality comprehensive development or not. All citizens in Wuhan guarded dikes and fought against floods, and a reinforced concrete levee was built cross Wuhan after the 1998 flood period. Based on hydrological changes through a year, the platform of the levee was filled to a 28.5m elevation and formed the Yangtze River Beach Park with three-level elevation platforms. In this way, the mudflat along the river was transformed into a public space where citizens could have plenty outdoor activities (Fig. 1-3). With the guarantee of levee, Wuhan built bridges and tunnels, becoming the city with the densest passageway crossing the Yangtze River and the most densely populated waterfront area. 2020 witnessed a catastrophic flood on the Yangtze River again, but the city of Wuhan overcame the flood peak peacefully

and easily, while citizens became even more passionate about waterfront activities. Yangtze River Beach Park is considered as “the most indigenous space” by citizens, and its development integrates the human wisdom accumulated from the interdependence of the city and river since ancient times.

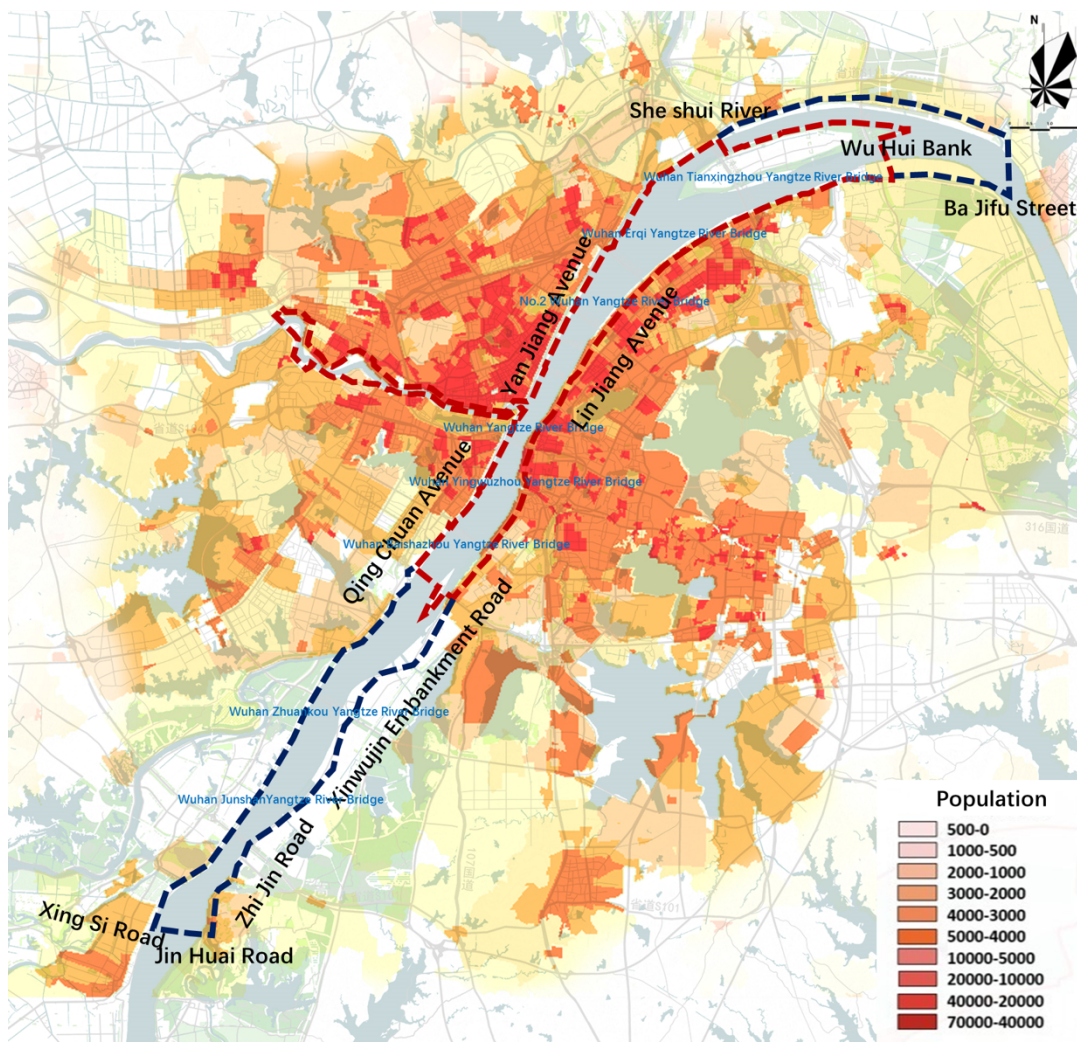


Figure 1-3. Residential distribution map of Wuhan waterfront area. Source: Plotted by Authors.

