

Study on the Use of Surplus Space under Viaducts in Urban Centres—A Case Study of Second Wuhan Yangtze River Bridge

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Abstract: The space under the viaduct is the stock space of the city, the reasonable re-planning and renewal can satisfy the gap of the urban residents' desire for the public space, and complement the urban green space and the public space. Taking the remaining space under the Second Wuhan Yangtze River Bridge as an example, this paper combs and classifies the current situation under the second bridge of the Yangtze River, follows the people-oriented concept of urban development, and probes into different types of space under the bridge, from the point of view of humanization, the space under the bridge will be made into a more warm and pleasant urban public space.

1. Introduction

Urban surplus space means that in the process of urban development, it has not been rationally planned and utilized, a type of space with design potential that is to be used in the space between buildings, between communities, and under viaducts. With the high density development of the city, the land in the center of the city becomes more and more scarce, also brought a series of urban problems: under the viaduct a large number of remaining space can not be fully utilized, urban texture, context was split... Under the concept of people-oriented urban renewal, the waste of the remaining space under the bridge has become an urgent problem to be solved. As designers, we need to think about how to rationally plan the space under the viaduct and make use of it, re-functional, the negative space into a catalyst for urban public space. The existing research on the space under the viaduct in our country focuses on both space utilization and landscape planning. Li Dan, master of Landscape Architecture, Sichuan Agricultural University, has introduced the catalyst theory into the research on the remaining space of the second ring viaduct in Chengdu, from the design practice and the policy two levels proposed the system solution[1]. Zhao Nannan, master of Wuhan University, takes the main urban area of Wuhan as an example, combs the current situation of the use of space under bridges, fuses the concept of "Sharing" and puts forward strategies and suggestions for the use of space under urban viaducts. In the aspect of landscape planning, domestic scholar Yin Lihua simulates the natural light environment under the viaduct, analyzes the natural light environment law of the bridge shade, tests the photosynthetic characteristics of the plants in the bridge shade, and discusses the positive strategy of the green space landscape in the bridge shade [2].

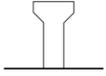
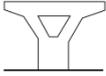
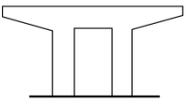
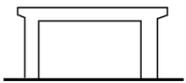
2. The Structure Type, Shape Characteristic and Utilization Form of Space under Viaduct

2.1 Types of Spatial Structures under Viaducts

As show in table 1. The structure types of viaduct space are central single-column type, central double-column type and two sides double-column type. The "T" type pier has only one pier column as the supporting structure, and the space under the bridge is narrow, forming smaller space and worse landscape; the space formed by the "Y" type pier is lower than that of the "T" type pier, "I" type pier column is very thick, narrow space under the bridge, lack of sense of the field. The central double-column type and the central single-column type can form a larger space under the bridge, in

which the central double-column type piers are closer to each other, and the double-column type piers on both sides are at both ends of the bridge, can form a larger usable space[3-4] .

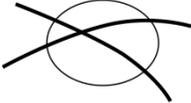
Table 1 Types of Structures in Viaduct Spaces

Type	Illustration	Features	Example
Central single column	Type-T  (image source: self-drawn by the author)	There is only one pier column as the supporting structure, the space under the bridge is narrow, the landscape is poor, and the forming space is small.	 (photo credit: Author's self-portrait)
	Type-Y  (image source: self-drawn by the author)	There is only one pier to support the bridge, the space under the bridge is narrow and low, strong sense of pressure. There is less room for formation	 (photo credit: Author's self-portrait)
	Type-I  (image source: self-drawn by the author)	With a single pier column as a supporting structure, the space under the bridge is narrow, and the pier column is very thick, so that the space under the bridge appears cramped and no sense of the field. There is less room for formation.	 (image source: the Web)
Central double column	 (image source: self-drawn by the author)	Taking two pier columns as supporting structure, the bridge deck is wider than the central single column type, the distance between the pier columns is closer, and the space of the lower part is wider.	 (image source: the Web)
Double column on both sides	 (image source: self-drawn by the author)	Two pier columns are used as the supporting structure, but the pier at both ends of the bridge has little influence on the integrity of the lower space, and has the largest utilization, and has a larger lower space.	 (photo credit: Author's self-portrait)

2.2 Spatial Characteristics under Viaducts

The space shape under the viaduct is affected by the viaduct body, and is mostly distributed in long and narrow strips, according to the different structure of the viaduct, the space under the viaduct has different characteristics (Table 2). The intersecting space is an open space with three-dimensional interlaced elevated paths as its main component. The spatial distribution was obvious point-shaped or block-shaped [5] .

Table 2 Spatial Shape Classification under Viaduct

Type	Linear extension space		Node intersection space	
	A single linear space	Multiple parallel linear spaces	Simple intersecting spaces	Complex intersecting spaces
The name of the subdivision space				
Subdivide viaduct and ancillary space types	 (image source: self-drawn by the author)	 (image source: self-drawn by the author)	 (image source: self-drawn by the author)	 (image source: self-drawn by the author)
Subdivide viaduct and ancillary space types	 (photo credit: Author's self-portrait)	 (photo credit: Author's self-portrait)	 (photo credit: Author's self-portrait)	 (photo credit: Author's self-portrait)

2.3 The Utilization of the Space under the Bridge

The use of the space under the bridge is affected by the structure of the bridge, the surrounding business, the terrain, the climate and other factors.

