Research on the Renewal Design Strategy of Industrial Remains of Guangzhou Zhujiang Brewery from the Perspective of Symbiosis

A Dissertation Submitted for the Degree of Master

Candidate： Wu Junsha

Supervisor： SCUT-POLIT0 co-supervisors

South China University of Technology

Guangzhou, China

Abstract

Against the background of rapid economic development and rising material and cultural standards, China's urban industrial structure and functional layout are undergoing profound changes. The contradiction between traditional industrial remains and modern urban development is becoming more and more prominent, prompting a large number of industrial remains renewal projects. However, the public's demand for diversification and composite functions of public buildings continues to grow, and the homogenized transformation model has been difficult to meet the needs of contemporary society, resulting in a lack of attractiveness of the project and poor operational efficiency. This situation shows that the core problem of industrial remains renewal design is how to reconstruct the organic connection between industrial remains and urban space, and realize multi-dimensional value enhancement in terms of urban development, cultural heritage, spatial optimization and functional integration.

Based on the “Symbiosis Theory” and the core ideas of Kisho Kurokawa's “New Symbiosis Ideology”, this paper systematizes the development and connotation of the Symbiosis Theory, and clarifies the three elements and necessary conditions for the realization of symbiosis in the field of architecture and planning. Through the critical analysis of typical cases, the study proposes the revelation and adjustment path of symbiosis theory in contemporary practice. The study further deconstructs the philosophical core of symbiosis theory, summarizes its design performance in industrial remains renewal into four dimensions: urban, cultural, spatial environment and architectural, and discusses in depth the inherent unity of symbiosis theory applied to industrial remains renewal, which provides theoretical support for the refinement of the subsequent renewal strategy and design practice.

Based on the “symbiosis” analysis of industrial remains renewal cases at home and abroad, the study summarizes the connotation, needs and principles of industrial remains renewal under the perspective of symbiosis, and puts forward the practical path of “analyzing symbiosis system, determining symbiosis goal and implementing symbiosis strategy”. Specifically from the “industrial remains and urban symbiosis”, “industrial remains and cultural symbiosis”,

“industrial remains and environmental symbiosis”, “industrial remains and architecture itself” four levels, systematically elaborated the specific design strategy of industrial remains symbiosis renewal.

Finally, the industrial remains of Guangzhou Zhujiang Brewery is taken as the research object to carry out the design practice. We focus on research and evaluation of the current “symbiosis system” of the site, and obtain the quantitative results of the “three elements of symbiosis”. Combined with the on-site questionnaire survey and architects' interviews, the results were cross-validated to identify the existing problems of the site. Based on this, the program takes “openness, ecology, culture and integration” as the design goal, and shapes a cultural and creative integrated experience space in the Pearl River Brewery area that is symbiotic with the city, industrial culture, regional culture, spatial environment and function. Through the combination of theory and practice, the article systematically discusses and verifies the design strategy and implementation path of contemporary industrial remains renewal under the perspective of “symbiosis theory”.

Keywords：Symbiosis Theory; Guangzhou Zhujiang Brewery; Industrial Remains Renewal; Design Strategy

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Chapter 1 Introduction

1.1 Research background

1.1.1 Industrial remains are of great value as special urban resources

As an important witness of the process of urban industrialization, industrial remains bear rich historical, cultural and social values. Compared with the more focused concept of industrial heritage, industrial heritage covers a wider range, including a large number of industrial structures and sites that have not yet met the criteria for heritage recognition but are still of great value. They are not only the material carriers of urban development, but also the spiritual symbols of industrial civilization. However, with the acceleration of urbanization and the adjustment of industrial structure, a large number of industrial remains are facing the fate of being dismantled or abandoned. How to preserve the historical value of these industrial relics in urban renewal, while giving them new functions and vitality, has become an important topic of current urban development.

In recent years, attention has been paid to the protection and reuse of industrial remains at home and abroad, and many successful cases have emerged, such as the transformation of Germany's Ruhr Industrial Zone and the transformation of Beijing's 798 Art District. These cases show that the renewal of industrial remains is not only the transformation of architectural functions, but also the re-integration of urban cultural, ecological and social functions. However, many domestic industrial remains renovation projects still have many problems, such as single transformation mode, lack of cultural connotation, and disconnection with the urban environment, resulting in the lack of lasting vitality of the transformed space. Therefore, it is of great theoretical and practical significance to explore a renewal mode that can not only preserve the historical value of industrial remains, but also realize its organic integration with the city, nature, culture and society.

1.1.2 Zhujiang Brewery is a represent of Guangzhou's industrial remains

The industrial remains of Guangzhou have distinct industrial characteristics and spatial distribution laws. As one of the important cradles of modern Chinese industry, the industrial remains of Guangzhou not only retain the remnants of traditional light industries such as textile and food, but also contain the remnants of heavy industries such as steel and shipbuilding. The spatial distribution of these industrial remains shows a remarkable agglomeration characteristic along the river, especially along the central urban area of the Pearl River. In 2018, Guangzhou State-owned Assets Supervision and Administration Commission announced the Detailed Planning Guidelines for Urban Design and Landscape of Key Sections of the Pearl River Scenic Belt (three 10-km), planning to build a 30-km boutique Pearl River scenic belt and shaping a picturesque world-class waterfront area of Pearl River[1]. According to the plan, the 30 km coast is divided into three 10 km, the west 10 km range from White Goose Tan to Guangzhou Bridge, belongs to the "modern Guangzhou" section; From Guangzhou Bridge to the east end of Pazhou Island, it forms the Lingnan waterfront where modern diversity and innovation gather. Ten kilometers to the east is the "Ecological Guangzhou" section, located between the east end of Pazhou Island and the Nanhai Temple. At present, most of Guangzhou's industrial remains are concentrated in the 30-kilometer coastal area.

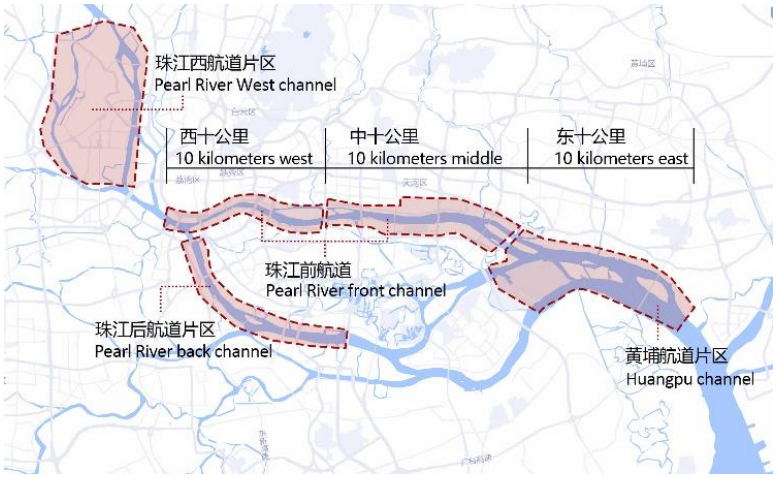


Figure 1- 1 Industrial cluster distribution on both sides of the Pearl River in Guangzhou
Source: Author

From the point of view of river distribution, the whole Pearl River is divided into four areas: the Pearl River front channel, the Huangpu Channel, the Pearl River back channel and

the Pearl River West Channel. The Pearl River Channel and Huangpu Channel are the important outer ports of Guangzhou, which have strong transportation power, and their industrial types are mainly transportation. The back channel of the Pearl River is the main inner port of Guangzhou, with a long coastline and a large number of dock storage factories. The Pearl River West Channel is located in the lower tuyere of Guangzhou, and the whole is mainly based on basic industries. The paragraphs together outline the spatial pattern of "one river and many groups" of industrial relics in Guangzhou. This distribution characteristic not only reflects the historical context of Guangzhou's industrial development, but also reflects the important influence of Pearl River shipping on industrial layout.

Zhujiang Brewery is located in the front channel of Zhujiang River, which belongs to the middle 10-kilometer section of the 30-kilometer scenic belt planning, and has a superior geographical position. Since the implementation of the "two backward, three forward" industrial structure adjustment policy in 2008, the district has successfully transformed a number of industrial parks into creative industry parks with the Asian Games as an opportunity, and achieved significant social benefits. Zhujiang Brewery also took this opportunity to successfully transform into Patii Beer Culture and art District, becoming a model case of the activation and utilization of industrial remains.

As one of the most representative industrial remains along the front channel of the Pearl River, the transformation and development path of the Zhujiang Brewery has important research value: First, its unique waterfront space characteristics and complex surrounding critical environment provide a typical case for the study of the interaction between industrial remains and urban space; Second, as an important part of the "Golden Triangle" in Pazhou region, its successful transformation has confirmed the unique value of industrial remains in creating urban cultural landmarks and enhancing regional vitality. Third, as a key plaza of the new round of urban planning and construction in Pazhou West District, the special development stage of the project provides a rare policy support and practical platform for the protection and reuse of industrial remains.

It can be said that Zhujiang Brewery is not only a living fossil of the industrial history of Guangzhou, but also an important sample for the study of the coordinated development of urban renewal and industrial remains in contemporary China.

Table1- 1 Overview of Guangzhou's industrial clusters along the river

Area	Name	Build time	Protection level
Pearl River Front Channel	Wuxianmen Power Plant	1901	Municipal-level 7th Batch Cultural Relic Protection Unit
	Guangdong Provincial Cotton Textile Mill	1933	-
	Guangdong Canned Food Factory	1956	-
	Southern Flour Mill	1960	District-registered Cultural Relic Protection Unit
	Pearl River Beer Brewery	1985	-
Huangpu Waterway	Couper Dock	1845	China Industrial Heritage - 1st Batch
	Huangpu Shipyard	1851	Municipal-level 5th Batch Cultural Relic Protection Unit
	Wenchong Shipyard	1955	-
	Old Shipyard (Predecessor of Huangputan Creative Commons)	1980s	-
	Guangzhou Thirteen Hongs Shipping Wharf & Warehouse Ruins	-	-
Pearl River Rear Channel	Swire Warehouse	1904	China Industrial Heritage - 2nd Batch; Municipal-level 7th Batch Cultural Relic Protection Unit

Table1- 1 Overview of Guangzhou's industrial clusters along the river (continued)

	Asiatic Petroleum Company Fati Warehouse	1906	Municipal-level 7th Batch
	Asiatic Petroleum Company Longmai Warehouse	1906	Municipal-level 7th Batch
	Union Harmony Machinery Plant	1911	Municipal-level 7th Batch
	Jardine Warehouse	1913	Municipal-level 7th Batch
	Standard Oil Warehouse	1920	Municipal-level 7th Batch
Pearl River Rear Channel	Nisshin Warehouse	1921	Municipal-level 7th Batch
	Texaco Oil Depot	1924	Municipal-level 7th Batch
	Shing Cheong Godown	1925	Municipal-level 1st Batch Historic Building
	Osaka Godown	1927-1934	Municipal-level 7th Batch
	Watson's Warehouse	1930s	-
	Guangzhou Paper Mill	1936	The third batch of municipal historical buildings
	Guangzhou Twin Bridges MSG Factory	1948	-
	Changgang Oil Depot	1958	China's Industrial Heritage (Second Batch)
	Guangzhou Bicycle Factory	1959	-
	Guangdong Hydropower Plant	1960	-
	Jinzhu Hydrogen Peroxide Factory	1960s	-
	Ministry of Communications 4th Navigation Engineering Bureau Shipyard	1951	Municipal-level 2nd Batch Historic Building
	Cheng'anwei Shipyard	1974	-

Table1- 1 Overview of Guangzhou's industrial clusters along the river (continued)

	Shangjiao Shipyard	1984	-
	Luoxi Village Industrial Zone	1988	-
	Sinochem Group Freight Warehouse	-	-
Pearl River West Channel	Guangdong Cement Works	1907	National Key Cultural Relic Protection Unit
	Zengbu Waterworks	1908	-
Pearl River West Channel	Guangzhou Brewery	1934	Municipal-level 7th Batch Cultural Relic Protection Unit & 5th Batch Historic Building
	Xicun Power Plant	1937	-
	Guangzhou Lime Plant	1950	-
	Guangzhou Overseas Chinese Sugar Refinery	1955	Municipal-level 2nd Batch Historic Building

Source: Author

1.1.3 Pazhou West District's urban renewal enters a new phase

As a strategic area of Guangzhou's urban development, Pazhou West District has outstanding location advantage and research value. Located in the core area of the north bank of the Pearl River Channel, the district occupies the core location of Guangzhou's urban spatial layout: it is closely connected to Pazhou Digital Economic Pilot Zone in the east, adjacent to the central axis of Guangzhou Tower City in the west, and echoes with the CBD and International Financial City on the opposite side. The three places jointly build the "Golden Triangle" core functional area of Guangzhou's urban development. The industrial remains retained in this highly urbanized special location faces complex needs for symbiotic development with multiple urban functions such as high-end commerce, digital economy, and cultural creativity.

The "Urban Design and Control Regulation Optimization of Pazhou West District" issued in 2015 marked the development of Pazhou West District has entered a new stage. The plan innovatively puts forward the development concept of "equal emphasis on industrial heritage protection and urban development", and provides policy guarantee and implementation path for the renewal and transformation of industrial remains of Zhujiang Brewery through the strategies of land use function mixing, development intensity zoning and spatial form guidance.

At present, with the acceleration of the construction of Pazhou artificial intelligence and digital economy pilot zone, Pazhou West has entered the substantial development stage. This process provides a rare practical opportunity to study the adaptive renewal of industrial remains under the background of intensive urban development. Especially in the context of the overall coordinated development of the "Golden Triangle", how to realize the interaction and symbiosis between the industrial remains of Pearl River Brewery and the surrounding financial, commercial and cultural functions through spatial reconstruction, functional composite, landscape construction and other strategies has become a topic of important theoretical value and practical significance. The urban renewal of this region is not only related to the transformation of a single industrial plot, but also an important practice to explore the systematic regeneration of industrial heritage in the core area of megacities.

1.2 Research purpose and significance

1.2.1 Research purpose

Guided by the "symbiosis theory" and taking the industrial remains of Guangzhou Zhujiang Brewery as the design research object, this study aims to explore the renewal design strategy of industrial remains in the process of urban renewal, and realize the organic integration of historical protection and urban development. Specific research objectives include the following aspects:

Firstly, theoretical construction. By systematically sorting out the connotation of "symbiosis theory" and its application in the transformation of industrial remains, the internal unity of "symbiosis theory" and the renewal of industrial remains is clarified, and a theoretical

framework for the renewal of industrial remains based on the perspective of symbiosis is constructed to provide theoretical support for subsequent research.

Secondly, strategy summary. Through the analysis of typical cases of "symbiotic" transformation of industrial remains at home and abroad, this paper summarizes and refines the needs and strategic framework of symbiotic association between industrial remains and cities, culture, environment and architecture itself, including the analysis of symbiotic system, the determination of symbiotic goals and the application of symbiotic techniques, so as to provide methodological guidance for the transformation of industrial remains.

Finally, practical application. Taking Guangzhou Zhujiang Brewery as the practice object, through the base investigation and symbiosis analysis, the paper puts forward the concrete transformation design strategy based on the symbiosis theory, verifies the feasibility and practical value of the theoretical research, and provides references for similar projects.

1.2.2 Research significance

(1) Theoretical significance

At present, the domestic research on the transformation of industrial remains mainly focuses on the transformation of building and space, and lacks the systematic thinking of urban context, historical heritage and ecological value. Based on the "symbiosis theory", this study proposes a systematic symbiosis transformation model of industrial remains from the perspectives of city, culture, ecology and society, aiming to fill the shortcomings of relevant studies and enrich the theoretical system of industrial remains renewal.

(2) Practical significance

Through the analysis of typical cases at home and abroad, the design strategy of "symbiotic" transformation of industrial remains is summarized, which provides an operable practice path for the protection and reuse of industrial remains. Taking Guangzhou Zhujiang Brewery as the practical object, the feasibility and practical value of the theoretical research are verified, which has important reference significance for the implementation of similar projects.

(3) Social significance

The transformation of industrial remains is not only the transformation of architectural functions, but also the re-integration of urban cultural, ecological and social functions. Through the renovation of Guangzhou Zhujiang Brewery, it can retain its industrial cultural memory, excavate its historical value, build a cultural creative base with the spirit of place, and lay a cultural foundation for the development of urban cultural tourism industry. At the same time, combining the riverside location advantage, optimize the urban green space system and ecological infrastructure, improve the regional ecological environment quality, and promote the harmonious coexistence of industrial remains and natural environment. In addition, relying on the cultural resources and location advantages of Guangzhou Pearl Beer, it will promote the value-added of regional economy, promote the upgrading of surrounding industries, and inject new vitality into the urban economic development; Through functional renewal and spatial optimization, the isolation problem between industrial remains and urban environment is solved, so as to improve the quality of public space and promote the harmonious development of society.

1.3 Research object and related concepts

1.3.1 Research object

The research object of this paper is Guangzhou Zhujiang Brewery and its surrounding remains distribution space. As an important economic and cultural center in southern China, Guangzhou's urban renewal has its particularity and representativeness. As a landmark relic of Guangzhou's industrial development, Zhujiang Brewery is located in the core area of Pazhou West District, with a unique riverside geographical location and rich industrial relics. Its transformation not only involves the functional renewal of industrial remains, but also involves the symbiotic relationship with the city, nature, culture and environment, which has important research value.

The "industrial remains" studied in this paper refers to the buildings, structures and related facilities left over from the Zhujiang Brewery in the process of industrial transformation, including factory buildings, warehouses, chimneys and other landmark buildings. These relics not only carry the historical memory of Guangzhou's industrial development, but also have a

high potential for reuse. The research scope covers the overall spatial layout of Zhujiang Brewery, including the riverside landscape zone in the macro dimension, the functional zoning in the middle dimension, and the building monomers and public Spaces in the micro level. The specific research contents include the integration of industrial heritage and urban function, the continuation of cultural memory, the restoration of ecological environment and the mechanism of community participation.

The present symbiotic environment assessment of Zhujiang Brewery is also one of the focuses of this paper. As the core goal of the study is to propose the renovation design strategy of Zhujiang Brewery based on the "symbiotic theory", the formulation of this strategy must be based on the in-depth investigation and evaluation of the current symbiotic environment. Therefore, through the analysis and evaluation of the symbiotic unit and the quantitative investigation of the symbiotic environment, this paper aims to comprehensively grasp the interactive relationship between Zhujiang Brewery and the urban, natural, cultural and spatial environment, identify the current problems and potential, and provide scientific basis for the subsequent symbiotic transformation design.

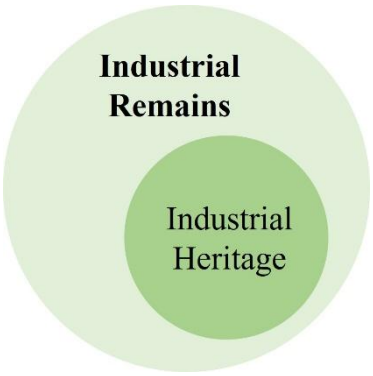


Figure 1- 2 Conceptual relationship
Source: Author

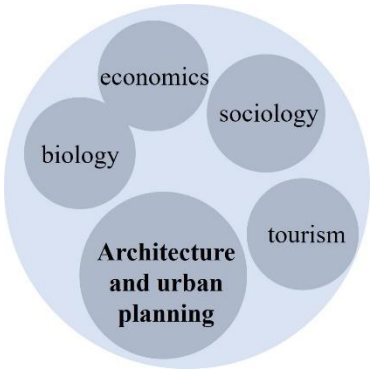


Figure 1- 3 Symbiosis Theory
Source: Author

1.3.2 Definition of concepts

(1) Industrial Remains

Industrial remains refers to the buildings, structures and related remains that have lost their original industrial production functions due to abandonment, replacement or demolition in the process of urban industrial transformation. Industrial heritage refers to industrial cultural sites of historical, architectural, social, technical or scientific value, including factories, workshops,

mines, machinery and equipment, processing and refining sites, transportation facilities, and places of residence, religion and education related to industrial activities. Compared with industrial heritage, industrial heritage is more extensive in scope and has more diversified meanings. At present, most Industrial remains do not receive enough attention, and the scope of protection is usually limited to Industrial heritage that has been recognized by the government as having legal status. However, those unused resources that are not listed in the protected list, despite the lack of official recognition, their historical and cultural value and potential impact on regional development can not be ignored, and also deserve attention and rejuvenation. Therefore, the research object of this paper is not only limited to industrial heritage with special value, but also includes those industrial remains with a certain service life, general value and reuse potential.

(2) Symbiosis

The perspective of symbiosis research in this paper mainly refers to the symbiosis theory in the field of architectural planning as the support, focusing on exploring the components and necessary conditions of symbiosis, that is, the symbiosis theory of Yuan Chunqing and the New Symbiosis Thought of Kurokawa. Yuan Chunqing proposed that the constituent elements of symbiosis include symbiotic unit, symbiotic environment and symbiotic model, which together constitute the basic model of stable symbiotic system. Kisho Kurokawa's symbiosis theory, on the other hand, combines Buddhist and biological concepts into one. For example, the "sacred domain theory", the "Dao" restoration and the "middle domain" are summarized as the three main conditions of symbiosis thought, which is the premise for realizing symbiosis between different cultures, elements and binary opposites. The symbiosis thought includes the symbiosis between interior and exterior, human and nature, heterogeneous culture, tradition and modernity, part and whole, history and future, etc.

1.4 Literature review

1.4.1 Overseas research status

The research on the transformation of industrial remains started earlier in foreign countries, especially in Europe, the birthplace of industrial revolution, the protection and reuse of industrial remains has become an important issue in urban renewal. In the late 20th century, with the advent of the post-industrial era, European and American countries began to attach importance to the historical value and cultural significance of industrial remains, and gradually formed a systematic theoretical system and practice model.

(1) Research on the theory and practice of industrial remains renewal

Foreign scholars have conducted in-depth research on the transformation of industrial remains from a multidisciplinary perspective. In 1955, the British scholar M. Rix first proposed the concept of "industrial archaeology", emphasizing the importance of industrial remains as historical witnesses, which laid the foundation for subsequent studies. In 1987, the Washington Charter adopted by the International Council on Monuments and Sites (ICOMOS) made it clear that the value of protecting industrial remains lies in the preservation of its historical character and the material carrier that embodies this character. In 2003, the "Nizhni Tagil Charter" formulated by the International Committee for the Protection of Industrial Heritage (TICCHI) further pointed out that industrial heritage is tangible or intangible industrial relics with scientific, aesthetic, historical and other values.

In terms of the value assessment of industrial heritage, scholar A. Klamer (2002) put forward the method of assessing social and cultural values, emphasizing the multiple value attributes of industrial heritage. South Korean scholars Mihye and Sunghee (2014) pointed out that the protection of industrial heritage should not be limited to reuse, but should also consider its cultural, historical and artistic functions comprehensively. In addition, Emanuele Romeo (2015) proposed that the sustainability of industrial culture should be the core focus of the renewal of industrial remains, emphasizing the cultural inheritance and innovation of industrial remains.

Foreign countries have accumulated rich practical experience in the reconstruction of industrial remains. In 2016, F. Chiapparino and Vuckovic proposed a transformation system that combines local environment, industrial culture and tourism model, providing a new idea

for the diversified utilization of industrial remains. In 2019, F. Fernandez, through a study of the remains of the olive oil industry, found that industrial remains can be transformed into tourism resources through the way of tourism, which not only contributes to the sustainable development of industrial land, but also promotes the revitalization of local culture and economy.

In terms of the transformation of waterfront industrial remains, Kaya E. (2020) takes Sydney's industrial historic waterfront as an example and proposes to integrate industrial heritage sites into multi-functional development zones and festival markets, while paying attention to the protection of historical culture. In addition, Christopher Ling (2007) proposed the potential and challenges of industrial landscape design through the analysis of post-industrial landscape in Britain, providing theoretical support for the ecological transformation of industrial remains.

(2) The application of symbiosis theory to the renewal of industrial remains

The research on the renewal of international industrial remains based on symbiosis theory presents a diversified development trend, and scholars from various countries have explored their own distinctive practice paths under the guidance of Kurokawa's symbiosis thought. Schmidt (2018) studied the industrial remains of the Ruhr region in Germany and established the renewal model of "structure retention - function implantation - system connection". By transforming abandoned steel blast furnaces into rock climbing facilities and gas storage tanks into exhibition Spaces, the organic symbiosis with modern urban activities while maintaining the "sacred domain" characteristics of industrial buildings was realized. Tanaka and Kurokawa (2016) practiced the vertical symbiosis strategy in the renovation of textile factories in Meiji period in Japan, retaining the wooden roof trusses as the historical display floor, transforming the middle floor into a design studio, and introducing catering retail on the ground floor, forming a three-dimensional symbiosis system of "historical memory, creative production and commercial service". The cross-cultural comparative study of Zhang and Felton (2020) reveals the essential differences in the renewal of industrial remains between China and Europe: European cases, such as the reconstruction of mining areas in Belgium, emphasize the

reproduction of the authenticity of industrial processes, while China's 798 art zone pays more attention to the symbolic extraction of industrial aesthetics, both of which jointly embody the essence of Kurokawa's " Heterogeneous Symbiosis " theory. Oosterman (2019) proposed the concept of "elastic symbiosis" in his study of London docklands. Through flexible design such as movable partition and folding stage, the dock space can simultaneously meet different needs such as office, exhibition and performance, and realize the concept of "variable architecture" advocated by Kurokawa. Chen (2017) focused on the transformation of negative space in industrial remains, transformed the vacant warehouse corridor of an Osaka textile factory into a temporary art market, set up a mobile booth by using the abandoned track, and practiced the activation strategy of the "space" theory on the remaining space. According to the tourism research of De Roeck (2022), Hashima in Japan reproduces the history of coal mines through immersive guided Tours, while Borinage in Belgium focuses on the artistic reconstruction of industrial sites. The two modes interpret the experiential symbiosis of industrial remains from the dimensions of time and space and aesthetics respectively.

Table1- 2 Study on application of symbiosis in industrial remains renewal abroad

Time	Author	Symbiosis method	Research Perspective
2016	Tanaka，Kurokawa	Vertical layered utilization (historical display - creative production - commercial service three-dimensional composite)	Vertical space regeneration of historic industrial buildings
2017	Chen	Negative spatial activation under the guidance of "space" theory (warehouse corridor art market + track mobile booth)	Industrial clearance space transformation
2018	Schmidt	"Structure retention - function implantation - system connection" trinity update mode	Overall renewal of industrial landscape
2019	Oosterman	Elastic symbiosis (movable partition + folding stage for multi-functional conversion)	Special dock space symbiosis renewal

Table1- 2 Study on application of symbiosis in industrial remains renewal abroad(continued)

2020	Zhang，Felton	Translation of cultural differences (European representation of authenticity versus Chinese symbolic extraction)	The cultural expression of industrial heritage from the perspective of comparative research
2022	De Roeck	Dual-track experience mode (Japan immersive history tour + Belgium artistic reinvention)	Industrial heritage tourism development

Source: Author

1.4.2 Domestic research status

The domestic research on the transformation of industrial remains started late. With the acceleration of urbanization and the adjustment of industrial structure, the protection and reuse of industrial remains have been paid more and more attention. In 2006, the proposal of Wuxi marked the official start of the research on the protection and reuse of domestic industrial heritage. In the same year, the State Administration of Cultural Heritage issued the Notice on Strengthening the protection of Industrial Heritage, which further promoted the development of related research.

(1) Research on the theory and practice of industrial remains renewal

Domestic scholars have discussed the transformation of industrial relics from many angles. In the book Conservation and Renewal of Industrial Architectural Heritage in the Post-Industrial Era, Wang Jianguo systematically discussed the formation reasons, protection and reuse methods and strategies of industrial remains, and defined and classified industrial remains buildings, laying a theoretical foundation for subsequent research. Liu Boying and Li Kuang (2010) summarized specific methods for the protection and reuse of industrial buildings through the analysis of industrial remains in Beijing. Wang Lin et al. (2017) constructed the protection and renewal system of industrial remains from the perspectives of space, culture and economy, and expanded the protection objects and system establishment of industrial remains.

In terms of strategic research on industrial remains renewal, Peng Fei used GIS to analyze and summarize the current situation of industrial remains reuse, and proposed that the current urban industrial remains renewal should be combined with stock planning, experience economy and other social backgrounds. Starting from daily life, Ma Rongjun put forward the combination of "routine" and the transformation of industrial remains, and summarized the characteristics and value of daily urban relics. Xu Dongfeng believes that the protection and reuse of industrial remains should assist the sustainable development of cities and reshape the characteristics of industrial cities. In his Research on the Symbiosis Design of Old Industrial Buildings and Cities under the Concept of Sustainability, Gai Hongzhang comprehensively analyzed the sustainable development problems of industrial remains in multiple aspects such as function, culture and environment, and solved the problem of how industrial remains and cities coexist.