2. Ideas of constructing Wuhan waterfront space – Returning to ecology and formulating systematic planning

The development and evolution of beach space in Wuhan undergoes three stages, including co-existence, struggling and integration. In the past nearly 20 years of rapid development, Wuhan always expanded a riverside area in every major developing opportunity. The position of rivers and marshlands in urban life is the primary consideration of ecological development and green city construction in the new era. In terms of the construction of waterfront public space domestically and internationally, the planning measures are divided into three parts based on the mode of “strategy – design – implementation”: Strategy-to strengthen the city-water connection within the area; Design-highlighting localized features in creating waterfront public space; Implementation -emphasizing projectization during constructions: long-term goals are uniform with short-term construction, and the strategic direction is uniform with implementation project (Dai. et al., 2019).

The Yangtze River flows 145 kilometers through Wuhan in east-west direction. Han River, the largest branch of Yangtze River, flows 62km through Wuhan from north to south. Three towns are located where

the two rivers converge. Water surfaces and mudflats occupy 1/4 of the total area of Wuhan, and undoubtedly take the central position of Wuhan. In this round of city comprehensive planning, the urban spatial structure is characterized by “Vitality Towards Water and Returning to Waterfront”, namely the river serves as the center, which highlights ecological priority and reflects gathering of talents. Focusing on urban development level, the top-level design integrates development of rivers, beaches and cities. Based on the concept of full life circle of ‘planning, construction and city operation’ and the idea of ‘point to area, demonstration to universality promotion’, it’s planned to promote the organic integration of city buildings and ecological environment, to formulate a long-term mechanism of full coverage, to build Wuhan into a world famous waterfront ecological city and to establish a system to connect special plans with city master/comprehensive plan.

3. Full factor space design – Creating characteristic waterfront scenes by levels

The waterfront area of environmental complexity is composed of water space, waterfront and land area adjacent to water body. “Total space” ranges from waterfront, and generally refers to the urban land space with about 15-30 minutes’ walk and 1km-2km distance. According to urban functions of water area and land area, the waterfront area is subdivided into waterfront urban construction area, waterfront building back area and riverside (lakeside) area.

The vision of the city’s blueprint focuses on the concept of “total factor” design while also emphasizing designs at a local level. The entire urban city space can be divided based on the five elements of “water body – waterfront dock – river beach – dike and road – waterfront buildings” and thus ensures a smooth blending between “the river, the beach and the city”, making itself a distinctive waterfront ecological space. (Fig. 3-1).



Figure 3-1. Schematic diagram of waterfront area at five levels in Wuhan. Source: Plotted by Authors.

3.1. Water body: Highlighted ecological environmental protection

3.1.1 Water quality purification and strengthened biodiversity protection and restoration

Protecting water ecology is the foundation of quality of urban waterfront space. In 2020, Ministry of Agriculture implemented a ten-year fishing ban in the Yangtze River. As an important ecological barrier area in the Yangtze River Basin, Hubei Province ranks top in terms of its water area and number of employees withdrawing from fishing industry. It costs high social and economic price to realize stable ban on fishing, which demonstrates the strong determination of the central and local governments to protect and improve the ecological environment. Thus, the planning proposes the following measures of water body treatment with waterfront system: 1. Measures such as sewage treatment plants, sewage interception facilities and ship reconstruction will be implemented to improve river quality. 2. The drain outlets and canal environment are governed comprehensively, and a multi-level ecological wetland filtration system is established. The degraded aquatic ecosystem is restored by governing water body, improving water quality, beautifying environment and selecting suitable plant species.