1) Traffic Space. Traffic-Type under-Bridge Space Refers to the Traffic-Oriented under-Bridge Space Type, under-Bridge Space Type for the Intersection of Traffic Hubs, Traffic Flow.

2) traffic + landscape greening space. In addition to traffic functions, some uses of the space under viaducts include small enclosed landscape islands or landscape strips used to distinguish traffic roads or for traffic noise reduction. Viaduct approach bridge height is low, narrow and dark, generally will also be used for closed greening, landscape space patterns inward, difficult to enter.

3) transportation + municipal infrastructure space. Car Parks, emergency fire stations, transformer rooms and other infrastructure will also be set in accordance with the needs of nearby residential areas under the viaduct to meet the living needs of nearby residents.

4) transportation + Leisure space. With the high-density development of urban space, the public space in the center of the city is scarce, and the remaining space under the viaduct with less traffic has been developed and utilized as the place of public activities, but most of them lack the overall planning and design, to be perfected.

5) comprehensive utilization of space. This kind of space is not unified design and planning, the overall state of waste, disorder, no clear function. Some of them have been used by the public as driving schools, temporary dormitories for workers, construction materials fence stacking, private occupation of the heap of sundries. There are many available resources, and the current problems in space are the most.

3. Exploring the Use of Space under Second Wuhan Yangtze River Bridge Viaducts

3.1 Current Status of the Second Yangtze River Bridge Viaduct in Wuhan

1) status of the bridge and its surrounding environment. The Second Wuhan Yangtze River Bridge is located at the junction of Wuhan Avenue and Peace Avenue in Wuchang District, Wuhan. It is near the Hengdi of Wuchang River Beach, Wuchang Ecological Cultural Corridor and the ruins of Beijing–Guangzhou Railway. West of the bridge is the Huangpu District Street interchange, which spans the Yangtze River channel and the second ring road during the winter solstice. North-south approach bridge, a total of 3 main roads and ramp bridge, bridge length of 3971.408

meters, relatively wide under the bridge, part of the planning for the park, space vitality. This research selects the space under the bridge from the intersection of Heping Street and the Second Changjiang River Bridge to the section along the Yangtze River Road, according to the surrounding planning can be divided into the study object: the main bridge section of Simeitang Park, the secondary bridge section of Simeitang Park and the section of China Railway Heavy Industry Corporation. Simeitang Park section of the space under the bridge since 1997 planning for the bridge under the cultural district. The space under the auxiliary bridge is mainly used for chess and card recreation and entertainment. The section of China Railway heavy industry is idle and deserted, which belongs to the type of comprehensive utilization space. The surrounding land types are green land, transportation land, public space for recreation and entertainment, and part of the municipal infrastructure land.

2). status of space under bridge. The Second Wuhan Yangtze River Bridge space is mainly used as road traffic, leisure and entertainment, municipal parking, municipal greening and comprehensive utilization, the Specific Use type shows in table 3.

Table 3 Specific Use Type of Space under Bridge

Use types	Road traffic	Recreation	Municipal parking	Municipal greening	Comprehensive utilization
Specific form	 (photo credit: Author's self-portrait)	 (photo credit: Author's self-portrait)	 (photo credit: Author's self-portrait)	 (photo credit: Author's self-portrait)	 (photo credit: Author's self-portrait)

3.2 Existing Problems under the Second Bridge of the Yangtze River

1) the slow travel system is broken and the travel safety is deficient. Because there are a lot of commercial office buildings around the second bridge of the Yangtze River, the traffic space under the viaduct is large and the traffic speed is fast, and the space of the sidewalk and the non-motorized lane is narrow, the fracture of the chronic system leads to the inconvenience of pedestrians, the potential safety risks, and the traffic jam and even traffic accidents.

2) neglect of human needs and lack of humanistic care. The phenomenon of spontaneous use under the approach bridge of the second Yangtze River bridge shows people's desire for public space, but the existing planning of the space under the bridge does not proceed from people's actual needs, there are night lighting, bicycle parking places and other problems. And there is no effective noise protection facilities under the bridge, seriously affecting the efficiency of the use of space under the bridge. Under the bridge, the ancillary space is abundant, but it can not effectively supplement the public demand of the nearby residents.

3) lack of overall planning and isolation from the surrounding environment. The second Yangtze River Bridge is adjacent to the Wuchang River Ecological and cultural corridor and the transverse embankment of Wuchang river beach. The design of the Simeitang Park under the bridge does not form a coherent landscape with the advantages of the local landscape, on the north side of the viaduct is an old factory building with a strong steel history. On the south side is the Ben Giang business district, which is under construction.

4) lack of historical atmosphere and cultural characteristics. The second bridge of the Yangtze River is close to the ruins of Beijing–Guangzhou Railway River and has a strong historical and cultural atmosphere of steel. However, the design of the space under the bridge does not make any historical and cultural connection, and the design lacks cultural features.