In terms of practical research, Li Chaoying took the practice of updating industrial remains into rental apartments in Guangzhou as an example to systematically sort out the practical methods of adaptive reuse. Taking Shanghai as an example, Hu Chen elaborated the connection between the cultural and creative industry and the renewal of industrial remains, and put forward the vision of organic integration and win-win development. Liu Yao conducted research on the industrial remains renewal project in Shenzhen and identified the positive effects of the regeneration of remains space on urban renewal and development.

In the aspect of community renewal of industrial remains, Jin Zhiqiang et al proposed to transform industrial remains into public service space, emphasizing the characteristics of low cost and short cycle of such renewal. Yang Xiwen believes that industrial remains in different states can have different ways of community-based transformation, and industrial remains with low value can be updated into tertiary industry or community public service facilities. Zhang Jian and others advocate mixed development to promote comprehensive renewal, while taking into account social equity and creating a new community environment.

(2) The application of symbiosis theory to the renewal of industrial remains

In recent years, domestic scholars have conducted multi-dimensional research on industrial remains renewal based on symbiosis theory, and formed a series of results with practical guiding significance.

Wang Xiaoyu (2024) took the practical study of the industrial remains of Lunan Porcelain Factory in Zaozhuang as an example, and establishes the renewal model of "function replacement + context continuation + interface opening". By transforming traditional kiln into display space and adopting transparent boundary design, Wang Xiaoyu (2024) realized organic symbiosis with modern urban functions while maintaining the historical characteristics of industrial buildings. Han Ping (2019) practiced the symbiotic strategy of "cultural anchoring - environmental penetration - space-time superposition" in the reconstruction of the abandoned shipyard, transformed the sunken dock into an open-air theater, retained the crane equipment as landscape sculpture, and formed a space-time dialogue between industrial memory and contemporary art. Chen Qiang (2021) proposed a "demand-oriented" six-dimensional symbiosis model for the research on the renewal of Xianyun community in Chengdu, and established a deep connection between industrial remains and community life by transforming the freight market into a sports center and silos into children's facilities. Based on the symbiotic perspective, You Zifang (2021) constructed the framework of "heritage activation - functional composite - cultural regeneration", and realized the unification of economic value and cultural value of Jiangzhou Shipyard by transforming the dock into a water show and the workshop into a creative office. Li Chao, Liang Mengnan, and Hu Shihan (2018) established a "brownfield to green space" transformation mechanism in the transformation of Changchun No. 1 Thermoelectric Plant, transformed the coal yard into an ecological garden with rainwater collection function, and transformed the cooling pool into a constructed wetland ecosystem. At the same time, industrial structures were retained as landscape elements, and a new landscape system was constructed in which industrial remains and natural ecology co-exist in harmony. Through vegetation allocation and terrain remodeling, the dual value of ecological restoration and industrial memory protection is realized. Hu Jieming and Ding Xinyi (2022) innovated the concepts of Kurokawa's "sacred domain Theory" and "intermediate domain" and proposed a

triple symbiosis strategy: First, to achieve the "warm symbiosis" of factory space through reversible transformation technology, so as to preserve the readability of industrial buildings; Second, through the use of digital technologies such as holographic projection to activate industrial memory and form a symbiosis between old and new cultures; Third, through functional implantation, the factory and the urban business district can form a complementary business form.. This study provides a paradigm of technological symbiosis for the renewal of industrial remains in urban core areas. Yao Bolong (2020) explores a new model of symbiosis between industrial production and urban life. Innovative use of "open factory" concept, while retaining part of the production function, implant science education, ecological experience and other functions; Through the artistic transformation of industrial structures (such as silos), regional markers are formed; Use ecological restoration technology to transform industrial wasteland into biological habitat. This "production-ecology-life" trinity model provides a new paradigm for the sustainable use of industrial remains.

Table1- 3 Domestic application of symbiosis theory to industrial remains renewal

Time	Author	Symbiosis Method	Research Perspective
2018	Li Chao, Liang Mengnan, Hu Shihan	1."Brownfield-green space" transformation mechanism 2.Landscape utilization of industrial structures 3.Combination of ecological restoration and memory protection	Ecological restoration of abandoned land
2019	Han Ping	1.Cultural anchoring strategy 2.Environmental penetration design 3.Time and space overlap technique	Reuse of special types of industrial buildings
2020	Yao Bolong	1."production - ecology - life" trinity model 2.Artistic transformation of industrial structures 3. Application of ecological technology	Sustainable use of open industrial buildings

Table1- 3 Domestic application of symbiosis theory to industrial remains renewal(continued)

2021	Chen Qiang	1. "Demand-oriented" six-dimensional model 2, functional adaptability transformation 3. Construction of community space network	community renewal
2021	You Zifang	1. Heritage activation Framework 2. Functional compound strategy 3. Cultural regeneration mechanism	Landscape design of industrial creative park
2022	Hu Jieming,Ding Xinyi	1, reversible transformation technology 2. Digital memory activation 3. Complementary design of formats	Digital technology application
2024	Wang Xiaoyu	1. Function replacement strategy 2. Context continuation technique 3. Open interface design	Old city old industrial area urban renewal

Source: Author

1.4.3 Summary of research status

Through the review of the research on the renewal of industrial remains at home and abroad, it can be found that there are certain research results in the value recognition, renewal and utilization of industrial remains and community renewal at home and abroad, but there are significant differences in the depth of research, theoretical system and practical application. Foreign research started earlier, the theoretical system is relatively mature, especially in the value assessment of industrial remains, ecological transformation and community renewal accumulated rich experience, typical cases such as Germany's Ruhr industrial zone and the transformation of the High Line Park in New York, the United States, emphasize the symbiotic relationship between industrial remains and city, nature and culture. In contrast, domestic research started relatively late. Although remarkable progress has been made in policy support, theoretical research and practical exploration in recent years, such as the case of Beijing 798 Art Park and Shanghai Yangpu Binjiang public space renewal, there are still deficiencies in the integrity of the theoretical system and the localized innovation of practice.

From the application research of symbiosis theory in industrial remains renewal, it can be found that the research on industrial remains renewal at home and abroad has shown an obvious trend of theoretical deepening and practical expansion over time. The domestic research perspective has gradually developed from a single environmental governance to a multi-dimensional systematic study covering ecology, culture, community, industry, etc. In the past two years, it has gradually shifted to the application of digital technology and the integration and update of the city level, reflecting the development direction of technology-driven and holistic thinking. From Tanaka and Kurokawa's initial practice of vertical spatial regeneration of historical industrial monomial buildings to the immersive digital guided all-round spatial experience in 2022, the renewal of industrial remains from the perspective of symbiosis has entered a new stage of dynamic adaptation and cultural translation.

From the perspective of research objects, the current status studies at home and abroad cover fewer types of industrial remains on the whole. In the current domestic research status, there are few studies on the "symbiotic" renewal of industrial remains in important urban locations (such as CBD), and there is also a lack of practical guidance for the renewal of industrial remains with its own characteristics. Therefore, based on the deficiency of current research at home and abroad, this paper aims to supplement the renewal strategy of multi-type industrial remains from the perspective of "symbiosis" and the design practice of industrial remains symbiosis in important urban locations.

1.5 Research methods and framework

1.5.1 Research methods

(1) Literature research method

Through systematic search and study of domestic and foreign relevant academic works, journal papers and other literature materials, in order to build a theoretical system suitable for the research theme. On this basis, the relevant research directions are systematically sorted out and classified, and the research framework is gradually formed. At the same time, through the

in-depth analysis and comprehensive comparison of the existing literature, the research perspective with innovative value is refined.

(2) Case analysis method

Select typical and representative cases at home and abroad for in-depth investigation and analysis. It focuses on the multi-angle analysis from the dimensions of design concept, method and practice path. Combined with the actual presentation effect of the case results, the application mode and implementation path of "symbiosis theory" in specific practice are deeply discussed, so as to provide empirical support and case evidence for the transformation strategy derived from the theory.

(3) Investigation and research method

A comprehensive investigation based on symbiosis was carried out on the industrial remains of Guangzhou Zhujiang Brewery through the method of field investigation and questionnaire survey. Evaluate the current situation of the site from the three aspects of symbiotic unit, symbiotic environment and symbiotic mode, summarize the current problems and insight into the transformation opportunities; Through interviews with architects, first-hand information about the case studied and the renovation process of Zhujiang Brewery was obtained to improve the depth and accuracy of case studies and site studies, and to provide research basis for strategy proposals.

(4) System analysis method

A systematic perspective is adopted to view the industrial remains renewal design of Guangzhou Zhujiang Brewery, focusing on the overall coordination between industrial remains and city, nature, culture and community. Through the comprehensive investigation and analysis of the current situation of Zhujiang Brewery, the adaptability between Zhujiang Brewery and regional context, geographical environment, ecological resources and social environment is considered. On this basis, in view of its shortcomings in function, space, ecology and culture, a suitable symbiotic design strategy is proposed to ensure the scientificity and operability of the renewal scheme.

1.5.2 Research framework

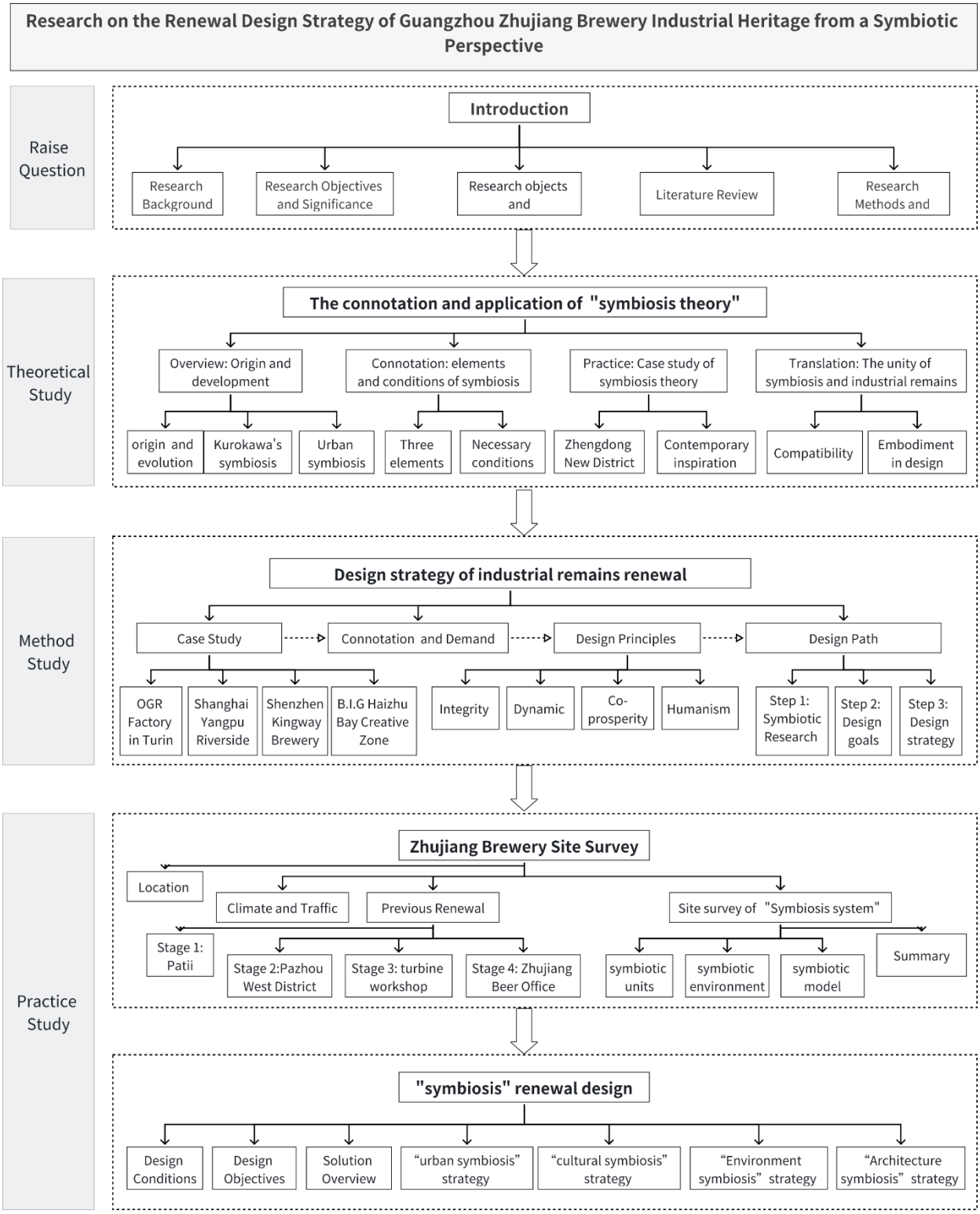


Figure 1- 4 Research framework
Source: Author

Chapter 2 The Connotation and Application of "Symbiosis Theory"

2.1 Overview: Origin and development

2.1.1 Biological origin and multidisciplinary evolution

The basic meaning of Symbiosis is "together" and "living", which refers to the mutually beneficial, collaborative interaction between two organisms. The concept of "symbiosis" was first proposed by German biologist Antonde Bary, who pointed out that symbiosis is a state in which different species of organisms live together, and different organisms rely on each other and work together to cope with complex environments, so as to obtain relative survival advantages. Subsequently, American biologist Scott further explored the material relationship between the two sides of symbiosis, and proposed in 1969 that an important feature of the biological life cycle is the symbiotic relationship, "symbiosis" is the permanent material connection between species, and this connection is a close relationship established between organisms in order to achieve common survival and reproduction. After the 1950s, the study of symbiosis was no longer limited to biology, and gradually developed into all fields of society, becoming an important theory and method for the study of economic, social, tourism, landscape and other disciplines.

Table2- 1 Review of symbiosis studies in different disciplines

Application Fields	Main characters and research perspectives
biology	1. Antonde Bary: Symbiosis is a state in which organisms of different species live together 2. Scott: "Symbiosis" is the permanent physical connection between species, which is a close relationship established between organisms in order to achieve common survival and reproduction 3. Caullery: Defined the concept of mutualism 4. Leweils: Proposed the concepts of favoritism and parasitism, which enriched the study of symbiosis

Table2- 1 Review of symbiosis studies in different disciplines(continued)

economics	1. Yuan Chunqing: Proposed that small economy can achieve the development model of integrated mutualism under the guidance of symbiosis theory, and expounded the basic research framework of symbiosis theory 2. Li Yuhua: Proposed collaborative innovation strategies such as optimizing symbiotic units and selecting symbiotic models
sociology	1. Hu Shoujun: Explained the concept of social symbiosis, believing that symbiosis is an effective way to solve the contradictions and conflicts between different social strata and groups 2. Fei Xiaotong: Explained that the grass-roots structure of Chinese rural society is a so-called "differential pattern", which is a symbiotic relationship network composed of personal connections
Touristik	1. Wu Hong, Gu Chaolin: Put forward the regional tourism cooperation symbiosis model to realize regional tourism integration 2. Ding Yanping: Construct a symbiotic structural model of tourism economy and ecological environment
ancient Chinese philosophy	1. Confucianism: "Harmony between life and birth", "harmony is precious", "the ideal of Great harmony" 2. Mohism: "Love each other and benefit each other" 3. Taoism: "Heaven and earth are born with me, and all things are one with me."

Source: Author

2.1.2 Kurokawa's architectural symbiosis theory

2.1.2.1 The origin - Metabolic theory

With the transformation of global society from the industrialization era to the information age and the acceleration of urbanization, profound changes have taken place in human life style and cognitive system. In this context, the concept of urban planning and architectural design also evolved. Kisho Kurokawa's Philosophy of Symbiosis was born in this social context and became the core idea of his architecture and urban planning theory.

Kisho Kurokawa's architectural theories and creative inspirations are rooted in the deep study of traditional Japanese culture and aesthetics, while being deeply influenced by modern civilization and information society. The formation of its theoretical system can be traced back to the evolution of architectural thought in the middle and late 20th century.

In 1958, the dissolution of the International Association for Modern Architecture (CIAM) triggered a widespread rethinking of the "internationalist" architectural paradigm. In this context, the "Metabolism", represented by Kiyonori Kikutake, Fumihiko Maki, Masato Otaka and Kisho Kurokawa, emerged. Drawing on the concept of "metabolism" in biology, this school proposes that cities and buildings should be regarded as an organic system similar to organisms, whose growth, evolution and decline follow the law of dynamic cycle, manifested as continuous energy exchange and material renewal. In this perspective, architecture and urban space are no longer eternal entities, but have a definite life cycle of time existence. This dynamic thinking has led to an innovative design approach: building elements are designed in layers with a frequency of renewal. The main structure is designed for durability to ensure stability, and the replaceable parts are designed for flexibility. This grading system not only maintains the overall stability of the building, but also allows flexible adjustment of local components according to demand, so that the building system can achieve sustainable and progressive renewal. This dynamic balance design concept provides a new way to deal with the uncertainty of urban development. Kisho Kurokawa's metabolic theory system always takes the growth and change of organisms as the core metaphor.

The most representative practice case of this theory is the Nakagin Capsule Tower, which vividly interprets the dynamic characteristics of life cells through spatial language. The project adopted a unique two-system construction strategy: on the one hand, a permanent concrete core is installed as a support structure, and on the other, a replaceable housing unit is designed. In the concrete implementation, 140 hexagonal prefabricated cabins are cantilevered asymmetrically between two core tubes, forming a highly experimental architectural form. This design not only ensures the stability of the main body of the building, but also realizes the

dynamic renewal of the building function through the replaceable living unit, which perfectly embodies the core proposition of the metabolism theory about the building life cycle.

The theory of metabolism had a revolutionary impact on Japanese architecture in the 1960s. As the core figure of this movement, Kurokawa not only created a series of iconic architectural works, but also promoted the development of modern architectural thought through systematic theoretical construction. The economic recession caused by the global oil crisis in the 1970s prompted the architectural industry to reflect on the limitations of modernism and show a diversified development trend. In this context, Kurokawa began to re-examine the concept of technological permanence, and instead explored the path of integration between traditional culture and modern civilization. As a representative of the third generation of architects after the war, he established a unique design philosophy in the complex social and cultural contradictions: he deepened the "Intermediate Zone" theory in the metabolic period into a symbiotic thought emphasizing "metamorpsis" and "ambiguity". This theoretical shift reflects not only the response to the challenges of The Times, but also the evolution and maturity of his architectural thoughts.

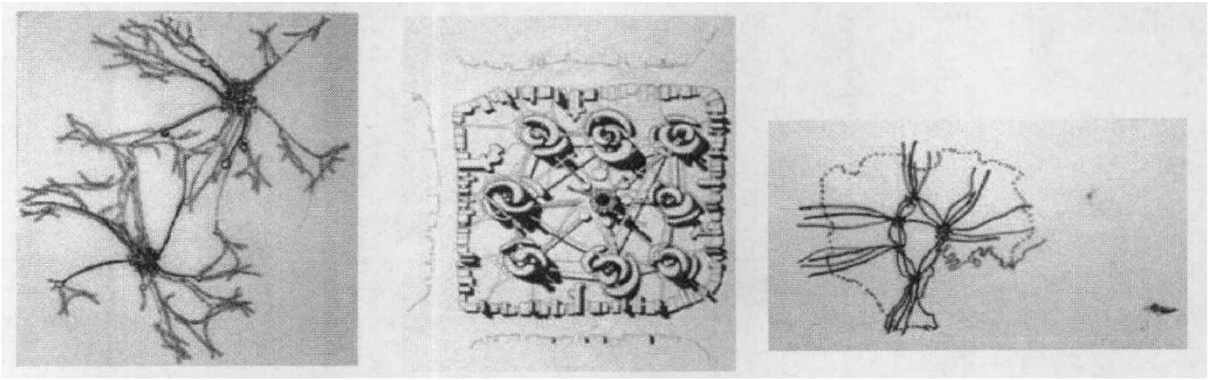


Figure 2- 1 Kurokawa metabolism
Source: Kisho Kurokawa's Theory and Methodology of Urban Design

2.1.2.2 Turning point - metagenesis theory

Since the 1970s, along with the severe global economic crisis, the drawbacks of modernist architectural thought have gradually emerged. The symbiotic thought that pursues diversity has begun to receive increasing attention. In architectural design, it is increasingly required that designers find the soul of the building from history and tradition and reflect the value of the

symbiotic thought. The symbiotic thought emphasizes the transformation from the mechanical age of dualism to the age of life. Based on the theory of critical inheritance metabolism, Kisho Kurokawa proposed a groundbreaking "Metamorphosis" theoretical paradigm. The proposal of this concept marks the major shift of his architectural thought from technological determinism to cultural ecology. From the theoretical source, the concept of "Metamorphosis" originates from the phenomenon of Mutation and metamorphosis in biology, which Kurokawa creatively translated into architectural theory to explain the dynamic evolution mechanism of urban space.

Table2- 2 Comparison Chart of the Mechanical Age and the Life Age

Comparison of the characteristics of the mechanical Age and the life Age		
keyword	the mechanical age	The age of life
	efficiency	energy saving
	productivity	circulation
	universality	ecology
	equality	metabolism
	World standard	sustainable development
	stratum	symbiosis
	dualism	Symbiosis of opposing elements
Philosophical theory and centralism	Humanism centered on rationalism	The symbiosis of reason and sensibility
	Western European centrism and hegemonism	The symbiosis of heterogeneous cultures
social formation	industrialized society	information society

Source: Author

At the level of theoretical construction, Kurokawa pointed out that the sustainable development of urban space cannot only rely on homogeneous expansion, but must stimulate

the vitality of the system through the continuous introduction of heterogeneous cultural elements. This view breaks through the homogenization tendency of modernist planning and provides an important epistemological basis for postmodern urban theory. Based on this understanding, he further proposed the " In-Between Space" design theory, which emphasizes the key role of intermediary space In coordinating the relationship Between architecture and the city.

From the perspective of practice, "gray space", as a transitional interface connecting indoor and outdoor buildings and coordinating urban space of different scales, has multiple values: on the functional level, it creates a continuous spatial experience; On the cultural level, it becomes the carrier of blending of heterogeneous elements; At the ecological level, it realizes the organic connection between artificial environment and natural system. This design strategy is fully reflected in works such as the New National Museum of Art in Tokyo (2007), where through carefully designed transitional Spaces, the building maintains its own integrity while forming a dynamic dialogue with the urban environment.

It is worth noting that Kurokawa's "metamorphosis" theory is not a denial of early metabolic thought, but its deepening development under new historical conditions. He creatively proposed the concept of "architectural life cycle" by combining the dynamic development concept of biology with the theory of cultural diversity. This theoretical breakthrough makes his thought go beyond the simple form innovation, rise to the height of philosophical methodology, and open up a new path for the development of postmodern architectural theory. As he emphasized in the New Symbiosis Idea, the core idea of true architectural innovation is not to create timeless forms, but to build systems that can continue to evolve. This insight still has important implications for contemporary architectural practice.

2.1.2.3 Mature Period - Symbiotic Philosophy

In the 1980s, Kisho Kurokawa's architectural thought entered a mature stage, and his theoretical system developed from the early metabolism and metagenesis theory to a systematic symbiotic philosophy. In his *New Symbiosis Thought (1987)*[2], he systematically proposed seven basic dimensions of architectural symbiosis: symbiosis between whole and part,

symbiosis between heterogeneous cultures, symbiosis between interior and exterior, symbiosis between history and modernity, symbiosis between architecture and nature, symbiosis between science and technology and humanity, and symbiosis between various cultures. These dimensions together constitute a multi-level theoretical framework covering space, time, culture and ecology. In order to implement these concepts, Kurokawa creatively developed the spatial strategy of the "Intermediate Zone", through the design techniques of blurring boundaries (such as the space under the eaves, the transition courtyard) to establish a buffer zone for the dialogue of heterogeneous elements; At the same time, the "Dao" connects the "Sacred Domain" to form a complete spatial narrative structure.

At the practical level, Kuala Lumpur International Airport (1998) fully embodies these theoretical considerations. In the terminal design, the symbiosis of steel structure and glass curtain wall (technology) and tropical vegetation (nature) shows the balance of technology and humanity; The integration of Malaysian traditional pattern (historical) and modern spatial structure (modern) realizes the symbiosis of cultural dimension; The 1.2-km-long "forest corridor", as a typical intermediate field, perfectly interprets the symbiotic relationship between the interior (artificial environment) and the exterior (natural ecology). Similarly, the Hiroshima Museum of Modern Art (1988) guides the audience between the modern exhibition hall and the traditional Kukshui courtyard (" Sacred Domain ") through a carefully designed visitor flow line (" Dao "), which not only realizes the organic unity of the overall building and the local space, but also creates a platform for dialogue between different cultural elements.

In his New Symbiosis Thought, Kurokawa emphasized that "the essence of symbiosis is the creative fusion of differences, and the Intermediate Zone is the catalyst for this fusion." This way of thinking, which translates abstract philosophy into concrete spatial strategies, marks Kurokawa's transformation from a technology-oriented architect to a thinker with philosophical depth. Its symbiotic philosophy not only provides a new idea of cultural identity for postmodern architecture, but also establishes a complete theoretical system through the systematic construction of seven dimensions and the operation method of " Intermediate Zone ", "Dao"

and " Sacred Domain ", which has a profound impact on contemporary architectural practice and provides a key foundation for the extension of theory to the urban scale.

When the idea of symbiosis breaks through the category of single architecture, its cultural integration mechanism, ecological adjustment function and spatial narrative logic will gain a more complete expression field in a more complex urban context. This foreshadowed the subsequent theoretical construction of "symbiotic city" (see section 2.1.3 for details), and also indicated the inevitable transition of Kurokawa's thought from architectural philosophy to urban practice.

Table2- 3 Development stages of symbiosis theory

Stages	Time	Main Idea	Practice Cases
The origin	1960s	Metabolic concepts. Proposed principles of "diachronic" and "synchronic"	Nakagin Capsule Tower
Transition period	1970s	Metamorphosis concept. Pioneering the concept of "grey space" in cities and buildings	Sunken courtyard of Nagoya City Art Museum
Mature period	1980s	The content of symbiosis philosophy is summarized as: symbiosis between nature and man, man and technology, external and internal symbiosis, local and whole symbiosis	Planning and design of the new capital of Kazakhstan and the overall development concept plan of Zhengdong New District

Source: Author

2.1.3 From architectural symbiosis to urban symbiosis

After completing the construction of architectural symbiosis philosophy system, Kurokawa's theoretical exploration did not stop at the scale of single buildings. As globalization accelerated in the late 1980s, he became acutely aware of the special importance of cities as carriers of civilization and began to expand the seven symbiotic dimensions to a broader urban system. This shift is not simply scaling up, but a fundamental change in theoretical paradigms

- from focusing on the symbiotic relationship of architectural elements to exploring the dynamic balance mechanism of multiple elements in complex urban systems. As he put it at the Tokyo Urban Forum in 1991: "When symbiotic philosophy meets the urban scale, it must develop a new grammar to deal with the threefold complexity of space, society and ecology." This theoretical self-consciousness marks a new and more challenging stage for Kurokawa thought.

2.1.3.1 Theoretical framework of symbiotic city

Facing the transformation challenge of urban development at the end of the 20th century, Kurokawa Noriko system constructed a theoretical system of symbiotic city. This innovative theory contains three key breakthroughs: First, in terms of spatial organization, he proposed the "cell city" model, which mimics the DNA double helix structure to design a circular network layout instead of the traditional radioactive expansion mode[3]. Tokyo Metabolic Vertical City Plan (1986) pioneered this concept, with its double spiral vertical transportation system and horizontally extended functional blocks, creating a new model for three-dimensional urban development. Secondly, in terms of functional integration, Kurokawa criticized the drawbacks of strict functional zoning of modernism and advocated the organic integration of residence, work, business and other functions through "urban cells". Finally, in terms of the implementation mechanism, he emphasizes the dynamic balance planning method, which provides a flexible framework for coping with the uncertainty of urban development. These three innovations together form the core pillar of symbiotic city theory.