3.1.2 Ecological elements are implanted for enhanced water-greening integration

1. Sandbars in the river under key protection: There are three sandbars within Wuhan, which constitute characteristic scenery in the river and a key flood prevention site. Sandbars that are submerged during flood season and exposed during dry season become the optimal habitat for aquatic plants and animals. Thus, human activities are less important while the primary goal is to protect its original ecological environment and not to interfere with biological activities. 2. Barges are governed in a centralized manner and transformed into a water corridor covered with lush vegetation which may fluctuate as the river fluctuates. During flood season, it will turn to be a floating island as a habitat for wildlife.

3.2. Waterfront beach land: Differentiated design of waterfront resources

After many years of development and evolution, urban waterfront is basically classified into life waterfront, production waterfront and original waterfront. According to the Planning, the waterfront within three ring line is defined as life waterfront with service functions facing residents’ daily life, leisure and recreation; the area outside three ring line with transportation service function for industry and agriculture is defined as production waterfront; the rest retains its original waterfront with basic flood control function.

Since three types of waterfront have different resource characteristics, their space characteristics also have obvious differences. 1. Life waterfront section is relocated out of the river, and plenty of dock facilities are removed except for public docks and ferry docks such as Yangtze Shipping, public security and city management so as to return the river, shores and scenery to citizens. 2. As for production waterfront, industries along the river are screened and may be closed, changed, relocated and transferred by category. The needs for industrial development shall be met, and the environmental design shall be organized according to industrial characteristics (Fig. 3-2). 3. The original waterfront is retained as per the original land condition of mountains, rivers, forests, farmlands, lakes, and grasslands, and the damaged ecological patches are restored as planned.



Figure 3-2. Transformation and renovation of dock (left), plant (central) and unconstructed area (right). Source: Plotted by Authors.

3.3. Dikes and roads: Ensuring city safety with combination of dikes and roads

In terms of geographical pattern, the flood control of Yangtze River Wuhan section is the most important. During flood season, Jiangnan Plain where Wuhan is located is subject to not only torrent from the mountains in the upper reaches but also the lake area in the lower reaches during wet season, as well as pressure of the Han River and Dongting Lake systems. Floods break out as scheduled every year. 25m water line in Yellow Sea Elevation is the perennial water level of the Yangtze River during flood season and anti-floating water level, while 27.3m is the warning water level and 29.73m is the highest water level on records. However, the average altitude is 24m in urban area, so dike construction serves as the basic safeguard of city safety. The comprehensive flood control system established over the years is relatively perfect. However, a towering reinforced concrete flood wall separates the Yangtze River from the city hinterland, which is always a pity of city space.

3.3.1 Reconstruction and improvement of existing flood control facilities

In accordance with the principle of “adjusting measures to local conditions”, the Planning explores the forms of flood wall in an innovative manner: 1. The built-up flood walls are provided in some sections; 2. dikes in some dangerous sections are transformed into ecological dikes of gentle slope type; 3. Partial stone revetment is reconstructed into ecological landscape bank slope; 4. old blocked channel gates are beautified.

3.3.2 Comprehensive improvement through combination of dikes and roads

Waterfront roads are classified into roads outside and inside dikes, which undertake disaster relief during flood season and serve as urban lifeline and meet urban life and production needs during dry season. Hence, the basic requirement is to ensure unblocked roads. Furthermore, landscape and sightseeing shall be combined based on different level and elevation requirements by designing sidewalks, bike paths and motorways by levels to connect landscape. The long-term goal is to build a light rail line connected with levee top so that citizens are encouraged to view landscape on both banks by public transport on levee top roads (Fig. 3-3).