4. Suggestions for Space Transformation under the Viaduct of the Second Yangtze River Bridge

4.1 Repair of Slow Moving System and Traffic Problems.

With the development of the motorway, the area of the slow-moving system under the viaduct has been reduced, the traffic volume is large, and the waiting time of traffic lights is long, the slow-moving system at Simeitang Park section is relatively well developed, but the slow-moving system of Simeitang Park section and China Railway Heavy Industry Corporation broke down, causing non-motor vehicles and pedestrians to mix under the bridge without the protection of safety measures, the lack of lighting at night and the dilapidated roads. Therefore, in the renewal strategy, the overall renewal system should be dredged to solve the problem of space accessibility under the bridge, to ensure the convenience and safety of pedestrian travel, and to improve the utilization of space.

4.2 Construction of Barrier-Free and Humane Public Space.

In the design of public space, the barrier-free design should be fully considered, and the use of ramps instead of stairs should be taken into account, pay attention to anti-slip treatment. The functional planning of the space should complement the functions of the surrounding businesses. There are a large number of residential areas, commercial office buildings and schools around the second bridge of the Yangtze River. Therefore, the needs of the nearby residents should be taken into account in the planning and design, by means of questionnaire investigation, we find out the actual needs of the residents and the existing functional shortcomings, and enrich and update the space in color and material on the basis of meeting the needs of safety and activities, the space under the second bridge of the Yangtze River is updated by adding lighting and activity space to guide pedestrians to enter and leave in an orderly way.

4.3 Ecological Restoration and Landscaping.

The Wuchang Ben Giang business district on the south side of the second Yangtze River Bridge and the Wuchang ecological and cultural corridor on the north side of the bridge are both developing rapidly and are clean and beautiful, not only the damage to the city's image, but also in the north and south of the city formed a landscape barrier, and the surrounding environment formed a sharp contrast. Therefore in the ecological environment: in addition to ensuring a certain planting rate, but also pay attention to the artistic planting, increasing the number of evergreen plants and variety of diversity, taking into account the dark and humid space under the bridge, shade-tolerant plants should be planted properly. In the planting of tree ponds, practicality, ornamental and artistic should be taken into account to break the dull impression of large areas of green plants. In terms of planning, the ecological and cultural corridor in Wuchang will be designed and planned in a unified manner, while the viaduct will be constructed with a unified grey cement structure, can add color doodle appropriately in the bridge body, change the inherent impression of the viaduct boring, promote the vitality of the space under the bridge.

4.4 To Shape the Railway Cultural Atmosphere and Cultural Landscape,

weaving and mending the sense of urban separation. The Second Wuhan Yangtze River Bridge is close to the ruins of Beijing–Guangzhou Railway and has a strong railway culture. In the adjoining space of the viaduct, there is the old factory building of Wuhan China Railway Heavy Industry Corporation, therefore, in the renewal strategy, we should pay attention to design with the surrounding historical and cultural buildings, and build the city public space with cultural characteristics and historical atmosphere. First of all, we should shape the place historically. For example, it is possible to creatively combine railway culture with modern urban culture by means of colored graffiti on the bridge, which not only perpetuates the long history of Beijing–Guangzhou Railway culture, it also shows the rapid development of Wuhan's new urban style, in order to promote the urban characteristics of Wuhan.

4.5 Integration of Space Functions and Rational Use of Resources.

At present, the space under the second bridge of the Yangtze River includes recreation space, green space, sports space, reading space, chess and card entertainment space, public cultural publicity space and parking lot, etc. But authors found that the parking lot is not used frequently, and it just used as a supplement to the sports place, and large parking spaces are a phenomenon of car graves. For example, long-term parking of second-hand cars and large parking spaces waste the space under the bridge and compress people's activity places. Therefore, in the process of re-planning and designing, the setting of activity places should be increased, the Second Yangtze River Bridge should be close to residential areas and commercial office buildings, and at the same time, the number of parking spaces should be reduced, a clear demarcation line should be set up between the parking spaces and the activity places, and reasonable activity routes should be planned to ensure the safety and order of people's activities, and more activity places should be set up in the places with a high density of population and a large number of people flow. Most of the existing sports venues are in a closed state (Figure 1, Figure 2) and only have football and table tennis venues, in the updating strategy, the types of sports places should be increased and expanded according to the actual needs of the clients, such as planning and setting of the sports places that people expect to increase by means of questionnaires, increase the openness of the sports ground, enhance the vitality of the space under the bridge.



Fig.1 The Enclosed Football Field



Fig.2 Closed Table Tennis Court

4.6 Setting up Interactive Experience Places to Enhance the Sense of Participation of the Public

People-oriented design concept requires that all design activities in the space can start from people. In the design planning of the public space under the bridge, interactive activities can be added. For example, in the painted walls of the bridge piers set aside a separate area for free graffiti citizens; set up interactive art installations... Let the public participate in the public space renewal process, so as to stimulate the public interest in the public space under the bridge, which is also beneficial to the post-maintenance of the public space under the bridge.

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