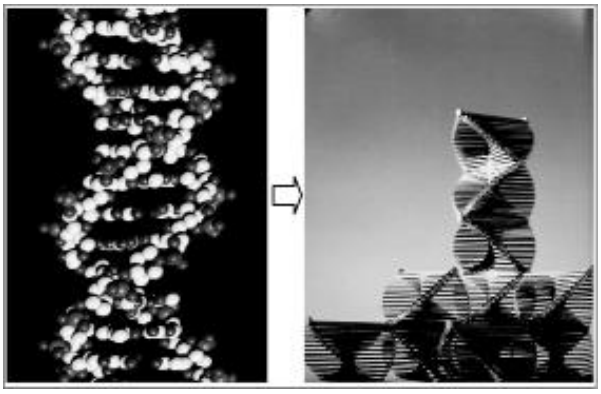


Figure 2- 2 Tokyo Helix City Concept
Source: Kisho Kurokawa's Theory and Methodology of Urban Design

2.1.3.2 Theoretical deepening :Ecological city

As global ecological and environmental problems become more and more prominent, Kurokawa's symbiotic city theory has gained important development in the ecological dimension. Inspired by economist Kenneth Berlin's ecosystem theory, he creatively incorporates ecological principles into urban planning practices.

Ecological City emphasizes the establishment of "human-nature" symbiotic relationship. Kurokawa believes that urban development must respect the laws of nature and maintain biodiversity by preserving ecological corridors and building blue-green networks. In the planning of Zhengdong New District, Longhu water system not only constitutes the core of the landscape, but also maintains the ecological balance of the water through the scientific wetland purification system, so that the artificial environment and the natural system form a positive interaction.

At the same time, the theory also puts forward a three-dimensional balanced development model of "economy-culture-ecology". Kurokawa argues that true sustainable development must balance economic benefits, cultural inheritance and ecological protection. This concept has been proven in practice in Kuala Lumpur Airport City, which not only preserves the tropical rainforest ecosystem, but also drives the regional economy through a modern aviation hub, while integrating traditional Malaysian cultural elements to achieve multi-dimensional coordinated development.

In summary, the concept of “Ecological City” is committed to building a new urban paradigm of sustainable development, the core of which is to establish a new relationship of harmonious coexistence between man and nature by systematically protecting the ecological environment and maintaining biodiversity. This concept breaks through the limitations of the traditional urban development model, integrates ecological protection, economic development and cultural prosperity into a unified planning framework, and forms a multi-dimensional and collaborative urban development system. This innovative urban development paradigm proposed by Kurokawa not only redefines the value orientation of modern urban planning, but also explores a path of urban construction that integrates ecological wisdom, economic vitality and cultural inheritance in practice, providing theoretical support and practical guidance for creating a livable, healthy and sustainable urban living environment.

2.2 Connotation: elements and conditions of symbiosis

2.2.1 Three elements of symbiotic system

Yuan Chunqing proposed symbiotic system and its three elements for the first time in his book *Symbiotic Theory - on Small Economy*[4]. This theory focuses on the biological world and human society, and defines symbiotic system as the collection of symbiotic relations formed by symbiotic units according to specific symbiotic patterns and types. Therefore, the three elements of symbiosis include symbiotic unit, symbiotic environment and symbiotic model.

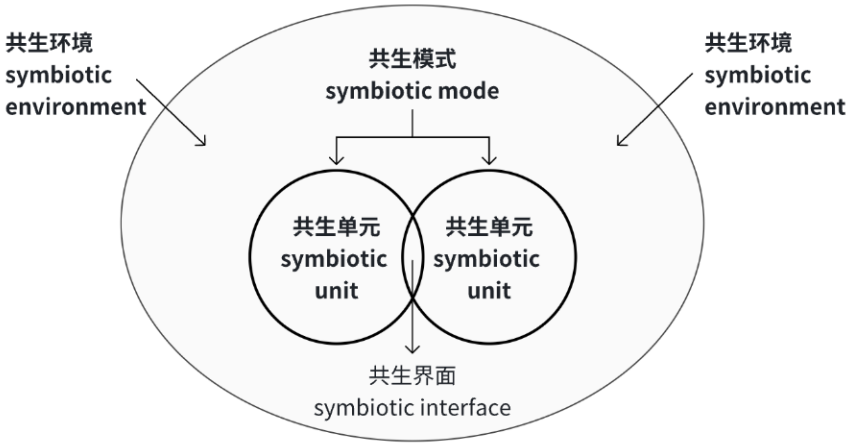


Figure 2- 3 Three Key Elements of Symbiosis
Source: Author

As the basic unit of energy production and exchange, the symbiotic unit constitutes the material basis of symbiosis, and its form and characteristics change with the difference of symbiotic relationship and level. For example, family members are symbiotic units in a family, while in society the family turns into symbiotic units. In the field of urban industrial remains renewal, symbiotic units have different classification methods according to the scale of the research object. At the macro level of the city, it can be divided into the old industrial remains area and other external urban Spaces. When studying the interior of old industrial areas, the symbiotic units are more finely divided into the retained old industrial remains units and the newly added modern living facilities units (such as the retained old industrial plant areas, new commercial areas, office areas, cultural activity facilities, etc.); When a single industrial building is taken as the research object, the symbiotic unit specifically includes the retained parts (such as the old factory building structure system, retained facades, internal industrial structures, etc.) and the new parts (new internal structures, new facades, new internal functional spaces, etc.).

The symbiotic environment encompasses all factors outside the symbiotic unit. It interacts with the symbiotic unit through the exchange of matter, information and energy, and may have positive/negative/neutral impacts on the symbiotic relationship. Within the scope of the entire urban system research, the symbiotic environment encompasses not only various physical environments (such as the natural environment, transportation environment, spatial infrastructure, etc.) but also immaterial social environments (such as regional economic and cultural development trends, government management, and the ideology of community residents, etc.). The topic of industrial remains renewal itself is located in a larger urban area and under a larger socio-economic background. Therefore, the analysis of the symbiotic environment should comprehensively consider the relevant material environment and social environment.

The symbiotic model mainly describes the interaction mode, intensity, material information and energy exchange relationship between symbiotic units, including four types of parasitism, favoritism, asymmetric mutualism and symmetric mutualism, and dynamically adjusts with the changes of symbiotic units and the environment. In the above several symbiotic modes, the parasitic mode is a symbiotic mode that does not produce new energy but only changes the energy distribution, that is, the parasite consumes the host energy, and the rate of energy consumption of the parasite is less than the rate of energy production of the host in order to achieve stability. Partial symbiosis is relatively rare, the whole will produce new energy but only flow to one side, the benefit of the other is not harmful, this model because of strong altruism is not sustainable. Asymmetrical mutualism is common and also produces new energy, but the distribution of new energy is not symmetrical and average, and its stability is affected by the degree and range of asymmetry. The last kind of symmetric mutualism is a more ideal state, its energy distribution is broad and uniform, can promote the common development and evolution of both sides, and the exchange efficiency and stability of material energy and information production are also the highest.

The above three elements together constitute the basic model of a stable symbiotic system, in which the symbiotic unit is the basic object, the symbiotic environment is the external

condition, and the symbiotic mode is the material information content that determines the integration between the symbiotic units, and is an important factor determining whether the symbiotic can be realized. The three elements interact and are closely related and indispensable.

Taking Kisho Kurokawa's symbiosis representative works, the Nakagin Capsule Tower in Tokyo and the renewal of the North Duisburg Landscape Park in the Ruhr area of Germany as examples, the three elements of symbiosis are analyzed respectively. This case perfectly interprets the dynamic stratification of symbiotic units (from individual buildings to urban systems), the diverse influences of symbiotic environments (policy + ecology + culture), and the gradual optimization of symbiotic models (from parasitism to reciprocity), verifying the analytical effectiveness of Yuan Chunqing's theory in the renewal of industrial remains.

Table2- 4 Three Elements of symbiotic system in the Nakagin Capsule Tower

Symbiotic unit	urban scale	Industrial Remain Unit: The capsule tower itself serves as an industrial heritage of metabolic architecture from the 1970s Urban Renewal Unit: Tokyo Ginza High-rise Commercial District (Dynamically Changing Urban Texture)
	architectural scale	Retained unit: Core tube (permanent structure, symbolizing the modular technology of the industrial age) New unit: Replaceable capsule chamber (metabolic unit, representing the needs of modern life)
Symbiotic environment	physical environment	Urban Space: "Vertical Industrial Heritage" in the High-density Tokyo Urban Environment Technical environment: The era limitations of prefabricated and assembled building technology
	social environment	Cultural Conflict: Metabolic Avant-garde Concepts vs. Traditional Japanese Architectural Aesthetics Economic pressure: The high maintenance cost under private land ownership eventually led to demolition
Symbiotic model	Parasitic mode	The capsule tower later became an "architectural specimen" and survived by relying on its cultural symbol value

Table2- 4 Three Elements of symbiotic system in the Nakagin Capsule Tower(continued)

Symbiotic model	Asymmetric mutualism	The architectural community promotes its concept, but the actual usage experience is not good (uneven energy distribution).
	Ideal symmetrical mutualism and symbiosis	It has not been achieved because the technical and economic issues of "capsule replacement" have not been resolved

Source: Author

Table2- 5 Three Symbiotic Elements of the North Duisburg Landscape Park in Ruhr

Symbiotic unit	urban scale	Industrial remain unit: Thyssen Abandoned industrial Area (blast furnaces, gas storage tanks, railway facilities, etc.) External urban units: The city of Duisburg and its surrounding residential areas, the Rhine-Ruhr urban agglomeration
	district scale	Retained industrial units: blast furnaces for steelmaking, abandoned factories, industrial pipelines, and railway tracks New functional units: Rock climbing wall (utilizing blast furnaces), diving center (transforming gas storage tanks), open-air cinema (industrial square), light art installation
	architectural scale	Retained parts: The framework structure of the steel plant, the brick-built facade, and industrial mechanical components New construction sections: steel frame viewing platform, glass curtain wall cafe, ecological vegetation system
Symbiotic environment	physical environment	Natural environment: Ecological restoration of the Emscher River and greening of industrial soil Transportation environment: Ruhr Industrial Heritage Tourist Route (Route der Industriekultur) Infrastructure: Renovated pedestrian paths, bicycle paths, and night lighting systems

Source: Author

Table2- 5 Three Symbiotic Elements of the North Duisburg Landscape Park in Ruhr (continued)

Symbiotic environment	social environment	Economic and cultural trends: The transformation demands of the Ruhr Area in the post-industrial era (from steel manufacturing to cultural tourism) Government management: Policy support from the North Rhine-Westphalia State Government for "IBA Emscherpark" (International Architecture Exhibition) Community ideology: Citizens' emotional identification with industrial heritage + public participation in design
Symbiotic model	Parasitic mode (initial probing stage)	Performance: Early artists temporarily occupied abandoned factories (consuming industrial heritage space but without systematic renovation) Energy relationship: Relying on the original industrial structure, it has not significantly enhanced the overall value
	Biased symbiosis (partial renovation stage)	Performance: Some facilities (such as converting gas cylinders into diving centers) only serve specific groups and have not fully benefited the community Energy relationship: Generating new functions but with uneven distribution of benefits
	Asymmetric Mutualism (Mainstream model)	Performance: Industrial relics are used as tourist attractions (economic benefits > investment in cultural protection), but citizens can use the park for free Energy relationship: New energy (tourism revenue + cultural value) flows more towards the operators, and citizens enjoy environmental benefits
	Symmetrical reciprocal symbiosis (Ideal Goal)	Performance: Blast Furnace Light Art Festival (Deep Integration of Industrial Heritage, Art, Ecology and Community Activities) Energy relationship: ① Economy: Tourism revenue feeds back for maintenance; ②Ecology: The contaminated site is restored to green space; ③ Society: Citizens and tourists share the space

2.2.2 Necessary conditions for symbiosis

In his book *New Symbiosis Thought*, Kurokawa clearly points out that the architecture of the future will be the product of symbiosis of multiple cultural elements, which is not only the harmonious unity of tradition and mechanical technology, but also a model of harmonious coexistence with the ecological environment. This kind of architecture will continue to develop in the direction of symbiosis between nature and humans, environment and architecture. Kisho Kurokawa's design always runs through the idea of mutual respect between architecture and heterogeneous cultures, as well as tolerance and transition between nature and technology, which together constitute his unique "symbiosis" design idea. Among them, " Sacred Domain", "Dao" and " Intermediate Zone " are the necessary conditions for the realization of spatial translation of symbiosis thought, and are practical tools to realize the symbiosis between different cultures, elements and dualistic opposites.

2.2.2.1 " Sacred Domain": spiritual anchor point

As a comprehensive concept, Sacred Domain not only contains cultural traditional elements such as customs, lifestyle, religious rituals and taboos unique to a particular country or group, but also constitutes the spiritual anchor of the cultural group on a deep level, that is, the core symbol to maintain collective identity and shape identity cognition [2]. Kurokawa regards Sacred Domain as the key carrier of symbiosis theory, and believes that true cultural symbiosis must be based on deep understanding and respect for the sacred places of different cultures. This respect is not a simple form of compromise, but the need to provide material carriers for the sacred places of different cultures in the space design, so that their spiritual values can continue and dialogue.

Taking food culture as an example, rice is only an ordinary staple food in most countries, but in Japanese culture, it is endowed with sacredness - from rice sacrifice to daily eating etiquette, "rice" constitutes a spiritual symbol connecting nature, divinity and human relations. Similarly, the American automobile culture and Hollywood film industry, as the sacred domains of modernity, also shape the collective memory and identity of the people. These sacred

domains become the core of culture precisely because they transcend practical functions and become aggregates of emotion and meaning.

In Kurokawa's architectural practice, the role of the sacred domain as a spiritual anchor is transformed into a concrete spatial strategy, namely materialization: through the shaping of core spatial plazas (such as the Kukama courtyard of the Hiroshima Museum of Modern Art), abstract cultural values can be perceived as carriers.

In the context of contemporary globalization, the theory of Sacred Domain highlights its practical significance - when cultural conflicts are intensifying, whether architectural space can provide a container for different sacred domains to coexist will become the key to test the success or failure of the theory of symbiosis. It is worth noting that "sacred domains" in the contemporary context should be dynamic and not simply emphasize the concept of static protection, which requires designers not only to avoid reducing sacred places to superficial symbols, but also to prevent the closed tendency of cultural essentialism, but to find a balance between traditional sacred domains and modern openness through spatial narration, technological empowerment, ritualized reuse and other ways.

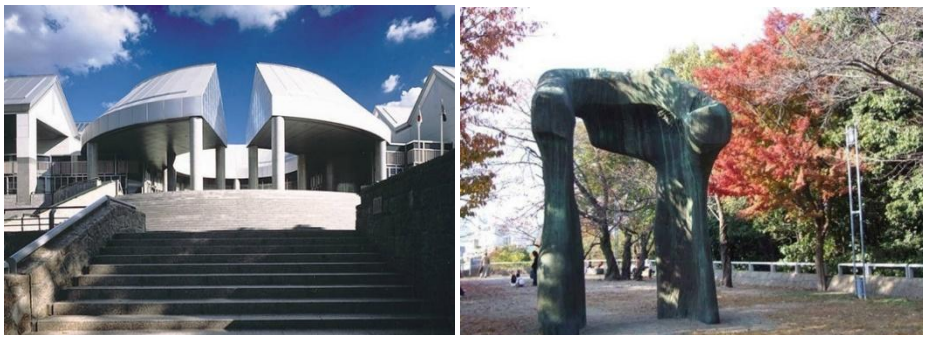


Figure 2- 4 Hiroshima City Museum of Contemporary Art
Source: http://digjapan.travel/zh_CN/spot/id=8238

2.2.2.2 "Dao" : sequence organization

Kisho Kurokawa's theory of "Dao" is a modern translation of the wisdom of the eastern spatial sequence. This concept is not only a rediscovery of the cultural value of the traditional Taoism, but also a critical reconstruction of the modern urban spatial organization. Its core lies in elevating "Dao" from a simple transportation carrier to a multi-dimensional sequential

organization system, connecting all dimensions of urban life through spatial narration, and showing multi-dimensional practical value in contemporary urban design.

In the functional dimension, the restoration of "Dao" realizes the improvement of multi-compound spatial efficiency by breaking through the limitation of traditional street single traffic function. Taking Roppongi New Town in Tokyo, Japan as an example, its main street design integrates commercial retail, cultural exhibition, leisure and social functions, forming a three-dimensional functional network. According to the 2020 survey data of the Tokyo Metropolitan Security Bureau, the functional mix of the street interface in this area reaches 68%. This multi-functional integration not only improves the efficiency of space use, but also creates a rich urban living experience. Notably, Roppongi's street design features seasonal cultural displays and flexible temporary commercial Spaces that transform a single traffic space into a vibrant corridor for diverse urban activities. Through the innovative integration of the functional dimension, the theory of "Dao" has effectively solved the problem of the single function in the modern city, and injected new vitality into the street space.

Figure 2- 5 Roppongi Hills, Tokyo
Source: https://www.japan-travel.cn/spot/2176/

In terms of spatial dimension, the theory of "Dao" has innovatively proposed the design concept of "semi-public gradient belt" with a width of 5-8 meters. This design parameter, derived from the design practice of Kicho Kurokawa Architects (1995) and subsequent empirical research (Miyamoto Research Office, University of Tokyo, 2016), effectively achieves an organic transition between public and private space by controlling key technical indicators such as permeability and shading coverage of the ground floor of buildings along the

street. The tracking study (2022) of China Academy of Urban Planning and Design shows that the streets with this design method are significantly superior to the traditional street mode in terms of vitality index, commercial efficiency and service time, among which the street vitality index increases by nearly 80%, and the commercial turnover also increases rapidly, which fully verifies the superiority of this spatial organization mode. These research results provide important technical support and practical reference for contemporary urban street renewal.

In terms of time dimension, the regain theory of "Dao" realizes the optimal design of pedestrian experience by constructing a "moving-stay" rhythm system[5]. The research suggests that the feature plazas should be set every 150-200 m, and this spacing design can naturally adjust the pedestrian walking speed to the optimal experience range of 0.6-1.2 m/second. Taking Ruyi Lake Ring Road in Zhengdong New District as an example, by setting characteristic stopping points, the average daily consumption of this area has increased by 42%, and the space use efficiency has been significantly improved . This rhythmic spatial sequence design not only meets the traffic demand, but also creates a rich stay experience, which provides an important reference for the contemporary urban walking system planning.

Figure 2- 6 Zhengdong New District Ruyi Lake Functional Layout
Source: Author redrawing

In conclusion, this spatial sequence organization of "Dao" can solve the three core problems of modern urban space: Solving the single function through mixed use; Bridging space fragmentation with gradient transition; Using rhythm design to repair the fragmentation of experience. In the context of today's intelligent development, the theory of "Dao" can further evolve into innovative forms: for example, the spatio-temporal sequence system integrating AR navigation technology, the elastic interface design configured with environmental awareness function, and the green corridor network integrating ecological regulation mechanism. In fact, these innovative practices continue the essence of Kurokawa's theory and provide important methodological guidance for contemporary urban design.

2.2.2.3 " Intermediate Zone" : transitional medium

Kurokawa's " Intermediate Zone " theory represents a unique philosophy of spatial mediation, which realizes the symbiosis of heterogeneous cultures by creating buffers and transitions between binary opposing elements. The concept goes beyond the definition of physical space to a comprehensive media system that connects different functions, cultures, and spatial and temporal dimensions. In architectural practice, the Intermediate Zone is often embodied as a transitional space with multiple identities and blurred boundaries, which can not only maintain the uniqueness of each element, but also promote its mutual penetration and transformation.

Figure 2- 7 Nagoya City Art Museum
Source: official website

In essence, the value of the Intermediate Zone lies in its unique fuzziness and inclusiveness. Taking the gray space of Nagoya City Museum of Art as an example, this transitional area, which is neither completely indoor nor purely outdoor, performs multiple functions such as entrance guidance, exhibition and exchange, leisure gathering, etc. Through ingenious spatial organization, it becomes an active interface connecting the inside and outside of the building, art and the public, and realizes the natural conversion of 32% of daily flow [1]. Through this kind of design practice,

Kurokawa shows that a good Intermediate Zone should have three characteristics: functional flexibility, cultural tolerance and time-space transition, and can create a dynamic and balanced symbiosis while maintaining differences. This spatial concept has important implications for the complex functional organization of contemporary high-density cities.

It is worth noting that the " Intermediate Zone " proposed by Kurokawa also needs to pay attention to a certain "moderation". In *Critical Regionalism*, Frampton (2018) comments that this theory breaks through the modernist either-or spatial division logic, but points out that it may fall into the dilemma of "over-intermediation" - when the proportion of transitional space is too large, it will weaken the characteristic expression of the subject space[6]. Therefore, in the follow-up practice, it is necessary to grasp the proportion of excessive space, balance the relationship between the main body and the transition space, and realize the symbiosis of the overall meaning.

2.3 Practice: Case study of symbiosis theory

2.3.1 Overall planning of Zhengdong New District

(1) Planning background

As the capital of Henan Province and the national central city, Zhengzhou has outstanding strategic position and comprehensive advantages. By virtue of the "double cross" junction position of Beijing-Guangzhou Railway and Longhai Railway, Zhengzhou has become an important comprehensive transportation hub and logistics center in China. However, in the process of rapid urbanization, Zhengzhou is faced with severe development challenges: limited by the spatial division of the existing railway corridor, the expansion of the central city is blocked, and the positioning of the capital city of a province with a population of nearly 100 million is not matched. The specific manifestations are as follows: (a) The disorderly spread of space leads to the mixed urban functions; (b) Infrastructure is overloaded, water and electricity supply and sewerage systems are overwhelmed; (c) Housing shortage and lack of public space coexist; (d) The commercial functions of the central district have become saturated. These problems seriously restrict the high-quality development of the city.

In order to break through the development bottleneck, Zhengzhou needs to reconstruct the spatial pattern. In September 2001, Zhengzhou City solicited the global Central Business District (CBD) planning and design scheme. After the review, the planning scheme proposed by Japanese architect Noriko Kurokawa stood out among many international top design schemes with its innovative "metabolism" theory and "symbiotic" design concept, and won the majority vote of the review experts.

(2) Urban planning scheme

The overall planning scheme of Zhengdong New District fully embodies the innovative application of symbiosis thought. In terms of spatial structure, the plan adopts the organic layout of "double ring symbiosis", and the central business District is presented in the form of "Ruyi" with a diameter of 3.7 kilometers, cleverly transforming the bronze cultural elements of the Central Plains into a modern urban image. Through the circular radial spatial organization, the development mode of traditional single-center city is broken, and the organic combination and collaborative development of functional units are realized. In terms of ecosystem integration, under the guidance of the concept of "ecological city", a "blue and green base" network with the Longhu water system as the core has been planned and constructed, with a total area of 12.3 square kilometers. The supporting rainwater collection and purification system can handle 12 million cubic meters of rainwater annually, perfectly interpreting the theoretical essence of "symbiosis between architecture and nature". The innovation of cultural dimension is also significant. The project re-interprets traditional elements such as "Ding" culture and "Ruyi" modeling through modern architectural terms, such as the abstract transformation of Songyue Temple pagoda modeling by Zhengzhou Convention and Exhibition Hotel, and the modern interpretation of ancient Musical Instruments and pottery forms by the Art Center, realizing the theoretical idea of "coexistence of history and modernity".

The planning area of Zhengdong New District is 260 square kilometers, which is divided into six functional areas: ① CBD Central Business District: it is the most core area, which is formed by two high-rise buildings and set up a commercial pedestrian street between the measurement ring, integrating business, housing, office and entertainment; ② Longhu Area: As

the deputy center of the city, with the dragon water system as the main landscape, the lake island area is planned as a high-end business district, and the surrounding area is laid out as an ecological residential area, forming a characteristic landscape pattern of "city in the water and water in the city"; ③ Longzihu Higher Education Park: Relying on the beautiful meaning of "Looking forward to the son of a dragon", with Longzi Lake as the core, gather key universities in the province, build a science and education innovation base integrating production, learning and research, and create a campus environment rich in cultural flavor; ④ Baisha Ecological leisure Area: with Xianghu Wetland Park as the ecological core, it focuses on the development of health and leisure industry and the construction of urban "green lung" and leisure holiday destination; ⑤ Comprehensive transportation hub area: integrating high-speed railway (Beijing-Guangzhou, Longhai), expressway (Beijing-Hong Kong-Macao, Lianhuo) and airport resources, forming a three-dimensional transportation system of "air and rail combined transportation" as a whole, strengthening Zhengzhou's position as an international comprehensive transportation hub; ⑥ Yellow River Ecological Culture Belt: Relying on the ecological resources along the Yellow River and integrating the cultural elements of the Central Plains, we will create an urban waterfront space integrating ecological tourism, cultural experience, leisure and entertainment. Kurokawa innovatively applied the theories of " Ecological City ", " Helix City" and " Symbiotic City" to all aspects of the overall planning of the new district, intending to build a future-oriented modern "beautiful water city" for Zhengzhou.

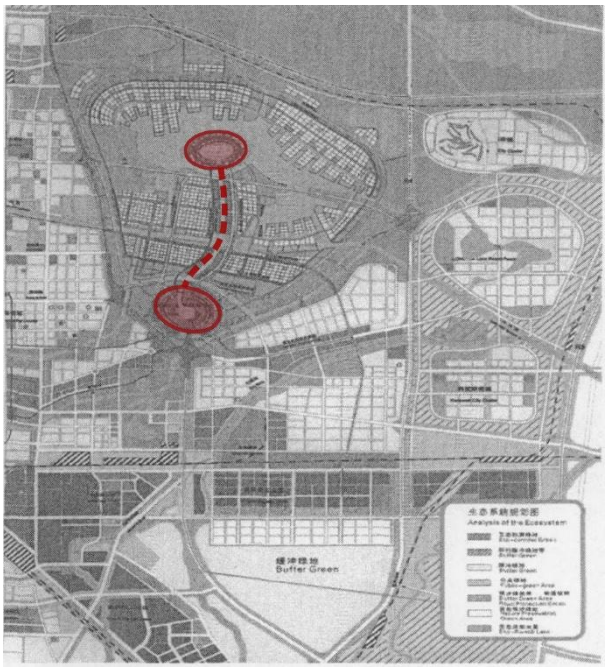


Figure 2- 8 Zhengdong New District Plan
Source: Author redrawing

(3) Critical reflection

The master plan of Zhengdong New District has also caused many controversies in the process of concrete implementation. On the positive side, the International Union of Architects awarded it the "Outstanding Award for Urban Planning and Design", which fully affirmed its innovation in the practice of eco-city concept. The actual results show that the heat island effect of the new area is 2-3℃ lower than that of the traditional urban area, the proportion of days with good air quality is 15% higher than that of the surrounding area, and the ecological benefits are significant.

But criticism also exists, the 2006 China Urban Planning Forum, academician Zhou Gan Zhi sharp criticism of the most representative: "Zhengdong New Area planning is a failure case, everywhere should not follow suit", he pointed out that the Japanese experts' plan "is obviously the work of amateurs". The doubts of the professional community mainly focus on five aspects:

Firstly, the problem of spatial scale imbalance is prominent. The building volume of the new district is generally too large, and the street space is misproportioned, forming a strong sense of pressure. The scale of public space is too large and lack of humanized design, the actual use effect is far from reaching the expected goal;

Secondly, the sustainability of ecosystems is in doubt. The water supply of artificial lake is difficult to guarantee and the maintenance cost is high. In extreme weather events, obvious defects such as poor connection with urban drainage system are exposed;

Thirdly, urban characteristics are seriously missing. The architectural form only pursues "internationalization" and lacks the expression of regional cultural characteristics. There is a significant fault in spatial texture with the old city, which fails to achieve organic integration.

Fourthly, the circular road system is not well connected with the existing urban network. The overall traffic organization is chaotic and disordered, and the guidance sign system is not perfect, resulting in even local drivers often get lost, and the coverage rate of public transportation is insufficient, and the walking experience is poor;

Finally, the comprehensive benefit is not satisfactory. Input-output ratio is unbalanced, and some areas have been vacant for a long time. Functional zoning is too mechanical, urban vitality is insufficient, and there is a big gap with the planning expectation.

These criticisms reveal the deep contradictions in the new district's construction: the excessive pursuit of formal beauty over functional needs, the emphasis on ecological indicators over humanistic care, and the emphasis on short-term image over long-term sustainability. The defects of the planning and design that are more form than function are exposed. As several planners have pointed out, the Zhengdong New District actually repeats the pitfalls of China's new town construction : replacing delicate urban darning with grand narratives and everyday spatial qualities with iconic landscapes.

2.3.2 Other representative cases

In his half-century of architectural practice, Kiki Kurokawa systematically interprets the multi-dimensional connotation of symbiosis theory through a series of pioneering projects. These works not only reflect the theoretical evolution from "metabolism" to "symbiosis thought", but also show its innovative application in individual architecture and urban planning.