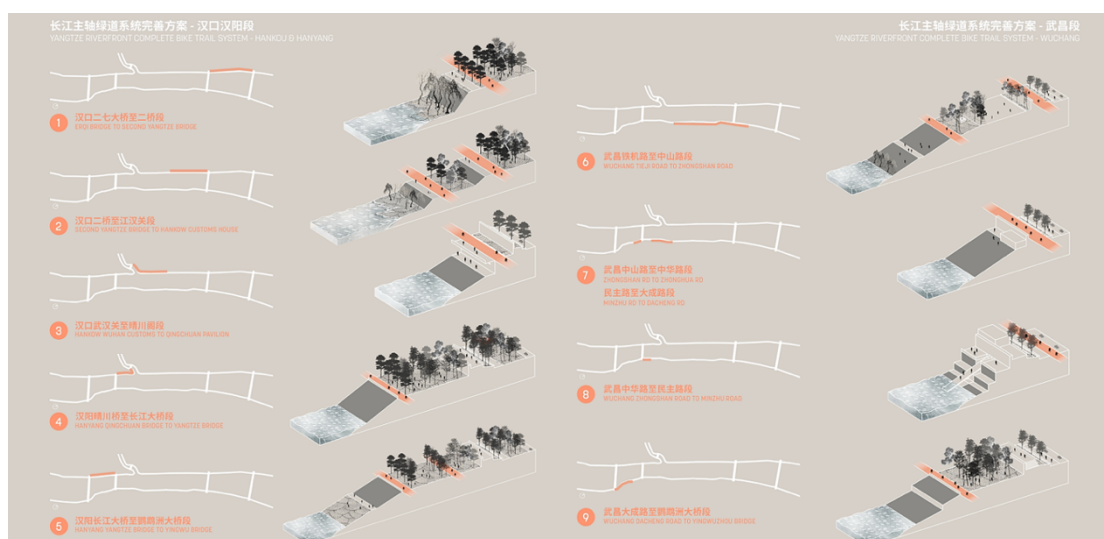


Figure 3-3. Analysis chart of dike-road combination in Wuhan waterfront area. Source: Wuhan Yangtze Riverfront Park Design by SASAKI.

3.4. Yangtze River Beach Park: Creating a flexible space featuring harmonious coexistence between human and nature

3.4.1 Creating a dynamic “city living room”

The design concept of “people first” shall be implemented in the urban waterfront area, namely various personal needs are met in spatial dimension. “City balcony” themed by district layout culture and art will be built (Fig. 3-4) to improve existing landscape of Yangtze River Beach Park. In addition, cultural corridor, art space and vitality show will be provided. In order to form the public cultural and art space in Wuhan, it’s planned to build Guangdong-Hankou Railway Relic Park and Industrial Heritage Creative Park so as to transform the existing historical elements of Yangtze River Beach Park into public art works and continue city memory. Meanwhile, an open area will be arranged for public cultural activities such as Douyu Live, river crossing and Wuhan Marathon. In this way, a dynamic “city living room” will take shape.



Figure 3-4. Rendering of city balcony in Wuhan waterfront area. Source: Wuhan Yangtze Riverfront Park Design by SASAKI.

3.4.2 Respecting the laws of nature and shaping a flexible activity space

In line with seasonal fluctuation of river, several winding secondary rivers will emerge in the park at high and medium water level by topographical design, which can not only serve as migration corridors for wild aquatic animals but also allow boats to pass safely. During dry seasons, these riverbeds are served as non-conventional passage through which people may walk through and explore the thick grasses (Sebastian, 2010). Wetlands provide habitats for species that prefer open habitats, while hidden bird-watching stations in the woods provide learning opportunities for wildlife lovers (Fig. 3-5).

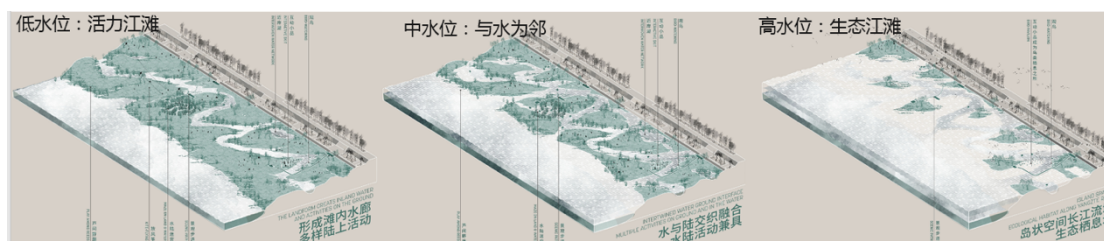


Figure 3-5. Analysis chart of flexible activity space in Wuhan waterfront area. Source: Wuhan Yangtze Riverfront Park Design by SASAKI.

3.5 Hinterland architecture: Optimizing riverside skyline and improving “the first façade” on both banks

Urban hinterland is the third layout except river and bank. Especially, Wuhan downtown has reached a magnificent waterfront development area after years of construction. The riverside buildings in water or along banks are both non-negligible elements of waterfront space.