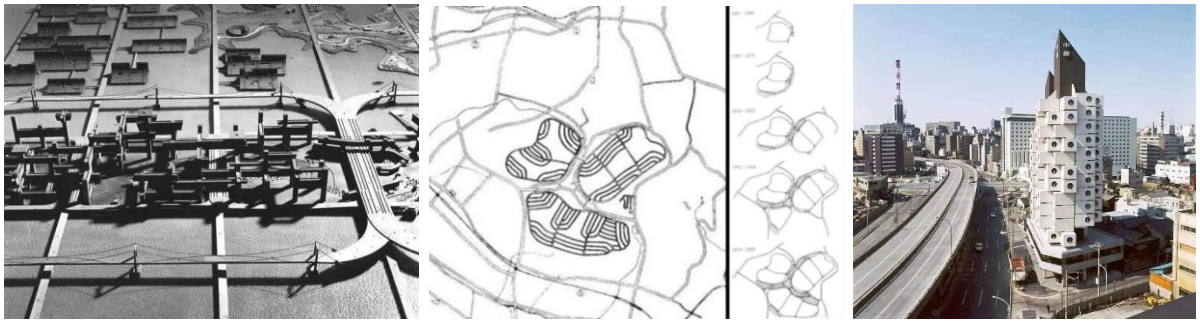
The Rural Town Plan of 1960 elevated a farming community of 2,000 people onto a 5-meter-high grid platform, forming a vertical symbiont of "city in the air + farmland on the ground". By connecting production and living space through the intermediary layer of "contact surface", the urban-rural superposition model solves the original confrontation between urban and rural areas. In 1961, Kisho Kurokawa followed Kenzo Tanshita to participate in the famous planning of Tokyo, and the "Helix City" model proposed by Kurokawa designed the transportation system as a double helix DNA structure, with horizontally extended floors as functional carriers. This scheme has transformed the biological genetic mechanism into a spatial order, and solved the expansion problem of high-density cities through the symbiotic logic of "sustainable infrastructure and variable functions". The residential area planning of Lingye New Town in 1967 formed a complete "symbiosis" between residence and city, connecting residential units through peripheral circulation roads to form a three-layer overlapping urban form of cells, which also provided a prototype reference for the subsequent master planning of Zhengdong New District. In 1972, Nakagin Capsule Tower pioneered the use of prefabricated cabin units as architectural genes, each cabin integrated living and equipment functions, and was bolted to the core tube to form a replaceable "building cell". The project achieves triple

symbiosis: Firstly, the dynamic balance of standardized units and individual needs; Secondly, the process integration of industrial prefabrication and on-site assembly; Thirdly, the architectural life cycle is coupled with the time of urban development. Although the renewal was stalled due to technical limitations in the later period, the concept of "architectural DNA" has deeply influenced the development of contemporary modular architecture.

From the early architectural practice of Noriko Kurokawa, it can be found that the concept of symbiosis has always been developed around the core concept of "infrastructure + variable unit", and its value lies not only in the form innovation, but also in the construction of the theoretical framework of urban dynamic balance.

2.3.3 Practical inspiration and contemporary adaptation

Kurokawa's symbiosis theory has been tested in practice for more than half a century, and its core value and contemporary adaptability have gradually emerged. From the modular experiment of the early Nakagin Capsule Tower to the comprehensive practice of Zhengdong New District, these cases jointly reveal that the spatial organization dimension needs to realize the organic unity of structural innovation and human scale, and excessive pursuit of visual order often leads to the marginalization of daily life needs. Contemporary urban development should, while maintaining the core of Kurokawa's "basic structure" theory, strengthen the functional mixing degree through new concepts such as 15-minute living circle, and learn from the unit thinking of the cabin building to develop more adaptable spatial modules, so as to form a positive interaction between macro urban design and micro place construction.



(a) 1961 Tokyo Plan (b) 1967 Ryono New Town (c) Nakagin Capsule Tower

Figure 2- 9 Kisho Kurokawa Symbiosis theory masterpiece

Source: Internet

In the economic and cultural dimension, the ecological practice of Zhengdong New District highlights the importance of sustainable operation mechanism. Contemporary urban renewal needs to go beyond the simple translation of cultural symbols, transform the idea of "architectural DNA" of Nakagin Capsule Tower into operational renewal guidelines, and build a deep correlation between cultural IP and industrial innovation. This adjustment can not only avoid the phenomenon of "landscape island" in the early stage of Zhengdong New District, but also ensure the long-term operation and maintenance efficiency of 12.3 square kilometers of blue-green network, and realize the dynamic balance between cultural value and economic feasibility.

In terms of technology inheritance, from the overhead platform of Rural-Urban Symbiosis Planning to the three-dimensional development of Zhengdong New District, it has always faced the challenge of integrating traditional construction wisdom with modern technology. Kurokawa's concept of "RikyuGrey" in his later years reveals that technical adaptation needs to retain appropriate ambiguity to deal with uncertainty. In future urban development, the "contact surface" theory should be deepened into a concrete spatial transformation technology, and the symbiotic system should have the ability of dynamic optimization through contemporary technological means.

These adaptation directions not only retain the theoretical core of Kurokawa's seven symbiosis dimensions, but also inject new elements such as economic feasibility, practical use and social inclusiveness, so that the symbiosis idea can better cope with the realistic challenges of contemporary Chinese urban development, and provide solutions with Oriental wisdom and modern rationality for the sustainable development of global cities.

2.4 Translation: The unity of symbiosis and industrial remains renewal

2.4.1 Compatibility of the two

As a special space carrier in the process of urban development, the renewal of industrial remains is faced with the balance of multiple contradictions, such as protection and development, history and innovation, economic value and cultural value. Kurokawa Noriko's

symbiosis theory provides innovative methodological guidance for resolving these contradictions. This theory emphasizes the dynamic coexistence and collaborative development of heterogeneous elements, which is naturally compatible with the multi-dimensional relationship that needs to be dealt with in the renewal of industrial remains. In essence, the renewal process of industrial remains is a practice process of seeking pluralistic symbiosis, which needs to inject new vitality into contemporary urban life while preserving industrial memory. This compatibility is mainly reflected in the following three key dimensions:

2.4.1.1 Industrial remains have the characteristics of multiple symbiosis

As the material witness of the industrial era, the spatial structure of industrial buildings itself contains rich symbiosis possibilities. On the one hand, the tall factory space, the unique structural form and the special material texture constitute the unique spatial genes of industrial relics; On the other hand, these places bear the memories of production and social changes in different periods. This characteristic of space-time superposition makes it naturally possess the basis of "diachronic and synchronic symbiosis" emphasized by Kurokawa. Through the analysis of typical cases at home and abroad, it is found that the successful renewal of industrial remains can often retain at least 30% of the original spatial features, while implanting about 70% of new functions. This proportion relationship is the best interpretation of the concept of "old and new symbiosis". For example, the transformation of industrial remains of Yangpu Riverside in Shanghai creates a waterfront space with harmonious coexistence of historical memory and modern life by retaining the original industrial elements such as dock cranes and introducing leisure walks and landscape facilities.

2.4.1.2 The renewal process requires a dynamically balanced symbiotic strategy

The transformation and renewal of industrial remains is faced with many relations of unity of opposites: the balance between protection and development, the integration of history and innovation, the consideration of economic benefits and social values. The concept of "Intermediate Zone" provided by symbiosis theory provides innovative solutions to such problems. It is concretely reflected in three levels: In the spatial dimension, a transitional "gray space" is set up to connect the old and new elements, such as transforming the loading and

unloading area of the original factory into a flexible urban living room; In the functional dimension, the mixed-use mode is adopted to achieve multiple symbiosis, such as transforming the industrial plant into a composite space with exhibition, office and commercial functions. In the time dimension, a flexible development framework is established to allow the gradual evolution of functions. The transformation practice of Berlin's industrial zone shows that this dynamic balance strategy can keep the industrial remains alive and avoid becoming a rigid museum space.

2.4.1.3 Overall symbiosis guided by systematic thinking

The renewal of industrial remains should not be limited to single buildings, but should be considered from the macro perspective of urban system. This requires us to use the systematic thinking of symbiosis theory, regard the industrial zone as a complete ecosystem, and consider the coordinated development of its physical space, industrial functions, community networks and other subsystems. The successful experience of the Ruhr District Industrial Heritage Corridor shows that by establishing region-scale functional networks, connecting scattered industrial sites into an organic whole, not only can better protect the value of industrial remains, but also stimulate the new momentum of regional rejuvenation.

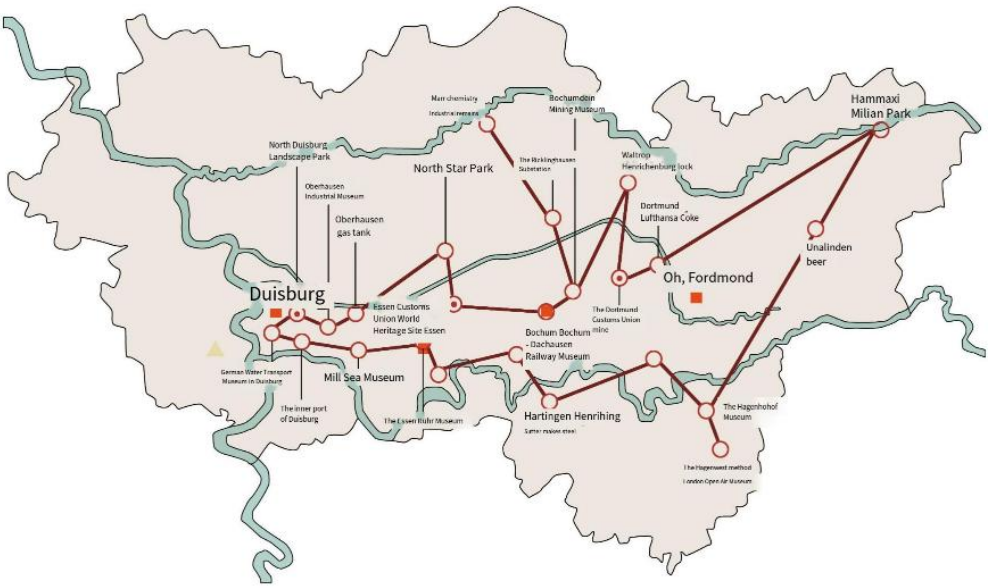


Figure 2- 10 Ruhr Industrial Zone Distribution
Source: Author redrawing

2.4.2 Significance of the combination perspective

2.4.2.1 Resolving the conflict between protection and development

The symbiotic perspective fundamentally changes the thinking paradigm of industrial remains renewal, transforming the traditional contradiction between protection and development into a mutually promoting symbiotic relationship. This theoretical breakthrough is mainly reflected in three aspects: Firstly, in the value cognition, it emphasizes that the historical value and modern use value of industrial remains are not opposites, but can enable each other; Secondly, in the implementation path, it advocates the organic integration of old and new elements through the combination of selective reservation and innovative transformation; Finally, in the effect evaluation, a comprehensive evaluation system that takes into account cultural continuity and functional adaptability is established. This dialectical thinking provides a more inclusive and flexible theoretical guidance for the renewal of industrial remains, so that the protection and development can achieve a dynamic balance in practice.

2.4.2.2 Promote the integration of industrial remains into urban renewal

Symbiosis theory considers the renewal of industrial remains in the macro context of urban development. At the spatial level, through functional reconstruction and streamline reorganization, the industrial remains are re-connected to the urban spatial network. At the time level, the flexible transformation strategy is adopted to preserve the possibility of adapting space to future development; At the social level, strengthening the social identity of industrial remains through cultural activities and community participation. This kind of systematic thinking breaks the limitation of the "island" renewal of industrial remains, making it truly become an active element to promote sustainable urban development, and realize the multiple benefits of cultural inheritance, economic revitalization and social integration.

2.4.3 Embodiment of symbiosis applied to industrial remains renewal

With the continuous development of symbiosis theory, it has become a scientific methodology in the field of urban planning and architecture design, and provides a certain theoretical guidance in the transformation and utilization of industrial remains. The core reason

for the application of "symbiosis theory" to the renewal of industrial remains is that the essence of "symbiosis" is highly consistent with the essence of industrial remains transformation: that is, the mutual respect and tolerance between architecture and heterogeneous culture, natural environment, technology, etc. At the same time, the symbiosis theory is also highly adaptable and innovative for solving regional problems.

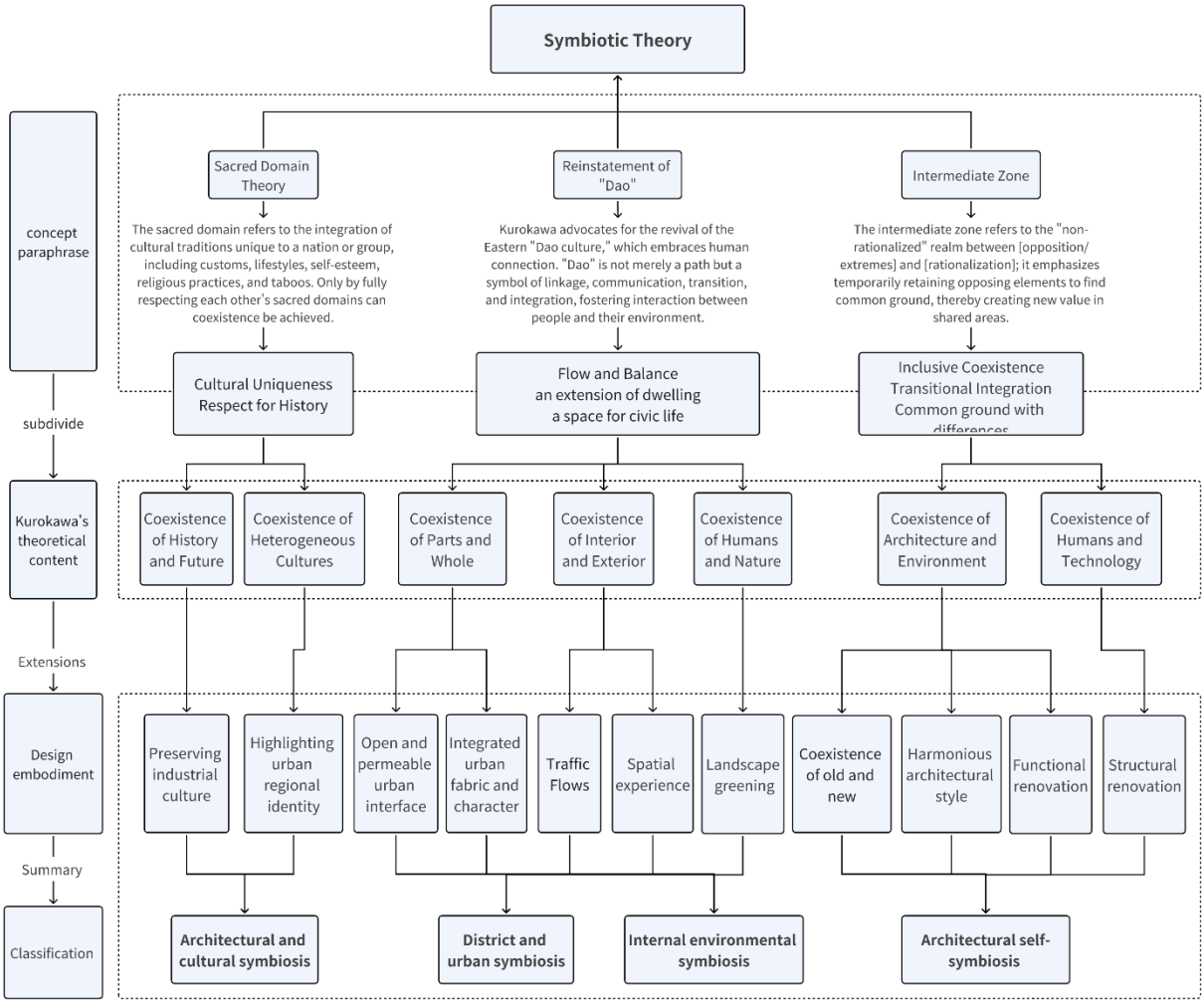


Figure 2- 11 The process of symbiotic theory into design expressions
Source: Author

Therefore, the following study extends the concept of symbiosis theory connotation to the field of industrial remains renewal, excavates the manifestation form of symbiosis theory connotation in concrete transformation practice, and then provides an important basis for subsequent research and summary of the "symbiosis" transformation strategy of industrial remains. The specific research process takes the form of "total - division - total", that is,

disassemble first, and then summarize. First of all, the ideological connotation of the three necessary conditions for symbiosis summarized above, " Sacred Domain ", restoration of "Dao" and " Intermediate Zone ", is extracted, and corresponding to the specific content proposed by Kurokawa in *New Symbiosis Thought*, and then extended to the specific design links in the architectural field, and finally summarized. The objective of symbiotic design in city, culture, space environment and architecture is put forward.

Specifically, it includes four research scales: symbiosis between architecture and culture, symbiosis between districts and cities, symbiosis of internal environment, and symbiosis of individual buildings. The relevant contents involved in the design strategies and design practices in the subsequent chapters are respectively referred to and described by the key words "city, culture, environment, and architecture".

Symbiosis theory, as the core concept of the pluralistic era in the 21st century, has attracted much attention in many fields such as architecture, society and economy, and the fuzziness in symbiosis theory is also regarded as one of the important construction methods of contemporary architectural design. At present, the trend of architectural diversification is significant, and modern architectural ideas and broad architecture are facing many challenges. Kurokawa advocates abandoning blind worship of technology, returning to tradition, and exploring new integration points of traditional culture and modern architecture. Therefore, it is a timely and targeted method to study the renewal of industrial heritage from the perspective of symbiosis.

In the context of China's rapid urbanization, the phenomenon of "one city in a thousand" is prominent, and there are problems such as excessive preservation, transformation or one-sided pursuit of short-term economic benefits in the transformation of industrial remains, and lack of comprehensive planning. Based on the theory of symbiosis, the discussion on the design method of the old industrial zone renovation is helpful to improve the reconstruction strategy of the old industrial building, and provides a theoretical reference for the renovation of the Zhujiang Brewary in Pazhou West District.

The symbiosis theory emphasizes the integration of heterogeneous elements and realizes the organic combination of historical and cultural elements and modern technology through

polysemous expression. However, it is worth noting how to avoid the risk of symbolization in cultural translation, which is specifically manifested as follows: Firstly, the handling of industrial elements often remains at the symbolic retention at the formal level, such as simply retaining the factory facades or industrial equipment as decorative elements, while ignoring the deep cultural connotations behind them, such as the production processes and workers' lives. Secondly, the abstraction of symbols may cause difficulties in cultural interpretation, and ordinary users find it hard to understand the industrial memory that designers are attempting to express. For instance, some renovation projects simplify industrial buildings into visual symbols of "industrial style", while the internal functions are completely commercialized, resulting in a pseudo-symbiotic state of "skin protection and core replacement".

In the renewal of industrial remains, moderate symbolization does indeed help establish visual identity. The key lies in grasping the balance between "symbol" and "connotation". The ideal approach should be to take industrial symbols as the entry point, and then through multi-dimensional design methods such as spatial sequence, functional organization, and material application, construct a complete industrial culture translation system to avoid getting trapped in shallow symbol collage.

2.5 Summary

This chapter focuses on the construction of symbiosis theory system and its applicability in the renewal of industrial remains, providing theoretical basis for subsequent design strategies. The research first conducts a diachronic review to clarify the development context of the symbiosis theory from its biological origin to its translation in architecture. It focuses on analyzing the theoretical core of the "three elements of symbiosis" (symbiotic unit, symbiotic environment, and symbiotic model) proposed by Yuan Chunqing and the "three conditions of symbiosis" (sacred domain, Dao, and intermediate domain) proposed by Kisho Kurokawa's symbiosis theory, and clarifies the theoretical framework of the combination of the two: That is, Yuan Chunqing's three elements of symbiosis are used as the methodology to construct the analytical framework, and Kisho Kurokawa's symbiosis theory is used as the values to guide

the symbiosis strategy. Next, based on the critical analysis of Kurokawa's representative case, the practical limitations and adaptation path of traditional symbiosis theory in the contemporary context are revealed.

The research further raises the key issues of theoretical translation: concretizing the abstract symbiosis conditions into an architectural operation language - "Sacred Domain" corresponds to the authenticity protection of historical elements, "Dao" reflects the continuous construction of spatial sequence, and "Intermediate Zone" realizes the interaction layer design of the old and new media. This translation enables symbiosis theory to effectively respond to the core demands of industrial remains renewal: mutual respect and tolerance between architecture and heterogeneous culture, natural environment, and technology. By applying the symbiosis theory to the renewal of industrial remains, the problems existing currently can be effectively solved, and the organic combination of history and modernity, tradition and technology can be promoted. This chapter clarifies the importance and necessity of the application of symbiosis theory and the renewal of industrial remains, and lays a solid theoretical foundation for the discussion of design strategies in the following chapters.

Chapter 3 Research on Design Strategy of Industrial Remains Renewal

3.1 Case studies of industrial remains renewal at home and abroad

3.1.1 OGR Factory in Turin, Italy

Turin is one of the three major industrial cities in Italy, and it is a typical development model dominated by a single industry, that is, the automobile industry as a pillar industry. At the end of the 20th century, the decline of the automobile industry led to rising unemployment and the abandonment of industrial areas, and Turin's economic status and productivity rapidly declined and needed to be revived.

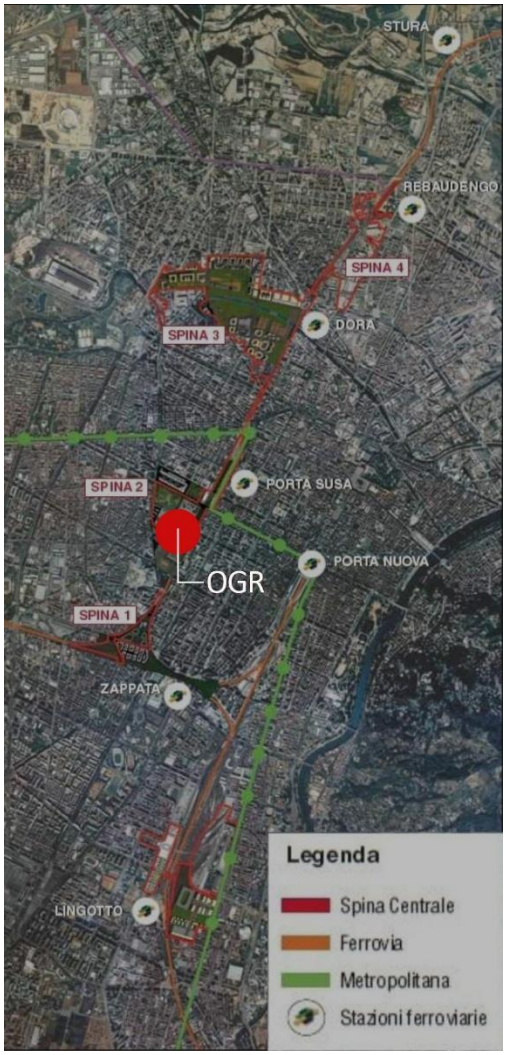


Figure 3- 1 La Spina Centrale
Source: Author redrawing

In April 1995, the Turin Urban Renewal Plan was officially approved, which started a series of renewal measures. PRG (Piano Regolatore Generale) is an urban master plan for the Piedmont region, the capital of Turin, Italy, which mainly involves urban design schemes and the renovation of abandoned industrial buildings. It consists of three "axes" from south to north, the most important of which is the 3 million square meter central axis "La Spina Centrale", which is the "spine" of Turin's urban renewal, focusing on the revitalization and connecting four abandoned industrial areas along the north-south railway line[7]. The renovation of the OGR is also part of the PRG plan and is located at the junction of Spina 1 and Spina 2 in the middle of the route.

(1) Multi-functional symbiosis promotes urban vitality

The PRG plan proposes to redevelop the old industrial area of OGR into public service functions, including education, economy and office. Most of the factory was demolished, some of the buildings were preserved and converted into classrooms, laboratories and dining halls of the Politecnico di Turin, and part of the main campus of the Polytechnic University of Turin was built on the original site. The H-shaped building was the last renovation project, and the current function was transformed into the ogr torino performance space.

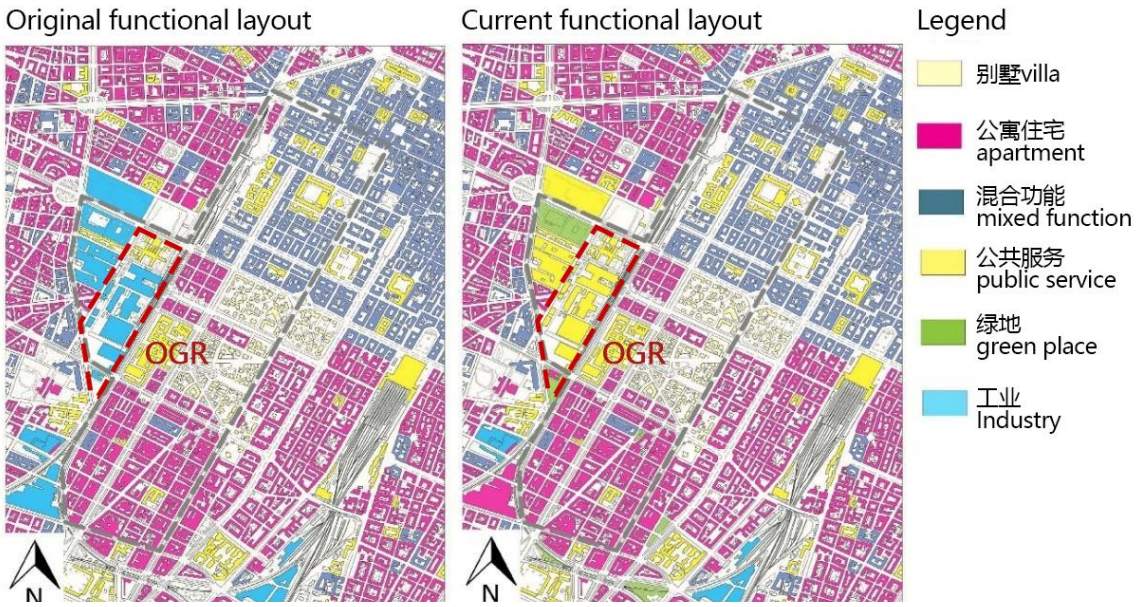


Figure 3- 2 Turin PRG Urban Functional Transformation
Source: Author redrawing

Figure 3- 3 OGR Factory Functional Renewal
Source: Author redrawing

The reconstruction of OGR is considered to be an operation from "train factory" to "knowledge factory", and its functional transformation achieves the goal of symbiotic development between the district and the city. By retaining the historical texture of the industrial buildings and implanting modern educational and cultural functions, the project successfully realizes the organic integration of multiple dimensions: In spatial dimension, the original factory structure echoes the newly built educational facilities, and the H-shaped building is transformed into a performance space, which not only continues the industrial memory, but also injects cultural vitality into the city. In functional dimension, the composite layout of education, scientific research, culture and performing arts and other functions creates a 24-hour uninterrupted urban vitality circle; In social dimension, the symbiotic development of university campuses and public cultural facilities promotes the positive interaction between knowledge innovation and cultural consumption. This transformation not only preserves the spiritual value of the industrial remains, but also reintegrates it into the urban life system through functional reconfiguration, becoming a model of urban renewal in Turin.

(2) Focus on minority culture to promote participation

First of all, in terms of cultural attributes, unlike the museum renewal in the previous failed experience, OGR design team created a more inclusive art and culture space for the minority circle culture, solved the periodic effect and unsustainability of the museum model as a representative of mass culture, and greatly improved the sense of participation in urban culture.

The practice of the scheme is OGR Cult (right wing of the H-shaped building), which specifically contains the two core Spaces of Sala Fucine and Duomo. OGR Cult is a multifunctional space of approximately 9,000 square meters that includes performances, exhibitions, concerts (both classical and electronic), theatre and dance. As a space for music and art, Sala Fucine hosts many avant-garde art design solo exhibitions, electronic music and other niche art forms through flexible spatial layout, making it a paradise for niche art lovers in Italy. Duomo is focused on undertaking cutting-edge technology culture such as seminars, forums and conferences of the nature of enterprises, and has successfully contacted many

corporate activities of the head of the industrial industry since its completion, such as the "BEYOND-Iveco Group Days" activities of the famous car company Iveco.

Figure 3- 4 OGR Cult
Source: Author

It can be concluded that the success of OGR benefits from grasping a crucial link in urban renewal, that is, enhancing the sense of participation in urban culture, starting with minority circle culture, and promoting public word-of-mouth effect.

(3) Innovative mode of operation

As we all know, the heart of the industrial city is production, and compared with the previous failures, the most important breakthrough of the OGR update is to restore the production attributes and capabilities of the industrial area, while carrying out a certain transformation and upgrading. In terms of production function, it focuses on the incubation and training of start-up enterprises, and provides a large number of jobs, economic output value and social value for the city through industrial transformation.