3.5.1 Forming undulating urban waterfront skyline with proper density and proportion

Skyline, landscape corridors, landmark buildings, and other elements are under key control among riverside building communities. It requires construction at far-middle-near landscape to form undulating urban waterfront skyline with proper density and appropriate proportion as well as delicate city interface through optimizing existing construction. According to the Planning, the spatial structure composed of three sections of ancient cities, three strategic functional areas and multiple sections of characteristic functional areas is determined based on riverside hinterland landscape. It also determines the spatial images in different sections. The visual center and classic skyline are shaped by refining continuous river view (Fig. 2-5).

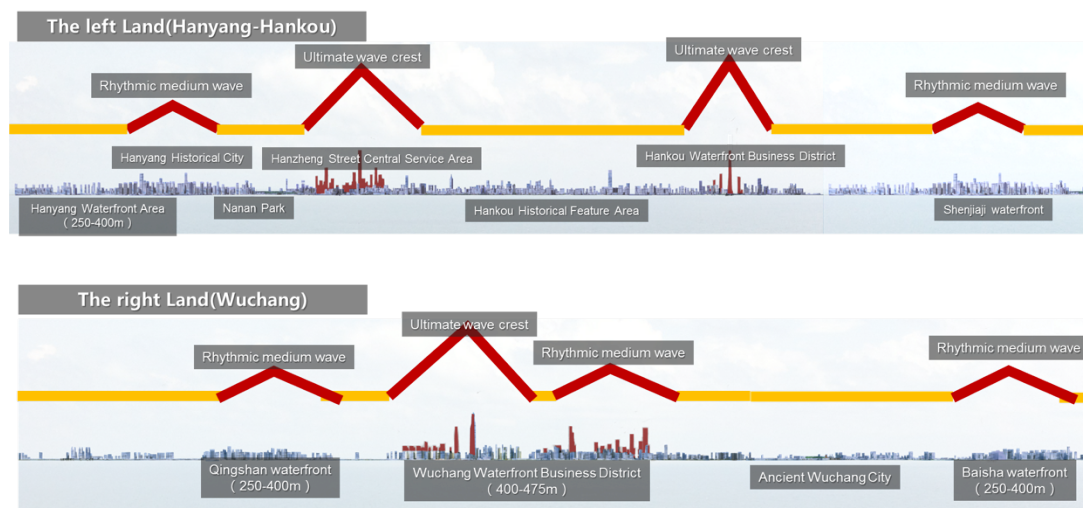


Figure 3-5. Analysis chart of skyline in Wuhan waterfront area. Source: Plotted by Authors.

3.5.2 Renovation and improvement of riverside building features

Based on riverside routes, buildings along the river will be subject to preservation, restoration, regeneration and reconstruction in order to redraw a mental map with different urban characteristics. According to the overall identification of “Huaxia Nationality, Urban Water Features and Inclusive Innovation”, it’s planned to strengthen the differentiated interface guidance of three types of waterfront landscape, including historical culture, modern city and natural ecology, optimize existing spatial levels, introduce world-top masters and build landmarks.

4. Summary of integrated urban water management strategies

Since founding, Wuhan thrives for rivers while never relaxing integrated urban water management. The Yangtze River Beach has become a typical space that contains the complex feelings in Wuhan. Hence, its spatial characteristics are public, disaster-resistant, commemorative and open. To sum up, the space creation strategies include safety-based design, ecology-centered approach, cultural sustainability, vitality stimulation and accessibility.

4.1 Safety-based approach

Flood control safety is essential to the survival of a city. The flood control system does not refer to a dike but a comprehensive system which is closely related to river, lake and ditch system in the upper and lower reaches (Ma, Song & Qi, 2017). On one hand, the main dikes on Yangtze River and Han River as well as the protective embankment system in rural area will ensure the safety of central urban area. On the other hand, the natural landform from suburb will be maintained. The dispatching flood control management system will be operated intelligently based on the climate and water volume in the upper and lower reaches, so as to regulate the lake and trench storage capacity within flood control cycle to ensure proper wet and dry season.

4.2 Ecology-centered approach

It is planned to construct Yangtze River Beach with natural respect and the maintainance of the natural form along the river banks. Fishing ban on the Yangtze River and designation of ecological preservation areas are important measures to ensure the restoration of rivers and waterfront. Mountains, rivers, forests, farmlands, lakes, grasslands and other natural forms will breed unique creature. Ecological preservation areas are designated via levee and protection forest outside the built-up area. The damaged ecological patches are restored for continuity. The ecological space in Yangtze River Beach will be taken as the ridge of the built-up area, which will penetrate into urban areas through blue-green axis network to ensure that citizens will fully experience the ecological space in city center.

4.3 Cultural sustainability

Hinterland of Two Rivers and Four Banks is the most dense area of historical and cultural relics, which can clearly display the different historical features and traces of human activities in different periods (Yu & Zhang, 2007), especially the relics of flood fighting, water transport and water conservancy facilities, which reflects the wisdom of laboring people of various generations. Various relics, facilities, plants and monuments are retained in shaping the space of Yangtze River Beach Park, and transformed into a waterfront historical and cultural feature gallery with “overall pattern + segmented guidance” based on traditional Chinese landscaping ideas. For example, there are Tiebanzhou with ancient culture and Jinkou Town, a flourishing commercial port, which can represent the traces of five foreign countries and concessions, memory of red-bricked houses and eighteen blocks that can exhibit the industrial history of the People’s Republic of China, and “Intelligent community and sponge city” that can reflect modern new industry. Finally, the cultural pattern of “multiple landscape along one gallery” will be formed (Fig. 4-1). In addition, there are several themed tourism routes by land and water to form multiple touring circles.

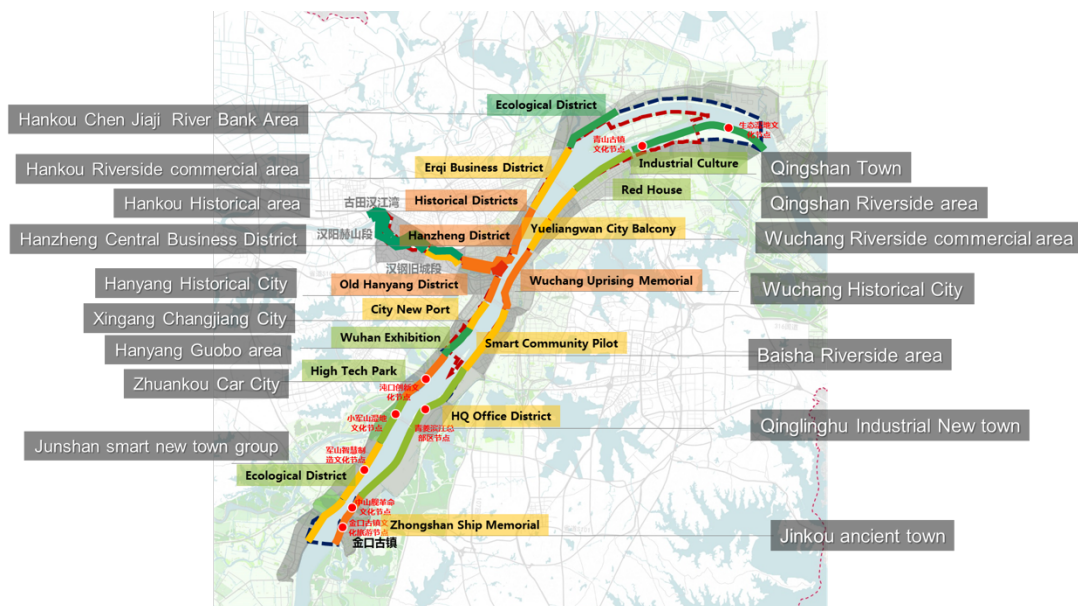


Figure 4-1. Analysis chart of cultural pattern of Wuhan waterfront space. Source: Plotted by Authors.

4.4 Vitality stimulation

Waterfront space should focus on strengthening the diversity of public activities. Landscape shall be equipped with functions to create high quality activity space. Integrating waterfront space into urban public service network is an important strategy to enhance urban vitality and competitive advantage. The green belt, service axis, landmark structures, and waterborne platforms will be under key construction so as to form colorful dynamic space.