OGR tech (H-shaped Architectural Left Wing) is a studio for ideas and talents, a connector for innovation and technology, and a bridge between Turin and the world. As a co-working space, it is open to the world, bringing different people together for a collision of ideas. 12,000 square meters of innovative research space, 499 intelligent workstations, 15 multi-functional conference rooms, 8 collaboration rooms, and nearly 50 negotiation Spaces fully empower entrepreneurs and creative project development. In terms of operation mode, OGR has also

attracted strong resource parties and leading enterprises to empower its business. In 2023, the CRT Foundation entered into a partnership with Microsoft to support businesses with a social or environmental impact, called the European Data-Driven Acceleration Program (second edition), which is carried out within the OGR Center for Applied Research in Technology Networks and Innovation; In addition, The OGR team has also supported many potential technology startups such as Alba robot (one of the 100 startups selected and participated in the Startup World Cup finals), The Newsroom (winner of the "Best Female Startup in Portugal" award), and so on, further expanding its influence[8].

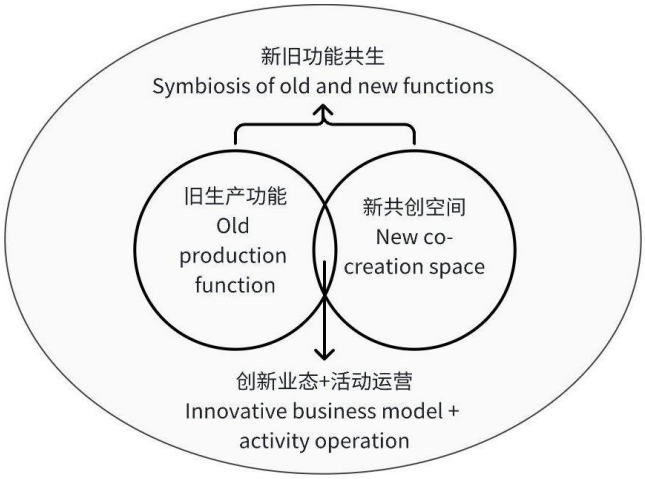


Figure 3- 5 OGR Factory Symbiotic System
Source: Author

Figure 3- 6 OGR Tech
Source: Author

The event operation is another initiative to activate the vitality of the urban community, and by scheduling the annual event plan in advance, it can effectively ensure the implementation of the OGR renovation plan, so that the renovated space is active and helps to provide dynamic services to the city.

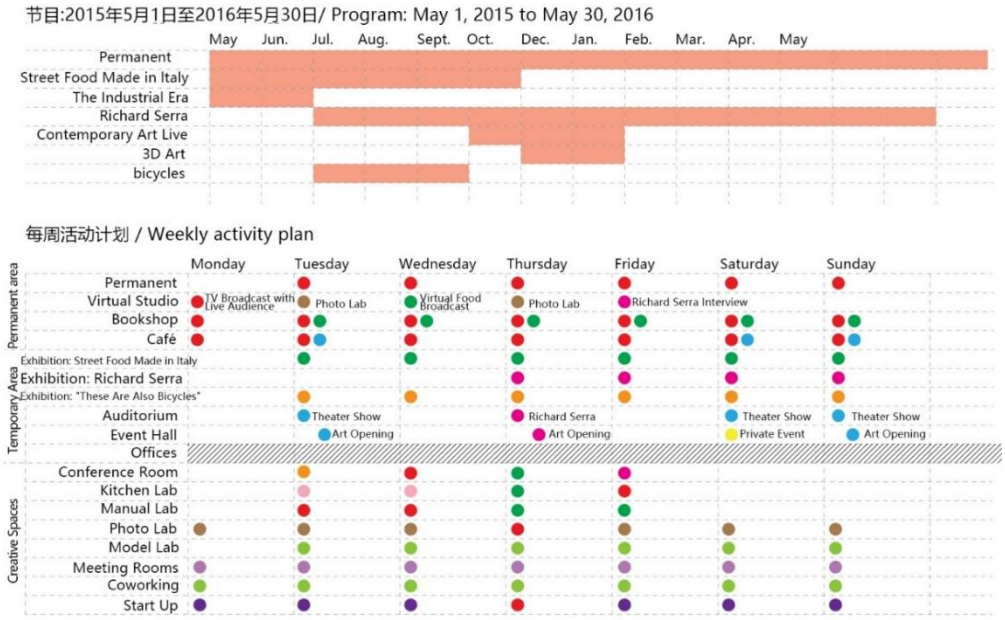


Figure 3- 7 OGR Factory Activity Operation Plan
Source: Author redrawing

(4) Interactive experience brings to vivid historical scenes

OGR mainly activates the space experience of art exhibition through two ideas: the first is to integrate with the sustainable development of the research system, make use of the historical space inherited by com'era com'e, take the industrial history as the clue, reproduce the industrial experience as the core, and design a series of interactive experience devices to provide a key place for local research and education;

The second is based on the cooperation between FUTURE PARK Space and TEAMLAB team, proposing the concept of "changing space", creating an immersive and customizable experience by creating interactive projections that can be moved and touched, and allowing visitors to control and diy their own content and experience.

The permanent exhibition space is divided into five themes: ① the historical and geographical background of Turin City, ② daily life and factories, ③ OGR (Officine Orandi

Oiparazioni), ④ migration, and ⑤ cultural exchange. Different theme Spaces exist in a continuous space where visitors can flexibly select multimedia content, such as the first interactive platform is a map of the Turin area drawn by 10 led strips, the tray is equipped with pressure sensors, loaded with batteries, can detect the presence of visitors, and pulses according to the trampled area to activate the projector. In turn, a series of historical and contemporary images and videos are juxtaposed to show visitors the historical changes in various areas of Turin. This immersive experience technology relies on a specific holographic projection screen produced by Cimex, a completely transparent crystal board that allows the image to be moved from one area to another without being affected by the projection.

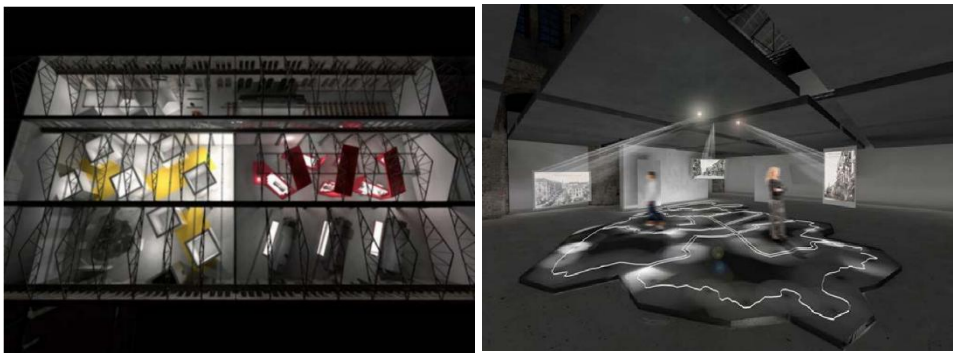


Figure 3- 8 OGR Interactive Experience Zone
Source: LA CULTURA DEL PROGETTO NEL RIUSO INDUSTRIALE:LE OFFICINE GRANDI RIPARAZION

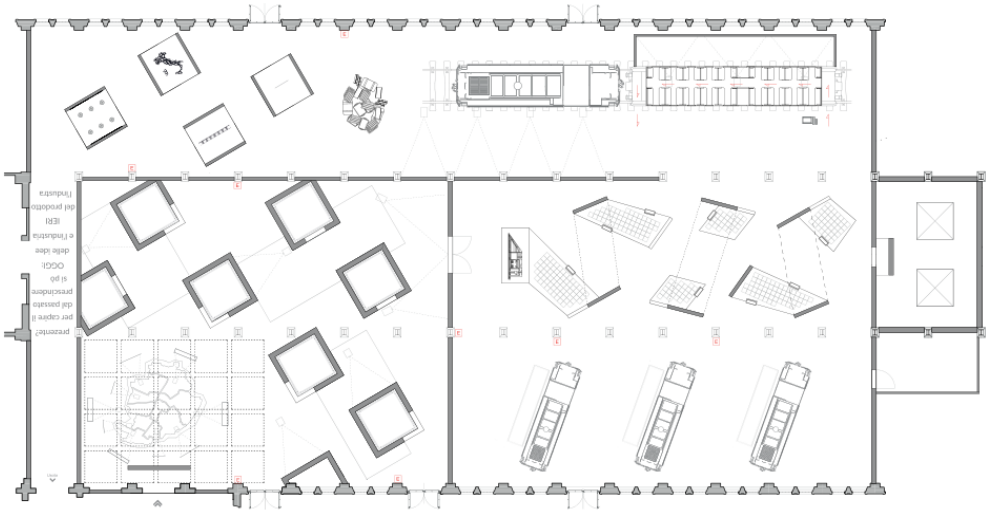


Figure 3- 9 OGR Exhibition Space Interactive Experience Zone
Source: LA CULTURA DEL PROGETTO NEL RIUSO INDUSTRIALE:LE OFFICINE GRANDI RIPARAZION

In this area, the guided path aims to show visitors the historic but defunct factories of Turin, such as Superga, FIP Italian Piano Factory, Royal Tobacco Company, Nebiolo, etc. Through

different spatial forms to match the most suitable for the display of its content, such as a group of diameter of about 6m volume elements arranged tour path to show the Superga shoe factory brand concept, factory development story, etc.; The uniqueness of the exhibition space at FIP Italian Piano Factory is reflected in the screen at the top, which can play clips of famous concerts as a unique soundtrack to the piano exhibits.

3.1.2 Shanghai Yangpu Riverside public space renewal

The Yangpu Riverside in Shanghai is 15.5 kilometers long and is divided into three sections: north, middle and south. The southern section is the core section of the previous renovation, with a total length of about 5.5 kilometers, starting from Qinhuangdao Road in the west to Dinghai Road in the east, and rich in industrial heritage. The section is located in a favorable geographical position, close to the Shanghai Economic and Trade Center and Lujiazui in the upstream, and the East China Sea in the downstream via the Yangtze River estuary. There are more than 300 factories of various types built by the West in China during the Republic of China, and it is the largest industrial zone in Shanghai and even the whole country. With the continuous advancement of urban construction since the 21st century, the factories in the lot have been moved away, and the remaining factories and wharves have cut off the accessibility of the riverfront, resulting in a long-term lack of vitality along the riverfront. Until the release of the Three-year Action Plan for the Construction of public Space on both sides of the Huangpu River (2015-2017) in 2014, the updated design practice of the public space project in the south section of Yangpu Binjiang was finally implemented.

Figure 3- 10 Yangpu Riverside District Location
Source: Author

(1) Cultural festivals enhance the city's popularity

Cultural festivals play an active catalytic role in stimulating urban vitality and promoting urban renewal and transformation. Yangpu Binjiang takes advantage of the 2019 Shanghai Urban Space Art Season to promote the development and construction of Shanghai's east and

west banks with the theme of urban space. At the same time, the development of the cultural festival has no specific restrictions on the space and display mode, and has variability and flexibility[9]. For example, in this case, a large number of exhibition Spaces are set in the 5.5km long public space system of Yangpu Riverside, where industrial relics and art exhibits complement each other. People walking in the public space of the riverside can inadvertently enter one art exhibition area transformed by industrial relics, such as the opening woolen and flaxy warehouse, the pavilion transformed into the coal ash wall of Yang shupu Power Plant and children's painting exhibition transformed by boiler factory warehouse wall, etc. During the event, the waterfront industrial heritage site became a large-scale exhibition area open to the public throughout the day, attracting crowds and relevant exchanges and discussions.

Since 2002, Shanghai has taken the World Expo as an opportunity to replace the industrial remains on both sides of the Huangpu River. Among them, Jiangnan Shipyard, Shanghai Steel No. 3 Works and Nanshi Power Plant have been transformed into China Ship Hall, Central America Joint Hall and City Future Hall respectively, which have been transformed and utilized as Expo pavilions, setting off the climax of China's industrial remains transformation museum.

Figure 3- 11 Shanghai Urban Space Art Season Industrial Heritage Plazas
Source: Author redrawing

(2) From "Industrial Rust Belt" to "Life Show Stage"

The spatial practice of Yangpu Riverside starts from comprehensively connecting the riverside area with the water, realizing the integration of the heritage zone, the vitality zone and

the ecological zone, and simultaneously constructing a three-way coexistence system of the riding way, the jogging track and the walking way[10]. This move breaks the closed pattern of the original industrial zone, lays the vitality foundation of the urban public space, effectively promotes the renewal and development of the region, and gradually extends to the inner space of the city. In the four years since the design of the demonstration section was launched in 2015, the original Yangpu river sightseeing line has extended 5.5km downstream from the Bund, realizing the transformation from "closed abandoned industrial production shoreline" to "open living shoreline for ecological sharing". By studying the formation and development of urban texture, the design team excavates the internal logic of the inheritance of industrial memory and the activation of industrial elements in the post-industrial era, and pays attention to the

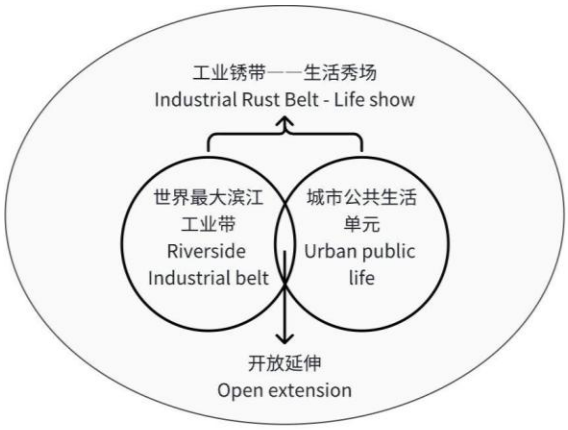


Figure 3-12 Yangpu Riverside Symbiotic System
Source: Author

Figure 3- 13 Four Spatial Configurations of Yangpu Riverside
Source: Author

symbiosis of people, machines and sites, thus completing the spatial practice of transforming the production-oriented waterfront to modern service-oriented functions. It not only integrates urban land use and industrial layout to guide the adjustment and transformation of industrial structure, but also optimizes the correlation structure between waterfront and hinterland to achieve multi-dimensional superposition of urban waterfront landscape remodeling.

(3) multi-compound spatial pattern

Yangpu Riverside is a tourist port image established by Shanghai. Based on the urban development and functional needs, four spatial patterns of "cultural media", "ecological leisure", "modern science and technology" and "creative culture" have been established, so as to achieve

a multi-compound mutualism and symbiosis system. Specifically speaking, the cultural media unit mainly transmits the historical and cultural development of Yangpu riverside to the public through material carriers such as industrial remains; The ecological leisure unit transfers the production activities of the riverside in the industrial era to the leisure activities of modern citizens, and maximally opens the waterfront activity space in the form of leisure promenade and activity center; The modern science and technology unit translates the advanced industrial development of the historical riverside space into modern advanced information technology; The creative culture unit mainly presents the development of riverside's industrial culture through fashion center and urban exhibition hall. Through the construction of the composite space of the above regional environment, Yangpu riverside has been successfully shaped into an urban living room in the new era, a living space containing multicultural places, pleasant living places, high-quality space places and healthy sports places.

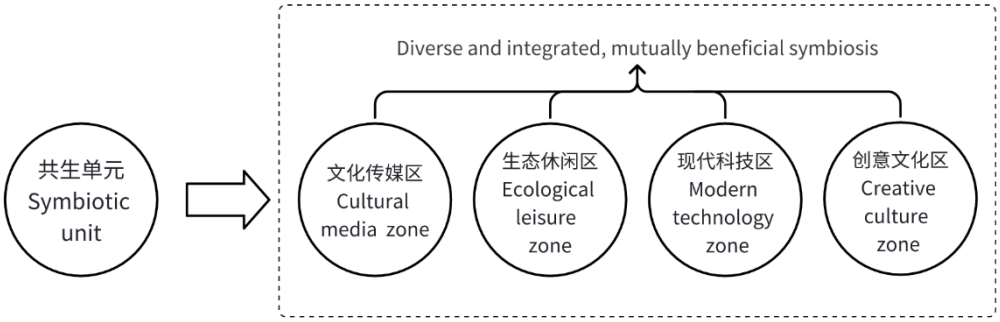


Figure 3- 14 Spatial Composition of Symbiotic Units
Source: Author

(4) Symbiosis of architectural certainty and uncertainty

In the industrial age, urban space mostly presents efficiency-oriented "certainty", such as space division with a sense of boundary. While modern space has more ambiguity and compound "uncertainty". The regeneration of Yangpu Riverside public space can be said to be a symbiosis of "certainty" and "uncertainty": certainty is to look back at the past and find the clues of industrial remains; Uncertainty is looking to the future, responding to the human characteristics of the post-industrial era, while leading the spatial renewal. The following selects three representative cases of renovation of building units in the south section of Yangpu riverside for specific interpretation.

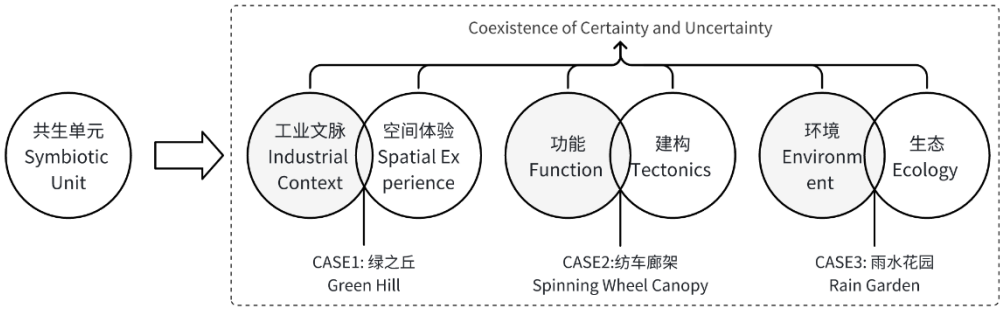


Figure 3- 15 Architectural Composition of Symbiotic Units
Source: Author

① Green Hill: Certain industrial culture and uncertain spatial experience

Green Hill used to be a mechanical repair warehouse of a tobacco company. It is a reinforced concrete frame slab building that lacks technological value and has no obvious characteristics. Due to the planned road crossing and its huge north-south volume, it seriously blocks the sight line of riverside landscape[11]. The ingenuity of the transformation lies in the use of layers of retreating platforms to reduce the volume, and as a bridge connecting the city and the river bank, it breaks the impression of the original industrial building as a closed and introverted city, and the retained concrete material also reminds of the past of the industrial era. The free circular ramp in the building overhangs

Figure 3- 16 Yangpu Riverside Green Hill
Source: Author redrawing

the river, providing a different kind of urban waterfront landscape space experience, and also forms a time and space opposite the Lu jiazui financial District in the distance. The combination of definite industrial culture and non-definite spatial experience makes Green Hill perfect integration of architecture, landscape and industrial context.

②Spinning Frame : Certain functional logic and uncertain construction principles

In the renovation of municipal landscape facilities in Yangpu riverside, the designer cleverly uses the spinning frame to resolve the height difference of the flood control wall, transforming the originally functional ramp facilities into a technical complex integrating the functions of ramp, porch and seat. Similarly, this definite functional logic and non-definite construction principle are also reflected in the water pipe lamps spread along the river, which remind the industrial zone of the mark of the pipe network by retaining the water pipe elements, and the water and gas circulating in the pipeline have changed from the industrial era to today's light and electricity.

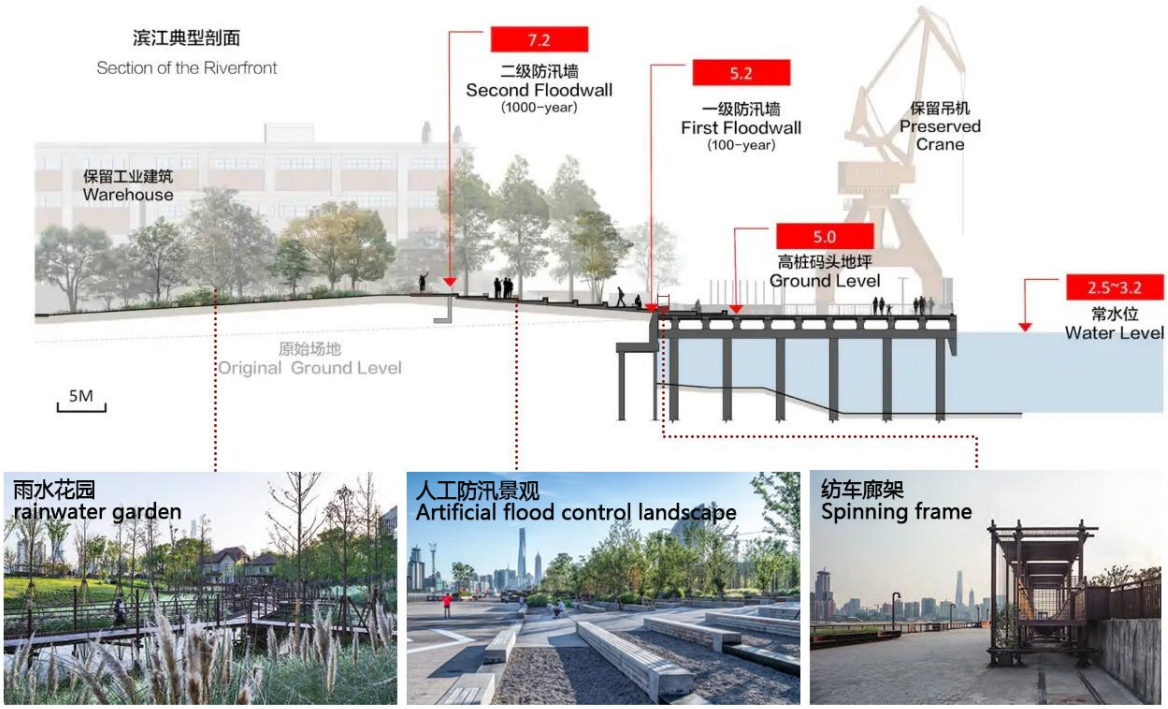


Figure 3- 17 Yangpu Riverside Floodwall Section Design
Source: Author redrawing

③Rain Garden: certain natural environment and uncertain ecological intervention

There is a low-lying water area behind the flood control wall of Yangpu riverside, which covers the dual theme of nature and humanity. Later, it was gradually designed and transformed into a rain garden, and developed into a unique landscape construction of Yangpu riverside. The site originally had a rich material base, and there was also a small red brick building full of historical and humanistic atmosphere. The design adopts the strategy of light intervention and low impact development to integrate historical memory into the wild wetland with overgrown vegetation and minimize the damage to the native environment. At the same time, the path organization and plaza embedding are carried out by imitating the classical garden techniques, and the walking experience of landscape gardens and the landscape temperament of industrial history are created through the details of terraces, pavilions, verandas, and plant configurations.

(a) Industrial Water Pipe Design (b) Rain Garden

Figure 3- 18 Yangpu Riverside Characteristic Plazas

Source: https://www.gooood.cn/

3.1.3 Shenzhen Kingway Brewery

As the only local beer brand in Shenzhen, Kingway Brewery carries the common memory of Shenzhen citizens and was included in the renewal plan in 2012. The overall transformation strategy is to carry out the transformation mode that attaches equal importance to public welfare and economy, to shape the characteristic space guided by the activation and utilization, and to realize the industrial positioning goal of integrating office, business and supporting facilities in combination with Yuehai City Business.

(1) The "local construction" concept

The renovation project of Kingway Brewery was designed by Urban Practice Office. Meng Yan, the main architect, proposed the concept of "local construction", which emphasizes local transformation and action. "Construction" means the urban symbiotic vision of "space is exhibition, exhibition is city, production is city" [12]. In this project, the designer continues the spirit and culture of industrial manufacturing represented by the original assembly line of the brewery, and creates a North-South spatial narrative line through nodal spatial intervention. The linear spatial narrative path cleverly replicates the beer production process steps, while creating different visual and tactile effects inside, superimposed historical and modern multi-era information. People can walk through the corridor between the beer cans and the pipes, overlook the garden transformed from the former sedimentation tank, and feel a series of non-daily spatial experiences.

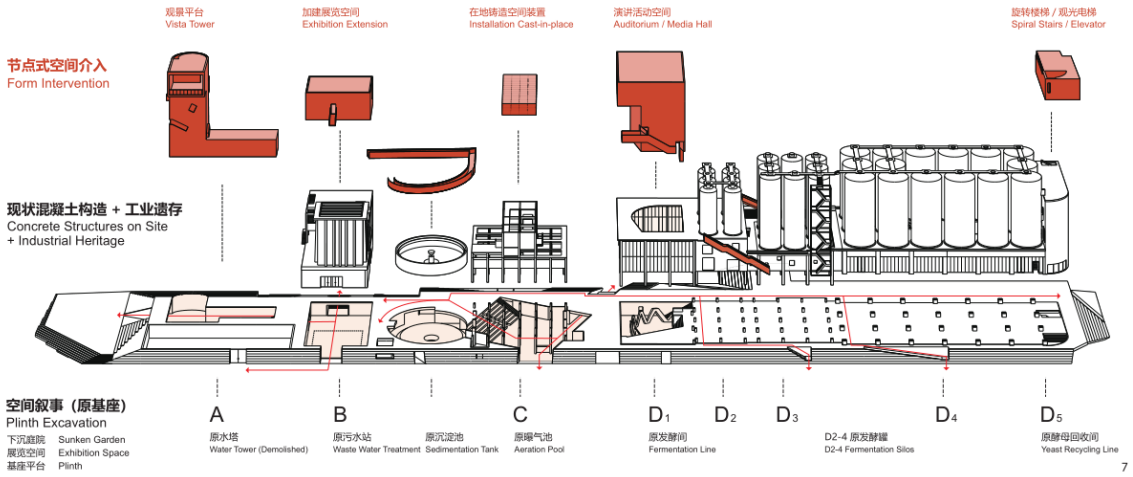


Figure 3- 19 Kingway Brewery "Local Construction" Concept
Source: https://www.gooood.cn/

(2) The new mode of "heritage compound protection"

The Kingway Brewery project is located in Luohu District, Shenzhen, with an updated area of about 90,000 square meters. Near the Dam International Jewelry Industrial Park and Luohu business center, the location advantage is obvious. In the field of industrial heritage renewal, its renovation is the first old industrial zone renewal project that adopts the composite model of demolition, reconstruction and comprehensive remediation. It not only guarantees the economic benefits of developers through demolition and reconstruction, but also guarantees social benefits through comprehensive renovation, so as to achieve a win-win situation for the

government, enterprises and the public. The specific operation is reflected in the functional compound and the land compound. First, the functional compound, based on the superior geographical location of the project and the natural flow of people around, adopts the combination of public welfare and business of "commercial shopping + public space + museum", turns the originally closed factory into an open park; The second is land compound, which balances the dual needs of commercial development and heritage protection by changing the nature of heritage land. The original industrial land is adjusted to public management and service facility land + commercial land (GIC+C1), and the M0 plot is divided to improve its plot ratio and commercial building area. This balances the impact of sacrificing the commercial frontage to preserve the industrial heritage. The composite land rebuilds the vitality of industrial heritage and promotes the symbiosis between urban development and heritage protection.

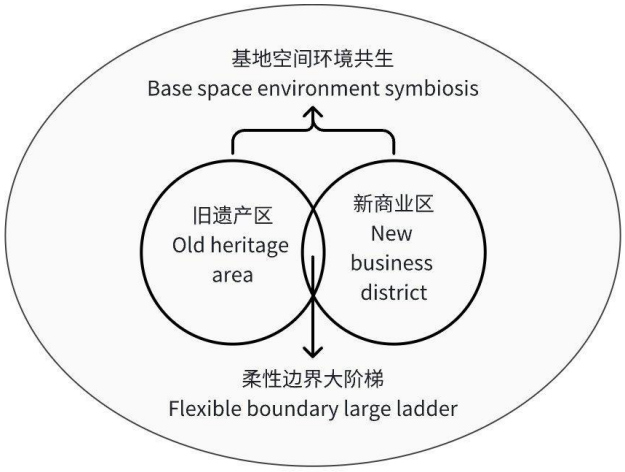


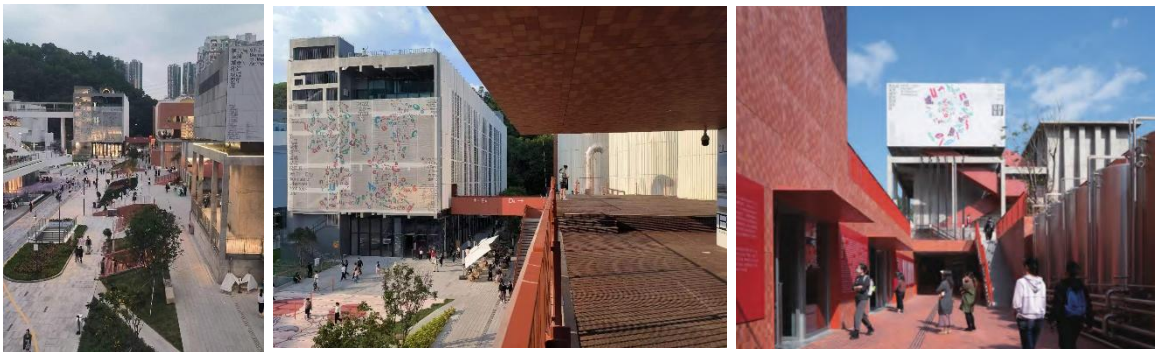
Figure 3- 20 Kingway Brewery Symbiotic System
Source: Author

Figure 3- 21 Kingway Brewery Land Use
Source: Author redrawing

(3) Base integration and spatial connection

In terms of enriching space experience, Kingway Brewery mainly relies on two strategies to achieve symbiosis between industrial space and site environment. The first is to integrate the scattered industrial space within the site by placing a continuous base, and reorganize the traffic to guide a complete spatial narrative path. On the outside of the base, the big steps on the west side cleverly resolve the height difference between the east and west sides of the site, forming a flexible transition boundary, creating an open space and strengthening the dialogue between

the old heritage area and the new business district; The underground space is excavated inside the base to create a series of sunken courtyards, passageways and activity Spaces, organize flexible vertical traffic, and provide space for citizens to participate in various cultural activities. The second is the spatial connection. In addition to the linear series of independent blocks placed in the base, the site strengthens the three-dimensional traffic of the second floor, and has strong interaction, connection and penetration with the underground space, opposite commercial buildings, office buildings, urban peripheral streets and pedestrian Bridges respectively, providing an effective and convenient walking path experience.



（a）big steps boundary （b）second floor connection （c）underground space

Figure 3- 22 Kingway Brewery Site Photos

Source: Author

(4) Micro-intervention to preserve heritage characteristics

Due to the particularity of the production process, the industrial heritage retained by Kingway Brewery is very distinctive, such as beer cans, conveying pipes, fermentation silos, sedimentation tanks, etc., which have high industrial cultural value. Therefore, the design team used micro-interventions to maximize the characteristics of each industrial building, and carried out a series of transformation measures in terms of material reuse and spatial activation.

① Water Tower

The renovated water tower serves as the symbol of the main entrance, which not only has a guiding and metaphorical role, but also has an excellent view and coffee leisure experience in function. Combined with the lighting design and the shape design, it becomes the first climax in the tour path.

② Sewage Station, Sedimentation Tank and Aeration Tank

The surface tiles of the sewage station were removed, and a steel structure box was added on top of the exposed concrete structure as an exhibition hall. The metallic aluminum foam cladding blends perfectly with the heavy concrete body below; The same technique is applied to the top of the aeration tank, where spliced metal cast aluminum rods are complemented by psychedelic lighting to create an eye-catching golden structure that resembles a vibrant beer foam. The large circular sedimentation tank in the middle of 18m is maximized to preserve the form and concrete material, and is combined with the steel bridge in the sky to create a landscape garden.

③ Fermenter Silo

The original fermenter workshop is a feature of the site, with a total of 18 inverted conical tanks with a diameter of 7.5m arranged on the indoor ceiling floor. Most of the tank and pipeline equipment in the room was retained by micro-intervention as an immediate exhibition hall. Only 3 tanks are removed to introduce natural light into the interior and form an inward gathering space as a large exhibition space. The space of the tank itself is transformed in two ways: one is to strengthen the structure of the tank according to the requirements of barrier-free elevator and evacuation stairs, and then give it vertical traffic function; The other is to build a bridge between the tanks with a minimally invasive incision to enhance the experience of its special space.

（a）Water Tower （b）Sedimentation Tank （c）Fermenter Silo

Figure 3- 23 Kingway Brewery Site Photos

Source: Author

3.1.4 Guangzhou B.I.G Haizhu Bay Creative Zone

B.I.G Haizhu Bay Creative Zone, formerly the site of Daganwei Warehouse, is located at No. 2 Zhenxing Street, Nanzhou Street, Haizhu District, covering an area of more than 30,000

square meters with a 90-meter waterfront. In 2008, under the background of urbanization, the enterprise gradually moved, and was transformed into a complex creative park integrating art, exhibition, office, sports and other functions. The design team of this project is Guangzhou Atelier cn°S, and the main creator of this project happens to be Prof. Zhong Guanqiu from South China University of Technology. Therefore, the author has the honor to invite Prof. Zhong to conduct an in-depth interview on this project.

It is learned from the interview that although the project does not directly adopt the design theory of "symbiosis", it reflects the idea of symbiosis in many details. The author summarized it into the following design points:

(1) Conform to the original spatial layout

In terms of spatial planning, under the premise of basically retaining the original storage layout, the design carried out a reasonable dreg of the space texture of the factory, opened up the space of the first floor of the building, separated the dynamic and static flow lines, and created a three-vertical and two-horizontal spatial pattern as a whole. As for the space of the waterfront yard, the design chooses to retain its open pattern and transform a large area of the waterfront open space into a sports and leisure venue. Prof. Zhong mentioned that "We have reserved most of the green trees inside the park, but we have not planted a large number of trees in the waterfront square space, in order to continue the large-scale empty feeling of the former cargo yard. So only part of the lawn was laid." After the transformation, the waterfront open

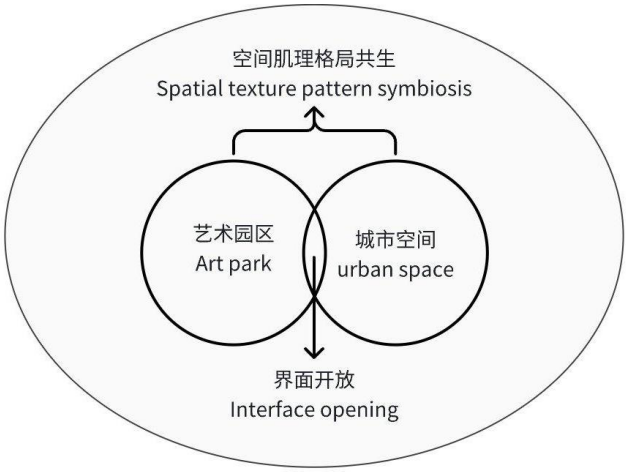


Figure 3- 24 B.I.G Haizhu Bay Creative ZoneSymbiotic System
Source: Author

square has attracted many advertising media, film and television enterprises to take the scene here, and the open river view has become a natural background board; The large sculpture and graffiti art walls, which were designed by professors from Central American University, also attracted many visitors who came to take photos. In addition, due to the relatively open space, in the evening, the square has also become a place for collective activities and leisure gatherings of middle-aged and elderly people. This shows that the square space can also achieve the effect of time-sharing utilization

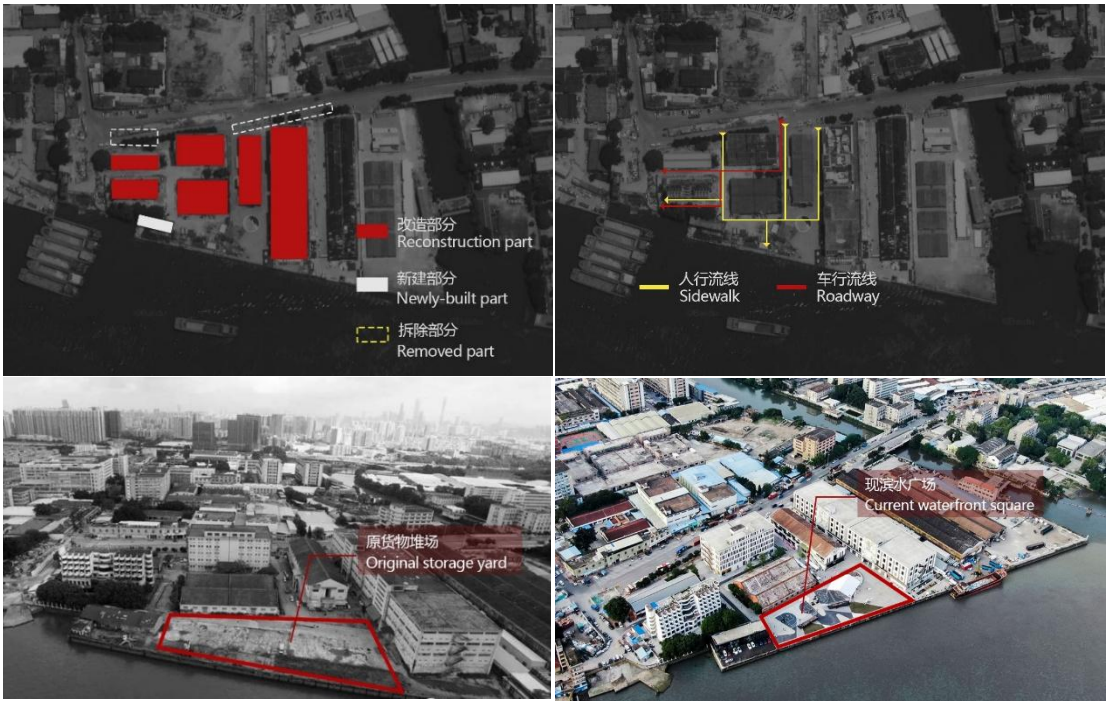


Figure 3- 25 B.I.G Haizhu Bay Creative Zone Spatial Structure
Source: Author redrawing

Figure 3- 26 B.I.G Haizhu Bay Creative Zone Waterfront Plaza
Source: Author

(2) Old warehouse: " fake removed and real saved"

There are two types of old buildings in the site in urgent need of renovation: one is the large-span warehouse with single-storey slope roof in the early 1950s, which is a brick-concrete structure; The other is the high-rise flat-roofed warehouse in the 1980s and 1990s, which is a reinforced concrete structure. The high-rise warehouse was built late, and the design is a combination of white walls and dark window frames, which is transformed into a full-rent cultural and creative space adapted to modern aesthetics. For the large-span warehouse with obvious historical features, the design team treats the historical buildings gently and chooses the main strategy of "preservation".

"We discovered its' true face 'when we conducted a site survey of the large-span warehouse with a single-storey pitched roof," Zhong recalled. The river facade of the warehouse is covered by the original authentic wall texture, so the red brick can be seen through the wall damage. In the end, the design team chose to remove the surface brush and reveal the original materials of the building, ensuring that the old warehouse with double slopes has a complete period style and facade character.

Figure 3- 27 fake facade(left) real red brick facade(right)
Source: cnS

In addition, the original pitched roof structure of the building is built by a single layer of old brick tiles. In order to retain the historical style of the existing pitched roof and the rhythmic beauty of brick masonry, the design team adopted a protective transformation strategy for the original roof system. On the premise of ensuring the functionality of the building, the traditional tile system was systematically restored, and a transparent sheet waterproof layer was added to the interior space. The double-layer roof structure cleverly solves the waterproof problem: when

a small amount of water seepage occurs, rainwater can be diverted along the transparent panels set at the Angle to the drainage gutter on both sides, effectively ensuring the dryness of the lower sports field. It is worth mentioning that the organic combination of sunlight board, traditional roof tile and wood purlin reflects the symbiotic relationship between old and new materials, and its industrial aesthetic characteristics have become the material carrier for interpreting the historical evolution process of architecture, providing users with an intuitive medium for perceiving the characteristics of industrial architecture times.

The old site of Daganwei warehouse has been revitalized by this transformation of "eliminating the fake and preserving the real", and is therefore included in the "Recommended List of the seventh batch of Historical Buildings in Guangzhou". The old industrial remains that may have disappeared in the urban development have been valued and retained in the "transformation" of respecting history, and have gained new vitality for forward development.

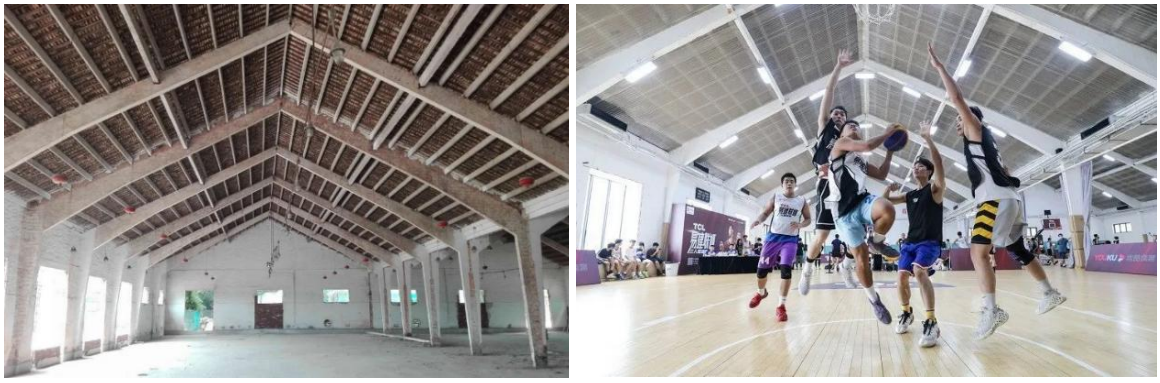


Figure 3- 28 Single-layer brick tile roof(left)　Transparent waterproof panels(right)
Source: cnS

(3) Public art brings Internet celebrity effect

Various types of public art combined with regional culture have been used in the renovation of the park to increase its popularity. First of all, public art and installations, such as sculpture, are featured. The giant cat sculpture in the square is very technological and eye-catching at dusk. Rainbow staircase is the second Internet celebrity punch

Figure 3- 29 Rainbow Staircase
Source: Author redrawing

point, using laser glass material, you can observe its different color changes in different light and time; The large wall painting graffiti also shows fashion, vitality and fun, and the design as a whole presents an international creative atmosphere. In addition, in terms of plant operation, relying on the celebrity effect, the warehouse was transformed into a basketball training hall. The Fire camp youth basketball Training Center initiated by the famous Guangdong basketball player Yi Jianlian also landed here, bringing people and popularity to the zone.

(4) Climate adaptation of building interface

At the micro-architectural level, the facade reconstruction strategy adopted by B.I.G Haizhu Bay Creative Zone is a representative case of "regional climate symbiosis" in the transformation process of industrial heritage. One warehouse significantly improved the window-wall ratio and window-ground ratio of the original warehouse by expanding the window holes and replacing the old Windows, and the other one greatly improved the lighting and ventilation conditions of the building interface by adding high bar Windows and adding roof skylights. In this way, it meets the new functional needs of transforming from "old storage space" into "new civic activity space".

Figure 3- 30 Before:Small window openings(left) After: Enlarged openings(right)
Source: Author redrawing

In summary, the renewal highlights of B.I.G Haizhu Bay Creative Zone are mainly reflected in adapting to the urban spatial layout and "old and new symbiosis", but the industrial history and cultural narrative of Daganwei are less reflected. In the interview, we learned that this is because the old industrial type of the area is warehousing buildings with a long history, and there is a lack of traceable industrial history stories. Therefore, the design can only be

constructed as a continuation of industrial memory by retaining anchor piles, industrial transfer beams, etc. At the same time, for the sports plaza along the river, the design chose to retain the empty sense of the original storage yard and cancel the planting of big green trees, which also caused the problem of poor walking experience of the square in summer.

3.1.5 Cases Summary

Through a horizontal comparison of the OGR factory in Turin, Shanghai Yangpu Riverside public space renewal, Shenzhen Kingway Brewery and B.I.G Haizhu Bay Creative Zone (Table 3-1), the characteristics of symbiotic practices in the renewal of industrial remains can be systematically summarized. From the perspective of the theoretical framework, these cases show obvious hierarchical differences in the three dimensions of symbiotic units, symbiotic environments, and symbiotic models. In terms of symbiotic units, the OGR factory has established a multi-subject collaboration network of "universities - enterprises - artists", forming a highly stable symbiotic relationship. However, B.I.G Haizhu Bay mainly relies on the single interaction of "cultural and creative creators - tourists", and its symbiotic foundation is relatively fragile. In terms of the symbiotic environment, policy drivers played a key role in all four cases. However, Yangpu Riverside's excessive reliance on the short-term event of the Shanghai Urban Space Art Season reflects the insufficient sustainability of its environmental support system.

The practical value of Kisho Kurokawa's symbiotic thought in the case mainly lies in three aspects: Firstly, the "Sacred Domain " as the spiritual anchor point determines the cultural depth of renewal. The H-shaped factory building of OGR and the aeration tank structure of Jinwei Brewery have both been successfully transformed into spiritual carriers with strong symbolic significance. However, although B.I.G Haizhu Bay retains material textures such as red brick walls, its transformation at the spiritual level is relatively weak. Secondly, the spatial sequence organization of "Dao" influences the continuity of the industrial context. Kingway Brewery has achieved an organic connection in the dimensions of time and space through the narrative flow line design of the beer production process. In contrast, the "three Systems" of Yangpu Riverside have been relatively successful in physical connection, but there is still room for improvement

in terms of cultural narrative. Finally, the transitional effectiveness of the " Intermediate Zone " is directly related to the integration quality of the old and new elements. The OGR Cult multi-functional hall perfectly harmonizes the contradiction between electronic music and industrial space through the design of the acoustic environment. Although the spinning wheel pervert along the Yangpu riverside is quite creative in terms of functional transformation, it can still delve deeper into the translation of cultural connotations.

By integrating the renewal effects of the four cases, it can be found that, essentially, the symbiotic renewal of industrial remains is a systematic negotiation process between historical genes and modern demands. The ideal renewal practice should achieve a balance at two levels: At the level of Yuan Chunqing's symbiotic theory, it is necessary to ensure the complementarity of symbiotic units, the adaptability of the symbiotic environment, and the evolutionary nature of the symbiotic model; At the level of the symbiotic thought of Kisho Kurokawa, a complete spatial translation system should be established, including anchoring the cultural core through the sacred domain, organizing the temporal and spatial sequence by using the "Dao", and mediating the conflict between the old and the new by leveraging the intermediate domain. The renewal of industrial remains in the future requires special vigilance against the trap of "symbolic symbiosis". It is necessary to avoid simply symbolizing industrial elements. Instead, the spiritual connotations of industrial sites should be deeply explored and preserved in the process of functional reset, truly achieving the organic integration of history and modernity.

Table3- 1 Horizontal comparison of case symbiosis

dimension	OGR Factory in Turin, Italy	Shanghai Yangpu Riverside	Shenzhen Kingway Brewery	Guangzhou B.I.G Haizhu Bay Creative Zone
Symbiotic unit	Old: H-shaped factory building/railway track New:Education/Science and Technology Innovation/Cultural Space	Old:Wharf/Warehouse/Pipeline New:Walkway/Garden/Exhibition area	Old:Fermentation tank/sedimentation tank New:Commercial complex/museum	Old: Warehouse with a pitched roof New: Art Space/Sports Field

Table3- 1 Horizontal comparison of case symbiosis(continued)

Symbiotic environment (physically)	North-south spina centrale/ Existing buildings (H-shaped factories)/Industrial area spatial texture	Natural base (Huangpu shoreline)/Industrial structures (wool and hemp warehouses, coal ash retaining walls of power plants)/Transportation system (cycling + walking + jogging system)	Equipment remains (18 fermentation tanks, etc.)/Terrain height difference/Commercial carrier (Yuehai City)	Waterfront interface (90 meters of shoreline + remains of anchor piles)/Microclimate (Pearl River Monsoon Channel)
Symbiotic environment (immateriality)	Policy (PRG Urban Renewal Plan)/Culture (Turin Electronic Music Subculture Tradition)	Policy "Three-Year Action Plan"/Event (Shanghai Urban Space Art Season)/Technology (Mature Ecological Restoration Technology)	Policy (Shenzhen's pilot Policy for Industrial-to-Commercial Transformation)/ Economy (Demand for Commercial Land in Luohu District)/Society (Participation in the Citizens' Beer Festival)	Policy (Catalogue for Phasing Out the Secondary Industry and Entering the Tertiary Industry)/Culture (Internet Celebrity Check-in Traffic)/Operation (Star Basketball Training Base)
Symbiotic model	Close symmetry, mutual benefit and symbiosis (balanced distribution of energy	Asymmetric reciprocal symbiosis (The short-term	Symbiosis with a preference for benefits → Symbiosis with	Parasitism → Mutualistic symbiosis (initially relying on traffic

	among education, science and technology, and cultural functions, forming a closed loop of industry-university-research cooperation)	benefits of art events and the long-term social benefits are difficult to synchronize)	mutual benefit (Commercial development takes the lead in the early stage, while culture feeds back in the later stage)	parasitism, later artistic function feedback)
Sacred Domain	The H-shaped factory building serves as the "industrial sanctuary" : -Retaining the steel structure skeleton symbolizes the glory of the automotive industry -Transform it into a performance space to continue the collective memory	Green Hill Concrete Frame -The exposed structure indicates the history of the tobacco industry -The form of withdrawal is a metaphor for industrial stratification	Golden aeration tank structure: -The metallic texture symbolizes beer foam -Lighting enhances the sense of ceremony	Red brick exposed wall surface -Distinguish the true from the false and showcase the construction techniques of the 1950s -Included in the list of historical buildings in Guangzhou
Dao	The "Spinal Axis" of the PRG program: -The north-south railway line connects the four major industrial zones -Physical and symbolic connections between the past and the future	Three systems along the riverside: -Three lanes of cycling, walking and jogging are placed side by side -Linear narrative connects 12 industrial relics	Narrative Path of Beer Production: -Visit the route to reduce the saccharification and fermentation process -Spatial sequence enhancement experience	Three longitudinal and two transverse textures: -Retain the original warehousing and logistics channels -Transform it into the main axis of art Tours

Table3- 1 Horizontal comparison of case symbiosis(continued)

Intermediate Zone	OGR Cult Multi-functional Hall -The acoustic resonance of electronic music (new) and industrial space (old) -The conversion of three events per day improves space utilization	Spinning wheel pergola -Flood control wall (function) → Translation of art installation (culture) -Skillfully carry out height difference resolution	Base sunken courtyard -Connect underground commercial facilities with above-ground ruins -The proportion of transitional space has increased	Rainbow Staircase -The laser glass medium reflects both new and old light and shadow -The act of clocking in activates negative Spaces
Summary of Symbiotic renewal evaluation	A model of cultural translation of the industrial sanctuary By injecting the triple kinetic energy of "education + technology + art", a symbiotic leap from parasitism (industrial decline) to symmetrical reciprocity (a closed loop of industry-university-research cooperation) has been achieved. The H-shaped factory, as a holy land, has successfully anchored	Event-driven phased success Short-term art festivals activate long-term spatial renewal, but the energy distribution between cultural functions (art exhibitions) and citizens' daily needs (leisure) remains unbalanced. It is necessary to enhance the translation depth of intermediate	The compromise and balance between economy and culture The sacred domain has strong visual appeal but lacks spirituality. The narrative of the "Dao" craftsmanship is complete. The middle domain needs to enhance cultural penetration to break through the	The practice of light symbiosis in the era of traffic The sacred domain retains authenticity but has a weak narrative. The external unblocking of the "Way" is hindered, and the middle domain remains at the level of visual stimulation. It is necessary to deepen the cultural transition mechanism

itself in the collective memory of the automotive industry	fields (such as rain gardens)	limitation of profit-driven coexistence

Source: Author

3.2 Connotation and demand of industrial remains symbiosis design

The essence of the industrial remains symbiosis transformation lies in the sustainable and win-win symbiosis mode between each symbiosis unit, and finally reach an environmental state of coexistence and balance. The symbiosis philosophy proposed by Kisho Kurokawa in the 1980s, "the symbiosis of heterogeneous culture, the symbiosis of part and whole, the symbiosis of interior and exterior, the symbiosis of architecture and environment, and the symbiosis of technology and human beings," has a high degree of consistency with the core connotation of industrial remains transformation. Its target needs correspond to the four types of design performance of city, culture, space environment and architecture: open and transparent urban interface, harmonious integration of cultural genes, green sharing of internal and external space and rich and coordinated architectural functions.

3.2.1 Harmonious and symbiotic urban relations

The renewal of industrial remains and urban development is a dynamic and adaptive process, which requires the establishment of differentiated symbiotic relationships based on specific location conditions and development needs. Kisho Kurokawa's symbiotic thought emphasizes the "symbiosis of parts and the whole", which is particularly important in handling the relationship between industrial remains and the city. As an organic component of the city, the renewal and transformation of industrial buildings must be based on the characteristics and development positioning of the area where they are located, and build an interactive relationship that is in harmony with the urban environment. Moreover, the specific forms should be adapted to local conditions. In the central urban area, industrial remains often needs a more open spatial interface to integrate into the urban public network; while in the characteristic industrial zones,

it may be necessary to maintain a moderate sense of territory to continue the industrial cultural features.

According to the results of the questionnaire survey, 95% of the respondents expect that industrial buildings should establish a positive interactive relationship with the city. They do not want it to be isolated and closed off, nor should it be completely open in a uniform manner. Therefore, constructing a coordinated and symbiotic urban relationship, restoring the functional communication of streets, and creating more dynamic boundaries are of great significance for enhancing the vitality of urban public spaces, strengthening the charm and livability of the city.

Figure 3- 31 Closed interface and open interface
Source: image.baidu.com

问题：请问您更倾向于哪种工业遗存与城市的开放性关系？
Question: What kind of open relationship between industrial heritage and city do you prefer?

选项Option	小计Count	比例 Proportion
希望不开放，与城市完全隔离 Closed, completely isolated from the city	9	5%
希望半开放，与城市有适当分离 Semi-open, with proper separation from the city	148	76%
希望完全开放，与城市融合 Totally open, integrated with the city	38	19%
本题有效填写人次 Valid respondents：195		

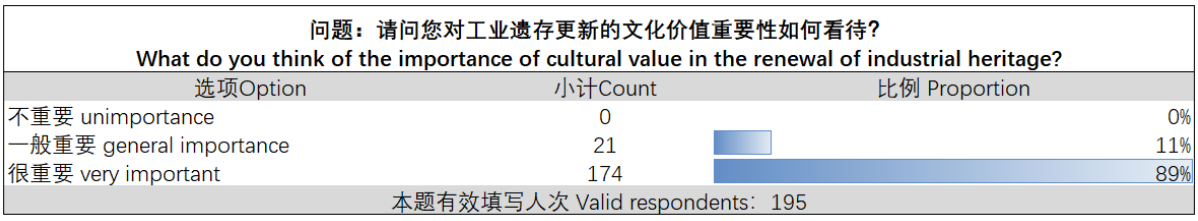
Figure 3- 32 Industrial Remains and Urban Openness Questionnaire
Source: Author

3.2.2 Harmonious blending of cultural genes

Kisho Kurokawa proposed that architecture should maintain a blending and symbiosis relationship with cultural genes. This concept of contextual symbiosis emphasizes intangible cultural elements such as historical symbols, aesthetic consciousness, lifestyle and landscape memory as the core of the design, and integrates and responds to the unique charm of the region, urban context and natural environment with an open attitude. In the case of the island of Mur in Graz, the design embodies the diverse coexistence of cultural genes. Mur Island is an artificial floating structure on the Mur River, which not only continues the river context, but

also becomes a symbol of the urban culture of Graz. Designer Vito Akensi has created this unique landmark by combining traditional architectural elements with modern design techniques while respecting the past and the future. Muir Island not only shows the integration of Eastern and Western cultures, but also reflects the harmonious unity of Graz as a historic city and the modernization transformation, realizing the symbiosis and inheritance of the context.

As the witness of urban history, industrial architecture carries the essence of industrial culture, and its unique construction and elements record the industrial production and life style, becoming a symbol of the industrial age. Faced with the challenge of loss of style brought by urban renewal, the transformation of industrial buildings should pay attention to preserving their form and spatial scale, integrating urban characteristics, and moderately retaining traces of industrial production. The survey results also showed that 89% of the population said that the distinctive cultural value of industrial heritage is very important and needs to be considered.