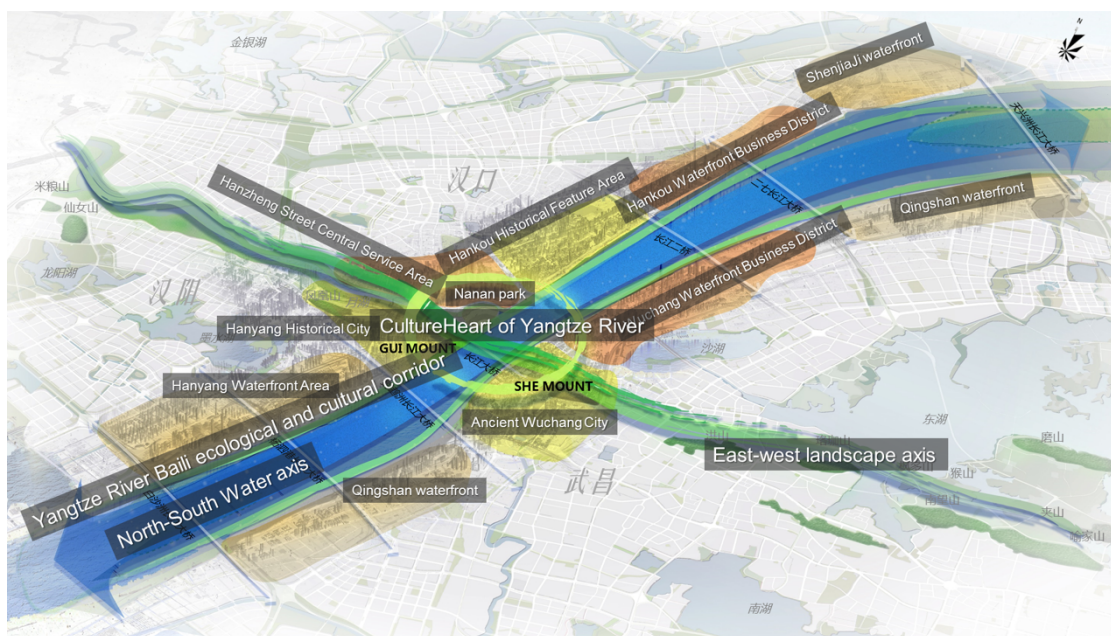


Figure 4-2. Characteristic functional area of Wuhan waterfront space. Source: Plotted by Authors.

It's not allowed to build quantified service houses within Yangtze River Beach but hold specific activities. According to the Planning, the vacant space will be utilized. First, service stations will be combined with shipping stations to meet the basic needs of citizens and visitors. Second, boats and docks will be fully utilized. Onshore structures are linked with the core buildings in city hinterland and transformed into

places with spatial characteristics and service function. In addition, service, technology, sports and other new functions are introduced to form waterfront vitality nodes.

4.5 Accessibility

There are several approaches to enhance the travel experience in waterfront area. First, it is required to guarantee the traffic capacity of roads near Yangtze River. With the concept of building vertical and horizontal roads to the river, the high efficiency and composite transport corridor integrating “city + bank” is established. City gardens, country parks and other resources are utilized. Meanwhile, it covers the track and bus service radius. The greenway network system will be established within Yangtze River Beach. There are a 300-500m walking cycle with the scenic spot as the center in city section, a 700-900m walking cycle in country section and a 1-1.2km walking cycle in rural section, supported by secondary stations for public services such as water drinking sites and toilets.

5. Summary

Urban waterfront public space is composed of natural ecological elements and artificial landscape. It is not only an important ecological corridor but also an optimal community space for citizens (Zhao, 2013). Planning for Hundreds-kilometers Waterfront Space of the Yangtze River in Wuhan proposes higher requirements for shaping unique topography and strengthening water-city integration and symbiosis with urban waterfront space. This research explores the planning mode for large-scale waterfront public space under conservation concept. It brings the idea of “Vitalization by Water and Returning to Waterfront” in order to produce the planning concept of integrated development of river, beach and city. The planning strategy of “safety, ecology, culture, vitality and open” will be applied to strengthen water-city connection. In terms of demonstration of local characteristics, the Yangtze River is taken as the axis, and the detailed transversely spatial planning design is put forward according to five levels. In terms of the safeguarding of planning implementation, the division of responsibilities among different government departments is carried out to form a chart and a table for planning and control. This paper aims to provide some reference for the development and planning of waterfront public space in other cities around the world.

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