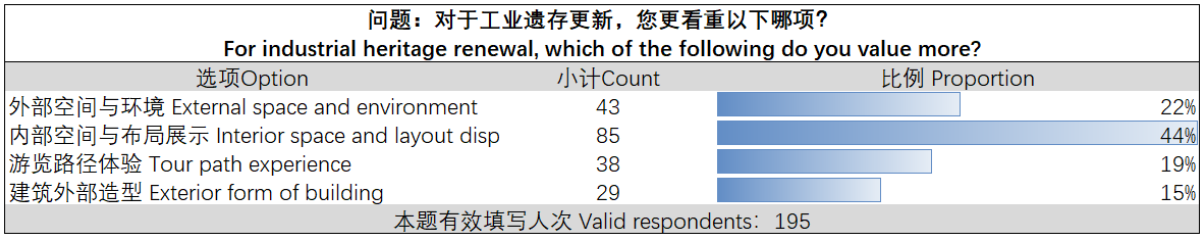
问题：请问您对工业遗存更新的文化价值重要性如何看待？ What do you think of the importance of cultural value in the renewal of industrial heritage?		
选项Option	小计Count	比例 Proportion
不重要 unimportance	0	0%
一般重要 general importance	21	11%
很重要 very important	174	89%
本题有效填写人次 Valid respondents：195		

Figure 3- 33 Cultural Value Significance Assessment Questionnaire
Source: Author

3.2.3 Spatial form of internal and external coordination

The design core of traditional industrial remains is to meet the production demand, and the space is independent from each other, lacking of ambiguity and interest. Traffic and production requirements in former industrial remains often lead to poor overall environmental conditions that are in urgent need of restoration. And this environment reinforces the separation between the inside and outside of the building, forming a closed internal space. Environmental symbiosis mainly refers to the space environment, the premise of having a good space environment is a suitable space form, due to the transformation of the production function of the old industrial zone, the internal and external space form also needs to be adjusted accordingly to adapt to the new function. Therefore, the symbiotic needs of industrial remains and spatial environment are actually closely related to functional needs. By optimizing spatial form, adjusting spatial

structure, and reshaping architectural and detail styles, the problems of space and use transformation of industrial remains can be solved, which is also the core goal and demand of renewal.

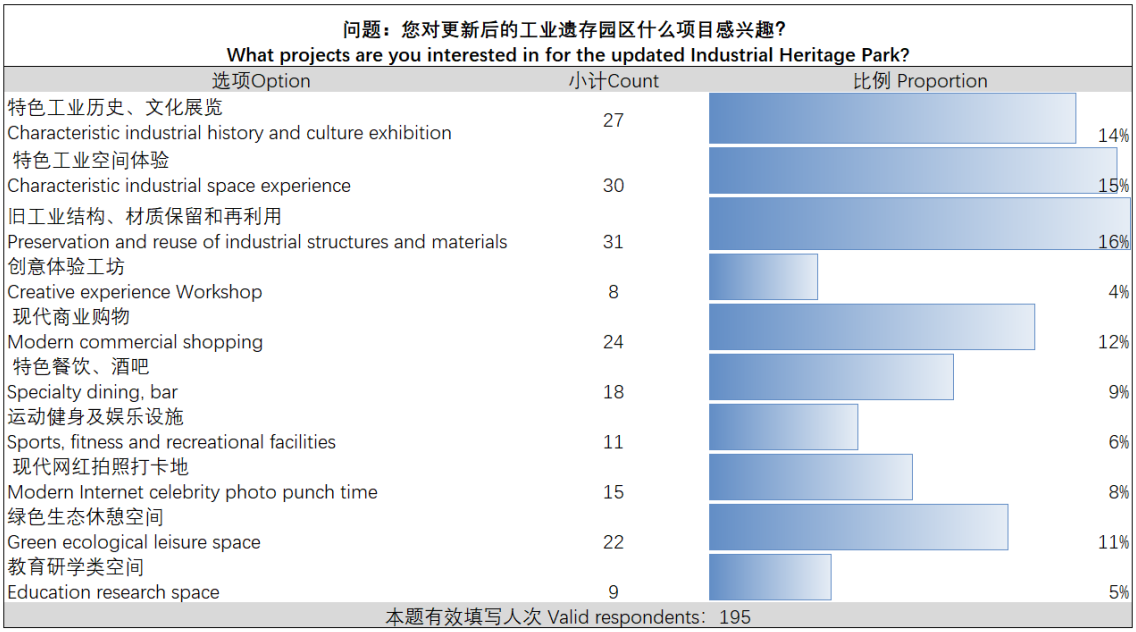


问题：对于工业遗存更新，您更看重以下哪项？ For industrial heritage renewal, which of the following do you value more?		
选项Option	小计Count	比例 Proportion
外部空间与环境 External space and environment	43	22%
内部空间与布局展示 Interior space and layout disp	85	44%
游览路径体验 Tour path experience	38	19%
建筑外部造型 Exterior form of building	29	15%
本题有效填写人次 Valid respondents：195		

Figure 3- 34 Industrial Remains Space Needs Questionnaire
Source: Author

3.2.4 "Old and new symbiosis" of structure and function

The core purpose of the transformation of the industrial remains preserved by value judgment is to give new life to these relics, and to realize the protection and reuse by exploiting their historical value. In this process, there will inevitably be a change from the original single production function to the compound new function layout, and it is also necessary to consider the applicability of the old building structural system, the connection between the new and old structures and space. Under the new era background, to meet the diverse needs of different people for the functions of industrial remains, to make the old and new buildings and Spaces



问题：您对更新后的工业遗存园区什么项目感兴趣？ What projects are you interested in for the updated Industrial Heritage Park?		
选项Option	小计Count	比例 Proportion
特色工业历史、文化展览 Characteristic industrial history and culture exhibition	27	14%
特色工业空间体验 Characteristic industrial space experience	30	15%
旧工业结构、材质保留和再利用 Preservation and reuse of industrial structures and materials	31	16%
创意体验工坊 Creative experience Workshop	8	4%
现代商业购物 Modern commercial shopping	24	12%
特色餐饮、酒吧 Specialty dining, bar	18	9%
运动健身及娱乐设施 Sports, fitness and recreational facilities	11	6%
现代网红拍照打卡地 Modern Internet celebrity photo punch time	15	8%
绿色生态休憩空间 Green ecological leisure space	22	11%
教育研学类空间 Education research space	9	5%
本题有效填写人次 Valid respondents：195		

Figure 3- 35 Renovation Project Interest Questionnaire
Source: Author

coexist harmoniously, and to inject vivid and changeable vitality and atmosphere into the updated regional space is the goal of realizing the symbiosis of architecture itself.

Through the questionnaire survey, it can be seen that most people are more interested in industrial characteristic elements, structures and spatial experience. At the same time, the functional diversity of the renewed industrial zone is also more important for users.

3.3 Principles of industrial remains symbiotic design

3.3.1 Integrity principle

Symbiosis theory emphasizes examining the evolution process of things from a holistic perspective, and everything is an interrelated and interacting whole. The principle of integrity requires us to base on the broader urban environment and realize the organic integration of industrial areas and urban spatial elements. As an important plaza bearing the city's cultural memory and historical context, the value of industrial remains lies not only in its own historical significance, but also in its close connection with urban social, cultural, economic, ecological and other elements. In the process of renewal, simply pursuing the optimization of function or form will often cut off its connection with the whole city. Therefore, following the principle of integrity, taking into account the material and cultural connotation, spatial layout and the interrelationship with the surrounding environment of industrial remains is the key to achieve sustainable renewal. This kind of systematic thinking not only helps to continue the cultural value of industrial remains, but also provides a more comprehensive solution for urban renewal and promotes the harmonious symbiosis between cities and industrial remains.

3.3.2 Dynamic principle

As a complex organism, city is always in the process of dynamic renewal and evolution. This dynamic nature is not only reflected in the change of urban form, but also profoundly affects the evolution of its architecture and space. From the perspective of symbiosis theory, we should not only pay attention to the current state of things, but also focus on the evolution of things, which requires us to go beyond simple static thinking and establish a dynamic thinking

framework. This kind of thinking has important guiding significance for urban planning and architectural design.

The formation of industrial remains often stems from the neglect of dynamic nature. Its function and spatial layout have been unable to meet the needs of modern society, so when it is reused, we also need to abandon static thinking and adhere to the dynamic principle. In the specific design process, it is necessary to combine the historical value of industrial remains with the contemporary functional needs to give them a new life form, but also to fully consider the possible changes in the future, to provide them with more development possibilities and freedom. To be specific, the dynamic balance between architecture and environment, function and space can be built through ecological restoration, industry introduction and space composite, so as to achieve the goal of sustainable development.

3.3.3 Co-prosperity Principle

Based on the theory of symbiosis, each element can achieve a state of "coexistence" through the "Intermediate Zone". However, this does not mean that all parties can achieve shared prosperity, but may favor one direction over the other. The renewal of urban industrial remains is a dynamic process, which is reflected in many aspects, such as the inheritance of historical memory, the continuation of context, the continuation of spatial structure, the optimization of architectural form and functional scale, and the harmonious development of natural links. Many failed industrial renewal cases have only achieved partial coexistence, and favoring one side over the other is unsustainable. Therefore, the renewal of industrial remains in the new era needs to follow the principle of "mutualism" as much as possible to achieve the relationship of "reciprocity" and "co-prosperity" between industrial remains and all relevant elements, and ultimately form a harmonious and win-win situation.

3.3.4 Humanism Principle

The core of symbiosis theory is to advocate a balanced relationship and emphasize the harmonious symbiosis between human and architecture in architectural design. In this process, it is necessary to fully consider people's subjective feelings and realize the unity of rational

design and emotional expression. Kurokawa's theory and practice show that architecture should not only be a pile of rationality, but should create a vibrant public space environment, and the principle of "people-oriented" must be carried out throughout. Therefore, the renewal design process of industrial remains needs to take into account the material needs and psychological needs of the population, listen to the voice of residents, and turn the cold industrial factory into a warm public interaction and activity space.

3.4 Design path of industrial remains symbiotic renewal

3.4.1 Step 1: Analyze the current symbiotic system

According to the analysis of the symbiotic theory in Chapter 2, the symbiotic system contains three basic elements: symbiotic unit, symbiotic environment and symbiotic mode, and there is a symbiotic interface between different symbiotic units. At the beginning of the transformation, the symbiotic system in the target area should be analyzed, and the symbiotic relationship should be analyzed and the symbiotic elements should be evaluated through questionnaire and site investigation.

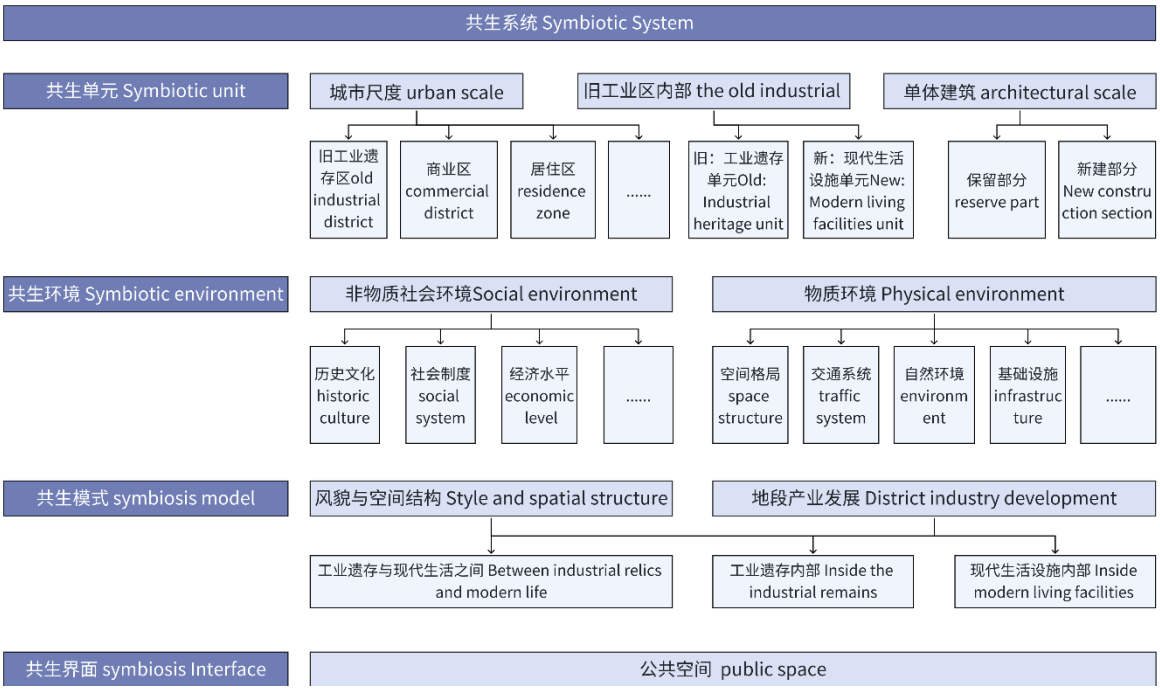


Figure 3- 36 "Symbiotic System" Analytical Model
Source: Author

The symbiotic unit of the old industrial zone can be summarized as two parts: industrial remains and modern life. At the micro level, the industrial building monomer and structure also exist as an independent sub-unit. Symbiotic environment is divided into material environment and social environment, including history, culture, industry, policy, land use, transportation, style and many other aspects. The symbiotic mode is the way of action between the above units, which can be viewed from both internal and external perspectives. Internally, it refers to the symbiotic mode between different units within the industrial remains system, and externally, it is mainly manifested in the coordination of the overall style.

3.4.2 Step 2: Determine the design objectives

The establishment of symbiotic goals should be based on the evaluation results of symbiotic factors. The goals should retain and continue the positive factors of the evaluation results, and put forward intervention measures for the negative factors. For the protection and renewal of the old industrial zone, the outstanding value and overall positioning of the area should be determined on the basis of investigation and evaluation, combined with the superior planning and urban design guidelines. Essen, a city in the Ruhr region of Germany, is one of the birthplaces of the European Industrial revolution and has a long history of coal and steel industries. Its industrial remains not only witness the transformation of the Ruhr district from an industrial powerhouse to a modern cultural and economic center, but also become an important resource for regional renewal. In the renewal project of the "Customs Union Coal Industrial Zone" in Essen, by preserving and transforming industrial buildings into museums, art Spaces and cultural and creative parks, the historical value of the industrial remains is preserved and new economic vitality is injected into the city. To this end, when formulating the renewal plan, the city of Essen emphasized the strategy of "integration of industrial heritage and modern functions", and established the theme of urban

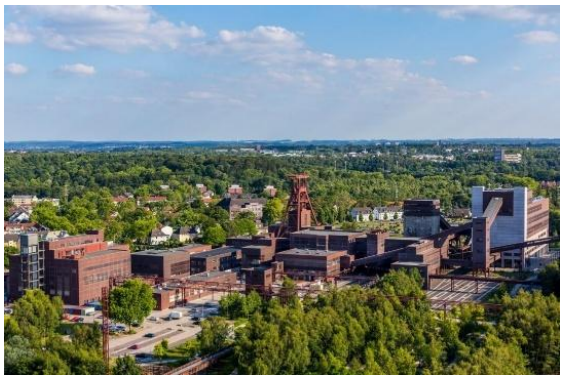


Figure 3- 37 Zollverein Coal Mine Industrial Complex, Essen
Source: https://visitworldheritage.com

development with industrial culture as the core. Since then, the relevant planning and construction have been carried out around this theme, successfully shaping the image of Essen as a model of industrial heritage renewal.

3.4.3 Step 3: Develop symbiotic design strategies

3.4.3.1 Design strategies of "Industrial remains and urban symbiosis"

(1) Open and inclusive urban interface

To promote the opening and integration of industrial remains and urban interface, a comprehensive design should be made according to the spatial environment, architectural status, street interface and other characteristics of the industrial area. Properly opening the closed interface of the industrial area will help promote the overall open layout of urban space, improve the accessibility and utilization rate of the area, and realize the mutualism between the city and industrial remains.

The boundary is the embodiment of the adjacent interface between the urban space and the industrial remains. By softening and eliminating the field boundary, the sense of separation between the city and the region can be effectively weakened and the purpose of integration can be achieved. Taking Guangzhou Shude Creative Park as an example, the use of continuous hollow-out brick walls as the "virtual" border can not only form a certain sense of order, but also increase the visibility of the park, avoiding the sense of closure of the park. Another example is the transformation of the original linear wall of Yichang Yunji Park, which softens the boundary form by implanting scattered landscape modules, breaking the original rigid

（a）Shude Creative Park （b）Yichang Yunji Park(before) （c）Yichang Yunji Park(after)

Figure 3- 38 Open Urban Interface - Cases

Source: https://www.gooood.cn/

straight boundary, sharing more space with the city, creating a flexible boundary of relatives, and achieving urban integration.

(2) Create a shared activity space for the public

The core of the transformation of the old industrial zone is to serve people, that is, to provide humanized space and facilities for people's activities and needs, and to transform the original cold industrial structure into a friendly and interesting activity space.

For example, the entire wall of the huge ore bunker was transformed into a rock climbing park. The design cleverly uses the grooves and scratches accumulated over time on the concrete wall of the bunker as a natural anchor point for rock climbers. At the same time, the different slopes of the concrete wall itself also provide rich experience for rock climbers. In addition, the silos for storing ore and coal have been transformed into "silo gardens" according to local conditions, and are also endowed with the theme of material recycling. The old pollutants are cleaned up and covered with new soil and different types of vegetation, forming a roof garden of different shapes.

The public space design of Duisburg Park provides citizens with a rich space experience and fun, which not only attracts many young people to visit, but also is favored by many film directors as a location for film and television works.

Figure 3- 39 Landschaftspark Duisburg-Nord Spatial Experience
Source: https://mooool.com

(3) Integrate into the urban slow traffic system

As an important component of urban transportation system, the slow traffic system mainly refers to the road network dominated by slow traffic modes such as walking and cycling. The organic integration of the boundary space of industrial remains and the urban slow walking system can effectively guide the slow walkers to enter the interior of the remains and extend the stay time. At the same time, through the connection of internal transportation system and urban public network, the continuity of urban space is enhanced, and the open sharing of urban interface is promoted.

Taking Rubber Factory Park in Shanghai as an example, its design fully considers the needs of citizens' activities and fully opens the front space to the urban slow lane. This treatment allows urban residents to freely walk through it, becoming a high-quality place for daily leisure and social interaction, and successfully transforming the originally closed industrial space into an open plaza of urban vitality.

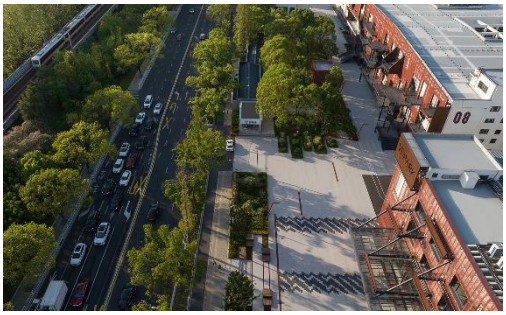


Figure 3- 40 Rubber Factory Park - Boundary space
Source: https://www.gooood.cn/

(4) Shaping ecological urban landscape

Under the concept of symbiosis, the construction of natural ecological urban landscape is to combine industrial remains, urban space and natural landscape to make the three become a new whole, achieve a new symbiosis balance state, and create a sustainable ecological environment and a good space atmosphere for the public.

The transformation project of DORA Park in Italy is a model of the post-industrial landscape reconstruction of the urban waterfront. The designer introduced the concept of "information layer" in the landscape design part, divided the original messy site vertically, and obtained four spatial levels of water treatment system, public activity area, elevated pedestrian area and road preparation system. The water treatment system effectively collects rainwater through open ditches, natural rivers and sloping roofs. Rooftop solar panels power the pumps, while the original power plant has been converted into a visitable water treatment facility, forming a complete rainwater collection and purification system that serves the entire campus.

The aquatic plants in the ditch not only strengthen the ecological function, but also become a unique ecological landscape in the park.

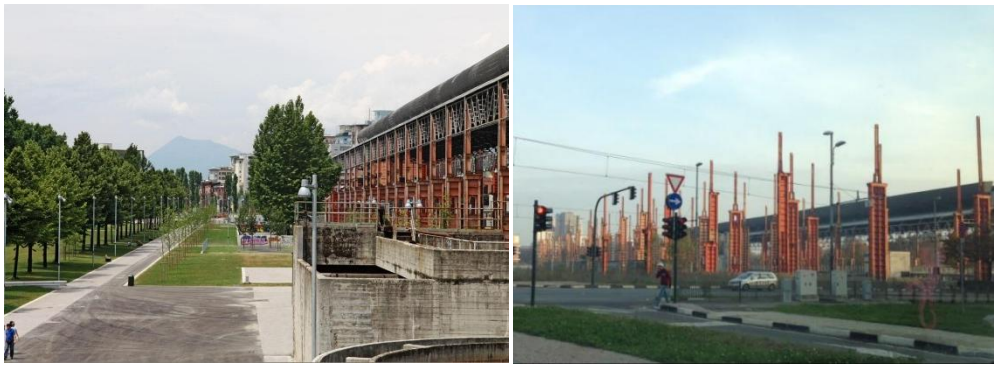


Figure 3- 41Dora Park Landscape, Italy
Source: Author

3.4.3.2 Design strategies of "Industrial heritage and cultural symbiosis"

(1) Reconstruction of industrial culture characteristics

The inheritance of industrial culture mainly refers to the continuation and regeneration of its cultural value, including material culture elements and non-material culture elements.

Figure 3- 42 Yangpu Riverside Industrial Heritage Adaptive Reuse
Source: https://www.gooood.cn/

Material culture elements refer to the material left over with industrial characteristics in industrial remains, including industrial buildings, structures, industrial equipment, means of transport and other material components closely related to industrial production activities. Yangpu Riverside in Shanghai has a hundred years of industrial culture history, and a large number of industrial structures are retained along the river. Urban renewal aims to preserve this industrial area with profound cultural heritage, and through the reuse of retained industrial symbols and structures, give the riverside industrial area a new vitality of the integration of history and future. For example, a large number of pipes left over from the old factory are used

as waste into protective railings and street lamp bodies in the water-facing space; For example, the original dock bolting pile has been retained to become a landscape sketch with a very industrial atmosphere in the square. The clever use of these industrial remains not only saves the renovation cost, but also preserves the characteristics of industrial culture, from the "walk-out" of history to the "participant" of the future city.

Non-material culture elements mainly include intangible industrial skills, industrial spirit, industrial history, corporate culture and other contents. Compared with material elements, non-material industrial relics and memories have no physical expression, but they reflect the production concepts, customs, artistic success and other contents worth inheriting in the industrial era. Chengdu Shuijing Street Wine House carries a profound intangible cultural heritage. Its wine-making history can be traced back to Jinjiang Spring in the Song Dynasty, through "Fusheng Quan" and "Quanxing Cheng" in the Ming and Qing dynasties, to Chengdu Winery and Quanxing Winery in the 1950s and 1960s, and until today's Shuijing Fang brand, which has continued for more than 600 years. This long brewing tradition not only preserves the ancient brewing technology, but also embodies the wisdom of successive generations of brewers, and its unique tasting culture can be called a living witness of the history of Chinese liquor development.

Figure 3- 43 Intangible Cultural Heritage: Brewing Scenes
Source: Internet

The inheritance of industrial culture is the key to seek the balance between tradition and modernity in the process of the reuse of historical relics. In the industrial culture system, whether it is material carrier or non-material connotation, it is an important component of cultural inheritance and expression. Therefore, to realize the sustainable development of industrial culture, it is necessary to dig deeply into various cultural elements in the remains,

focus on protecting and inheriting their characteristics and connotations, so as to achieve the harmonious symbiosis of industrial culture.

(2) Technology restores historical scenes

In the context of the new era of scientific and technological development, the use of digital and other technological means to enable the renewal of industrial remains conducive to breaking the homogenization competition, enriching the transmission channels of industrial culture, and improving the public's cognition and understanding of the heritage culture and its connotation. At present, there have been successful cases at home and abroad using advanced digital technologies such as VR, AR, virtual reality, digital twins, etc., to revitalize industrial remains. Taking SteelStacks Art and Culture Park in the United States as an example, after the renovation of the park, 24 intelligent interactive points are set up on its designed tour routes, that is, interactive digital Tours, including historical databases of old steel mills, historical photos, voice-guided interactive programs, etc., so that vivid industrial history and memory are all over the park; Another example is Beijing Shijingshan Park, which adopts the dual mode of industrial digitalization + scene digitalization to carry out science fiction universe stage performances through AR and VR technology and holographic projection, and continue the "Shougang spirit" in the form of digital innovation.

Figure 3- 44 SteelStacks Arts Campus(left) Shougang Park Digital Guide(right)
Source: Internet

3.4.3.3 Design strategies of " industrial remains and environment symbiosis "

(1) The internal space of functional compound

The transformation of the internal space of industrial buildings often involves the transformation of spatial form and function. In terms of function, the original single production

function needs to be transformed into a new function that adapts to the needs of urban development, and the spatial form needs to be transformed into a new spatial form that adapts to the function on the basis of the original morphological characteristics.

The Eataly project in Turin, Italy, formerly a vermouth distillery, has been transformed into a multi-functional experiential dining complex that includes dining, retail, cooking school, museum and more. The success of the project was due to the establishment of the spatial model in the pre-architectural planning, which abandoned the organization of the traditional flat floor space of the store, but created a multi-theme experiential brand retail space. The two courtyards are connected through a main street, and the glass ceiling is added to connect the different functions of the two sides. The main street connects "islands" of food and beverage themed with different food ingredients to form a characteristic market space, and the retained winery equipment provides a rich spatial experience[13].

Figure 3- 45 Eataly Plan
Source: Author redrawing

Figure 3-46 Eataly Interior Site Photos
Source: Author

(2) Harmonious and natural external environment

The spatial planning in the industrialization period only focused on production efficiency and practical functions, resulting in environmental aesthetics and human experience being seriously neglected. This single value orientation not only causes the simplification of the external spatial form, but also makes the environmental quality of the industrial zone generally low due to the excessive consumption of resources and pollution emission in the production process. In view of this situation, improving the quality of external space has become an important issue for the regeneration of industrial heritage. A good external space environment can not only improve the visual experience, but also promote the physical and mental health of users. The following will summarize the corresponding design points from two parts: the new and old space environment and the landscape plaza environment.

① Old and New Space

There are two ways to realize the symbiosis of the old and the new in industrial zone, one is the contrast of the facade materials, and the other is the integration of the old and the new.

The first is the contrast of the old and new facade materials. Due to the inevitable addition of new buildings and facade textures in the process of renovation, the facade materials and textures represent the technological development of the current era, and the visual impact formed by the contrast with the old materials just forms a unique aesthetic feeling. For example, the facade renovation of the Shenyao Art Center uses the exposed concrete structure as the front of the renovated hotel, which contrasts with the new FRP grille curtain wall next to it, increasing the facade richness of the external environment.

The second is the integration of the old and the new, which uses modern materials to interpret the past, so that the newly implanted functional facilities can echo the original industrial atmosphere of the site. Taking the 1862 shipyard renovation as an example, the design team used black brick to create a rhythmic, wrinkled facade texture, which not only maintains a harmonious relationship with traditional architecture, but also displays an innovative cultural expression through modern construction techniques.

② Landscape Plaza

A good external plaza space plays a vital role in the renewal of industrial remains, and a dynamic balance between human, architecture and natural environment can be established by constructing a systematic landscape plaza space. The detailed design of the plaza space helps to create a spatial experience that combines historical memory with environmental comfort. For example, the International Cultural and creative Town in Xixian New Area realizes the design of multiple Spaces through the topographical changes of the external environment and the arrangement of landscape facilities, and creates multi-level landscapes such as the central sunken square, water sculpture, lawn and runway in the external plaza space, thus effectively improving the quality of the external environment and stimulating the vitality of the park population.

(a)Façade Comparison-Shen Kiln (b)Façade-1862 Shipyard (c)Sunken Plaza-Xixian New Area
Figure 3- 47 Harmonious Natural External Environments - Cases
Source: https://www.gooood.cn/

(3) Shared Transition Space

Transitional space, as a medium connecting adjacent Spaces or interface Spaces, has the characteristics of transition and ambiguity. It can be located outdoors, or integrated indoors, or even presented as gray space. Its integrated function is to connect the building, the city, the environment, and the interior and exterior Spaces.

In Kurokawa's design, corridors, cloisters, grids, eaves and other gray Spaces are represented, which are cleverly integrated into the overall design of external space (courtyard) and internal space. For example, the Nagoya City Museum of Art (Figure 3-48), through the clever connection of the sunken courtyard and the atrium space, shows the design of the natural transition of the interior and exterior space. The use of glass curtain wall not only strengthens

the connection between indoor and outdoor space, but also brings unique space experience to visitors.

Figure 3- 48 Nagoya City Art Museum Sunken Courtyard
Source: official website

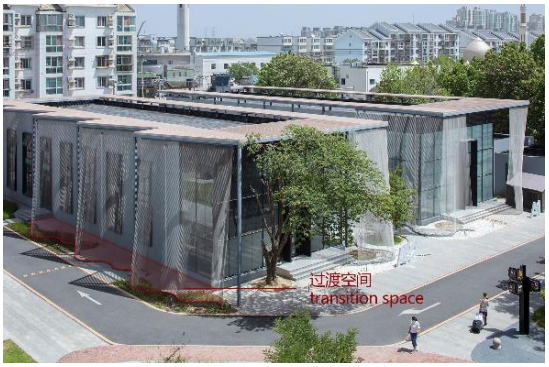


Figure 3- 49 Beijing Fashion Factory Transitional Space
Source: Author redrawing

The Beijing Fashion-Factory has been transformed into a modern creative industry park through an innovative renovation of a former textile factory building. The design team cleverly used textile process elements to translate traditional techniques such as draping, splicing and weaving into the architectural language to achieve space separation and connection. The facade of the building uses a special steel fabric curtain system, like a light valance around the main body of the building, which not only effectively regulates the indoor light intensity, but also ensures the privacy of the use of space. These transparent metal curtains are streamlined and dynamic, creating a layered transitional gray space between the building interface and the public areas. The creative collision of industrial grade stainless steel material and the soft texture of fabric not only gives the building a unique artistic temperament, but also dispels the square volume of the original building in a harmonious way, covering it with a poetic hazy coat.

3.4.3.4 Design strategies of " Industrial architectural symbiosis "

(1) Integration of old and new buildings

① Spatial merging

Spatial merging is to reorganize independent or weakly connected Spaces into an organic whole by establishing physical connections. This transformation method usually adopts the removal of partition walls to achieve spatial connectivity, or the addition of traffic elements such as corridors and stairs to build spatial connections, thereby enhancing the flexibility and

continuity of space use. In the practice of industrial building renovation, this method is especially suitable for dealing with multi-storey standardized small space, which is mostly composed of original production auxiliary area or living auxiliary room. Taking the transformation of the grain warehouse of Dapeng City in Shenzhen as an example, the design team not only reconstructed the internal space sequence to meet the functional needs of the exhibition by selectively removing part of the wall, but also optimized the visiting experience through streamline reorganization, so that the originally scattered display units formed a coherent narrative chain.

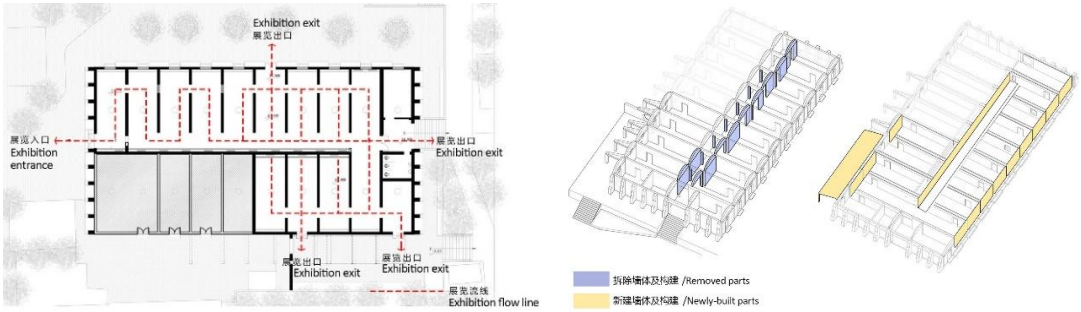


Figure 3- 50 Granary Exhibition Circulation(left) Space merging (right)
Source: Author redrawing

② Spatial separation

Spatial separation refers to the introduction of vertical or horizontal separation interfaces to achieve functional diversification while maintaining the basic form of the original space. This transformation method usually uses light partition walls, floors and other dividing media to redivide a single space into a composite functional area, thus significantly improving the use of space efficiency. In the implementation process, due to the redistribution of functional loads, auxiliary support structures often need to be added. At this time, special attention should be paid to the mechanical coordination and formal unity of the old and new structural systems to ensure the integrity and aesthetic coherence of the overall structure.

Taking the reconstruction of LocHal Library in Netherlands as an example, the project cleverly retains the original sense of grand scale of the industrial plant in the spatial reconstruction, and realizes functional transformation through multi-dimensional space

division strategy: In the horizontal dimension, the use area is expanded by adding mezzanine to meet the diversified functional needs of the community library; In the vertical dimension, the adjustable translucent screen system not only optimizes the efficiency of natural lighting, but also realizes the dynamic conversion of private and open modes. This innovative spatial separation method not only strengthens the visual connection between different functional areas, but also creates a rich spatial penetration effect, and finally successfully transforms the traditional industrial space into a modern cultural place full of social vitality.

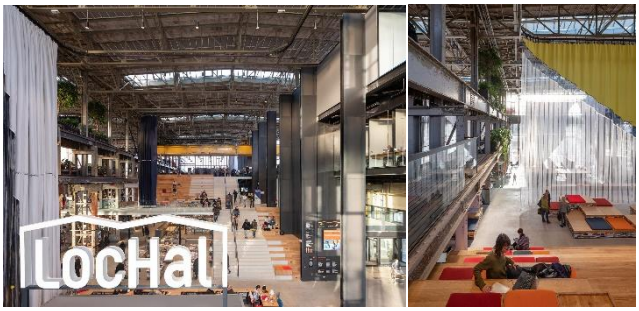


Figure 3- 51 Space separation- LocHal Library
Source: https://www.gooood.cn/

③ Spatial implantation

Spatial implantation is an innovative architectural transformation strategy. By embedding independent functional volumes in the existing large-scale space, a composite form of "box in box" is formed. This design method has a double advantage: it can not only preserve the integrity of the original building structure to the maximum extent, but also create a rich place experience through the reconstruction of spatial levels. The implanted new space volume often has distinct styling features and strong visual expression, and is usually set in the core location of the building as a spatial focus, especially suitable for the transformation of single-storey industrial plants with ample floors and open space. Taking Yue Art Museum as an example, while the original space structure remains unchanged, several "suspended boxes" are implanted to solve the commercial functional requirements, insert the commercial space into the air, and use the

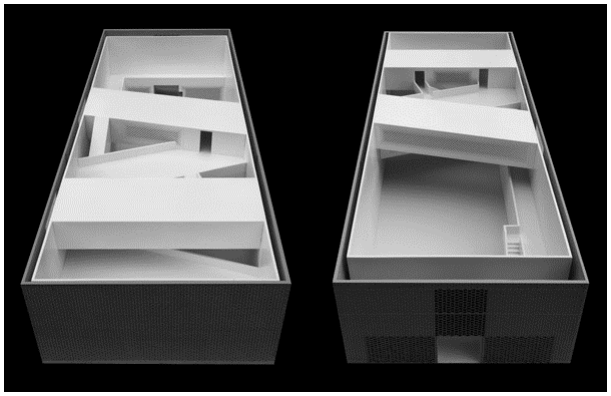


Figure 3- 52 Space implantation -Yue Art Gallery
Source: https://www.gooood.cn/

large space on the ground floor as an exhibition to ensure the spatial quality of the exhibition space. The height of the placed air box is staggered, forming three elevations in the building, so that the single large space is stratified in the vertical direction, and then enrich the line of sight relationship of the crowd.

(2) Reconstruction of the structure

The structural design strategy of old industrial buildings is an important link to realize the symbiosis of buildings themselves. Generally speaking, the structural transformation strategy of old industrial buildings can be summarized into three categories: structural preservation, structural reinforcement and structural demolition and reconstruction. When the load-bearing system of the old building structure is relatively well preserved and can be used as the load-bearing system of the reconstructed building after evaluation, the first structural preservation method is recommended. If the old structural system cannot bear weight independently due to new space or reconstruction requirements, it can be strengthened or adjusted. For example, Dongmao Warehouse in Shenyang, as a historical storage building assisted by the Soviet Union in the early days of the founding of the People's Republic of China, its most distinctive wooden roof truss system constitutes a unique spatial rhythm with a regular and simple form. However, with the update of the building code, the original wooden structure has been unable to meet the needs of modern use in terms of fire performance and bearing capacity. The renovation design innovatively adopts the strategy of "structural replacement" : on the premise of retaining the overall visual continuity, the wooden frame is replaced by the steel structure at intervals, which not only relives the mechanical burden of the original wooden structure, but also completely retains the unique spatial aesthetic characteristics of industrial buildings, and realizes the organic unity of functional activation and visual continuation of the historical structure.

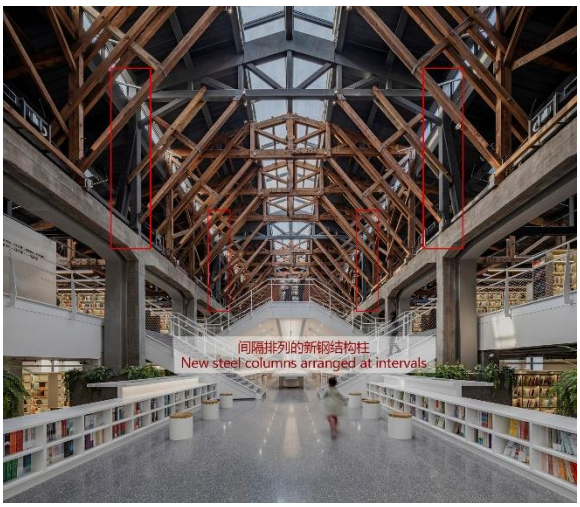


Figure 3- 53 Shenyang Dongmao Warehouse Structural Replacement
Source: Author redrawing

3.5 Summary

Based on the symbiosis theory, this chapter selects four typical cases (Turin OGR Factory, Shanghai Yangpu riverside public space renewal, Shenzhen Kingway Brewery, Guangzhou B.I.G Haizhu Bay Creative Zone) for analysis, and extracts the core connotation of industrial remains renewal co-existence: including cultural gene continuation, functional composite innovation, historical scene activation and spatial technology collaboration. Then, the study further clarified four core needs of industrial remains symbiosis design, and refined four basic principles of industrial remains symbiosis design: the integrity principle emphasizes system coordination, the dynamic principle focuses on sustainable evolution, the co-prosperity principle focuses on the balance of multiple subjects, and the humanistic principle focuses on user needs.

Based on above research and combined with the three elements of symbiotic system (unit, environment and model) proposed in Chapter 2, this chapter finally builds a systematic design path of symbiotic renewal of industrial remains. This path first identifies key problems through the analysis of the current symbiotic system, then sets specific design goals, and finally formulates specific strategies from four dimensions: In the urban dimension, strengthen the connection between industrial remains and urban fabric through an open and inclusive interface; In the cultural dimension, emphasis is placed on the reconstruction of industrial characteristics to realize the dialogue between history and modernity. In the environmental dimension, the use of complex and diverse space design to improve ecological and functional benefits; In the architectural dimension, the balance between protection and innovation is achieved through the integration of new and old technical means.

Through the combination of theoretical discussion and empirical analysis, this chapter establishes a complete design path system for the symbiotic renewal of industrial remains, which provides systematic theoretical support and methodological guidance for the subsequent design practice.

Chapter 4 Survey On the " Symbiosis System" of Current Zhujiang Brewery

4.1 Location

Zhujiang Brewery was founded in 1985 in the golden period of Guangzhou's new industrial development, which is a major milestone in the development of China's beer industry after the reform and opening up. After the relocation of Baihedong Base of Guangzhou Iron and Steel Group, the old site of Zhujiang Brewery has become a bright spot in the transformation of old industries in Guangzhou: not only retains rich industrial relics, but also maintains complete beer production process and technology. The existing buildings and production equipment in the factory witness to the vigorous development of Guangzhou's light industry, and also show the historical track of technological progress and industrial upgrading, carrying profound social emotional value, precious scientific and technological value, unique artistic aesthetic value and huge economic reuse value.

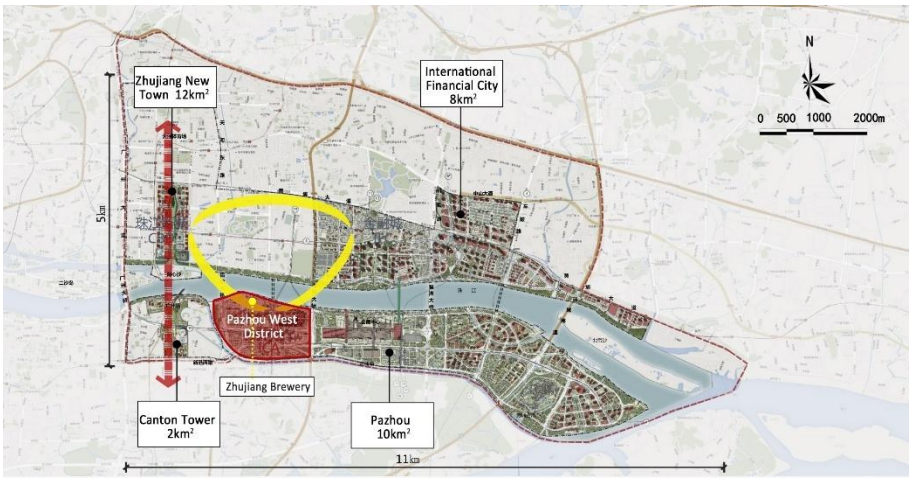


Figure 4- 1 Zhujiang Brewery Location
Source: Author

The site is located at 118 Modisha Street, Xingang East Road, Haizhu District, Guangzhou, occupying a superior geographical position on the south bank of the west of Pazhou. This area is located in the center of the "Golden Triangle Area" in the spatial development structure of Guangzhou, that is, the intersection of Zhujiang New City, International Financial City and

Pazhou Area. It is close to the CBD of Zhujiang New City and the new central axis of the city in the northwest, across the river from the International Financial City in the northeast, facing Haixinsha in the south, and adjacent to the Asian Consulate Area and Pazhou International Convention and Exhibition Center. As an important part of the fintech innovation cluster of Guangzhou headquarters, Pazhou West District gradually highlights its positioning as an Internet innovation cluster with the continuous settlement of Internet headquarters enterprises.

The industrial remains area of Zhujiang Brewery covers a total area of 24.29 hectares, of which 3.6 hectares of the riverside area has been created as a creative area for PaTi's beer culture, and 6.9 hectares of the north area has been reserved by the company. The main production area, including the sewage treatment plant and the second to fourth phase of the sugar fermentation plant, has been handed over to the government for storage. To sum up, Zhujiang Pati Old Industrial Zone is not only an important part of the core area of Guangzhou, but also a model of the integration of urban industrial upgrading and cultural innovation.

4.2 Climate and Traffic

Guangzhou is located in the south of the Tropic of Cancer, belongs to the subtropical monsoon climate. Its annual average temperature is up to 22℃, with abundant rainfall and long sunshine, so the four seasons are warm and humid. Therefore, in order to adapt to this climate, buildings in Guangzhou usually need ventilation and sunshade. For example, many architectural forms such as arcade buildings are adopted, which are not only conducive to ventilation and sunshade, but also convenient for pedestrians, which is an important embodiment of Guangzhou regional culture. At the same time, greening and landscape construction are also very important, the warm and humid climate conditions are also conducive to the growth of plants and the construction of urban microclimate.

In terms of the traffic, the site is adjacent to South China Express Road to the east, Liode Bridge to the west, and the Pearl River to the north, with a close traffic network around it and high accessibility. The surrounding metro Line 8, Line 4 and tram lines along the river are convenient for public transportation. Future plans also include additional tram stops and north-

south Metro Line 18. In addition, the water transportation plan will closely connect the two sides of the Pearl River through cruise ships, promote the connectivity of tourist attractions along the river, and further enhance the comprehensive transportation advantages of the region and the attraction of tourist cities.

4.3 Previous Renewal

In 1985, Zhujiang Brewery was built and put into operation in Guangzhou. The enterprise, jointly founded by the Guangzhou Light Industry Bureau and the Guangzhou Farm Management Bureau, is the first modern brewery in China to introduce a full set of foreign advanced equipment and brewing technology after the reform and opening up. Its production of Pearl River beer soon became one of the three major beer brands in the country, put into operation only five years to set a single brand sales of the country's second achievement, "Pearl River speed" became the legend of the industry. As a representative enterprise growing up in the wave of reform and opening up, Zhujiang Brewery has witnessed the whole process of China's beer industry from inception to take-off, recording the mark of the era of China's industrial modernization.

The period from 1985 to 2008 was the industrial production period of Zhujiang Brewery, during which the Zhujiang Brewery was built and put into operation. In 2003, the Planning Review of Zhujiang New Town proposed the small-plot development model for the first time, and proposed to build Zhujiang New Town into a CBD central business district integrating finance, commerce, office, entertainment and residence. In 2004, the strategic transformation began to establish a new model of coordinated development of beer brewing and beer culture. During this period, the factory reached a strategic cooperation with the world's largest beer producer - Belgium's AB InBev Group, and jointly built the "Zhujiang InBev International Beer Museum" on the east side of the factory. This cultural landmark integrates multiple functions such as beer history display and brewing process demonstration, providing the public with an immersive experience space to deeply understand beer culture.

4.3.1 Stage 1: Pati River landscape renovation

Since 2008, Guangzhou began to implement the "back two into three" urban development strategy. Because of its industrial positioning and urban development planning is not compatible, Zhujiang Brewery began to start the relocation project. Under the premise of ensuring uninterrupted production and operation, enterprises adopt the progressive strategy of "relocation while production" and gradually move the production base from the city center. By 2015, the company will completely stop the original production and move to the Nansha new development Zone as a whole. It is worth noting that before the official relocation, in order to meet the 16th Asian Games in Guangzhou, the overall landscape renovation along the Pearl River is needed, and given its location directly opposite Haixinsha Island (the main venue for the opening ceremony), the Zhujiang Brewery became a vital point of the redesign and revitalization plan. In 2009, the project was finally undertaken by the team of Atelier cn°S. According to the interview with Prof. Zhong(Lead architect of Atelier cn°S), the renovation project of Patii has two main priorities: one is to beautify the urban landscape along the former Pearl River coal terminal, and the other is to create urban public activity space.

Figure 4- 2 Party Pier Landscaping Proposal
Source: CnS

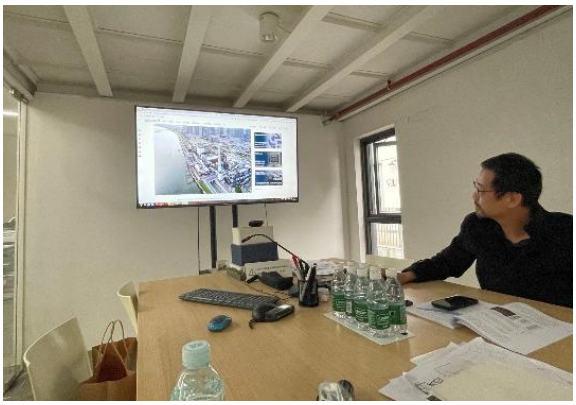


Figure 4- 3 Interview with Prof. Zhong from CnS
Source: Author

"Our design strategy is to create a landscape architecture, based on the strict height control requirements along the Pearl River, we want to use the landscape form to dissolve the building volume." Prof. Zhong said that in order to activate the vitality of waterfront public space, they payed special attention to create a plaza square with agglomeration effect in the linear shoreline of the Pearl River. The final polygonal shape system realizes three values through parametric

design logic: First, the polygonal dynamic rhythm echoes the natural rhythm of the Pearl River tide; Secondly, the polyline system effectively decomposes the building volume to meet the height limit requirements; Moreover, the resulting multi-level communication space creates a high-quality space carrier for the implantation of subsequent commercial formats. This formal language not only solves the technical constraints, but also constructs the dialogue mechanism between architecture, city and nature.

4.3.2 Stage 2: Urban-oriented renewal of Pazhou West District, 2015

According to the *Guangzhou (Pazhou) International Convention and Exhibition Center Control Detailed Plan* formulated in 2014, ZHUJIANG BEER GROUP divided the reserved land into two parts: 6.9 hectares of reserved development land in the north side, and 36 hectares of beer culture and art zone land adjacent to the Zhujiang River. The remaining 17.4 hectares of plant land is acquired and stored by the government, covering major industrial production facilities (including sewage treatment plants, saccharification and fermentation plants), utility systems, logistics areas and supporting living and office areas. The plan clearly divides the beer culture area and private land into cultural facilities, implements joint development and retains 25 industrial buildings and equipment; The land acquired by the government is planned for commercial development. Due to the limitation of development intensity and land use nature, the industrial remains of this area was not included in the scope of protection, and was finally developed in the form of new high-rise buildings.

In 2015, the *Urban Design and Control Planning Optimization of Pazhou West District* was further adjusted on the basis of the 2014 version of the plan, focusing on strengthening the dual goals of industrial heritage protection and urban quality improvement[14]. The plan systematically updated and guided the old site of Zhujiang Brewery, and determined the goal of building a compact new CBD in the west of Pazhou. In the subsequent iteration of urban design, Pazhou West District further optimized the scope of reservation, and focused on urban public space construction, regional public space quality improvement, land use layout and other aspects of the update strategy adjustment. Among them, the *Urban Design and Control regulation Optimization of Pazhou West District* focuses on specific measures such as ①

encrypted road network, ② construction of public transportation such as trams and water buses, ③ planning and construction of slow travel system, and ④ increase of public service facilities, aiming at achieving refined management to enhance regional vitality. At the same time, through the establishment of urban design control mechanism, the protection requirements of industrial old sites are refined into operational design guidelines, and throughout the whole process of plot plan review and implementation coordination.

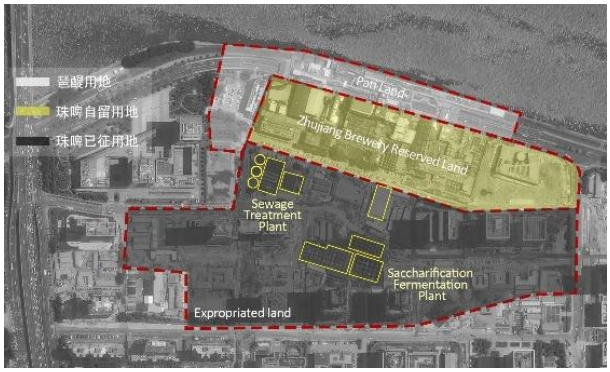


Figure 4- 4Zhujiang Brewery Parcel Division
Source: Author

Figure 4- 5 Pazhou Land Use Types
Source: Author redrawing

4.3.3 Stage 3: Renovation of Turbine Workshop

With the full migration of production functions, ZHUJIANG BEER GROUP launched the overall transformation plan of the factory, intending to build the original industrial site into a commercial-cultural project called “BREWERY”, reshaping the new business card of Guangzhou urban culture. Facing the complex industrial remains in the park, the renovation project needs to be systematically sorted out and refined. In 2018, CNS took the lead in updating the most complex building, the former steam turbine room and its adjacent equipment to make into the office building for ZHUJIANG BEER GROUP.

Due to the particularity of the location, the turbine room will be used as headquarters office in the short term, and may be transformed into rental office, shared office or cultural and creative commercial complex in the long term, and even develop into a mixture of various business forms. Based on this uncertainty, the design does not limit the problem to a single architectural design level, but focuses on three key dimensions (site streamline organization, spatial experience construction and visual interface continuity), and finally forms a "hybrid"

scheme with blurred functional boundaries and rich spatial connotations: The design systematically integrates the elements of the site, organically connects the riverside walkway, bar street leisure area and the transformed mechanical platform, forming a three-dimensional public space system extending to the city. Through the horizontal landscape penetration and vertical platform overlapping, the activity space of the riverside has been expanded in multiple dimensions, especially the retreating design that echoes the landscape of the Pearl River, greatly enriching the fun of walking experience. The office area is connected to the public space by an independent channel to ensure accessibility and non-interference.

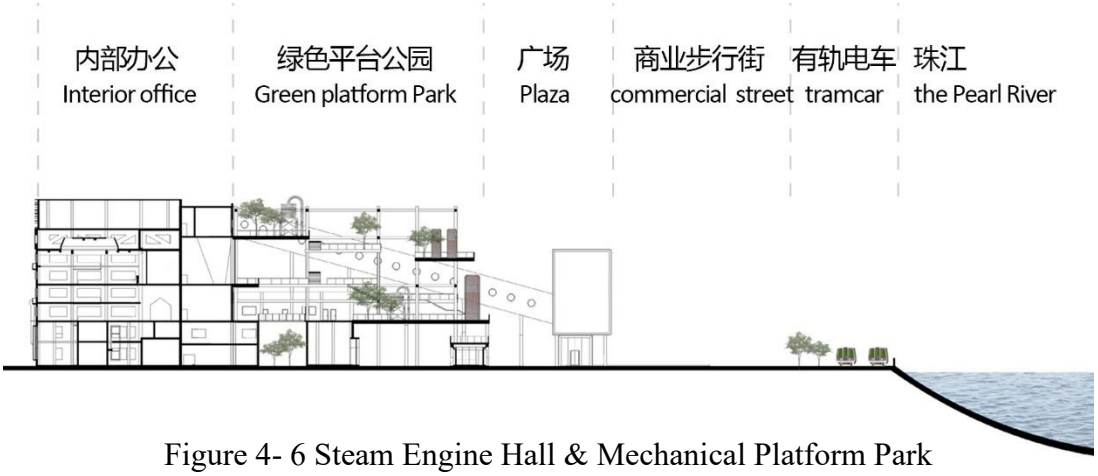


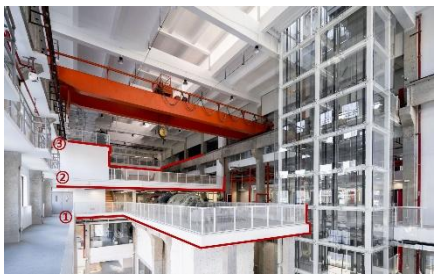
Figure 4- 6 Steam Engine Hall & Mechanical Platform Park
Source: Author redrawing

The turbine factory was originally a building dealing with coal, steam, and electricity, The scale is magnificent but dark and suppressed in a very unfriendly way. The core challenges faced by the design team were: How to transform it into a comfortable, modern office space while retaining its industrial character? After lots of work on site investigating and evaluation, CNS formulated a utilization plan for each building element, including machine components. Methods such as in-situ preservation, relocation, selective demolition, and reconstruction allow these elements to seamlessly integrate into a modern office and lifestyle setting.

"We are trying to find the most particular industrial memory, and write it into the regenerative genes of Zhujiang Brewery, so that it can be expressed quietly in the revitalization, people can step into this space Intertwined the new and old with a story to be heard. " said Zhong.

In terms of internal space utilization, the design team strategically implanted a mezzanine inside the existing space, which happened to form a " Triple-tiered Setback " spatial effect with the original air platform. At the same time, a number of open communication plazas are planned. This spatial reconstruction strategy not only breaks through the inherent mode of closed office cubicles in traditional state-owned enterprises, but also promotes the improvement of organizational communication efficiency by creating informal communication places.

In terms of the facade design, CNS chose to retain the order arrangement of the original concrete trusses and window holes, following the principle of "restoring the old as the old" to maximize the retention of industrial memory. At the same time, the use of large areas of modern glass Windows forms a sharp contrast between the old and the new, which reflects the modern simple style and continues the characteristics of industrial culture.



（a）Tiered Interior Spaces （b）Open Communication Space （c）Façade

Figure 4- 7 Steam Engine Hall

Source:（a）Author redrawing;（b）（c）https://www.gooood.cn/

4.3.4 Stage 4: Office high-rise project of ZHUJIANG BEER GROUP

With the deepening of urban renewal in Pazhou West District, the reconstruction of the old site of Zhujiang Brewery has entered the core development stage. According to the planning requirements of Urban Design and Control Regulation Optimization of Pazhou West District in 2015, the land should be built into an urban complex integrating headquarters office, hotel, business and leisure on the basis of preserving the industrial heritage, so as to fit the functional positioning of Pazhou Digital Economy Pilot Zone.

4.3.4.1 Competition concept scheme first (2021)

In 2021, ZHUJIANG BEER GROUP officially launched the international design competition for Zhujiang Beer Office high-rise and Hotel Complex, aiming to realize the

organic integration of industrial memory and modern business functions through high-level architectural design. According to the announcement, the renovation and upgrading of Zhujiang Beer office high-rise and hotel commercial complex project is located in the west of the park, and the construction content mainly includes three parts: ① The new part covers Zhujiang Beer headquarters building, serviced apartment building, beer culture center, beer creative center, underground parking lot in the west and the air corridor system connecting the buildings; The new part includes Zhujiang Beer Headquarters building, serviced apartment building, beer Culture Center, beer creative center, West District underground parking lot and air corridor system connecting each building; ② The renovation part involves the renewal and utilization of reserved buildings such as coal shed, malt silo, and selected buildings, as well as the protective transformation of characteristic industrial structures such as fermenters; ③ Additional projects include site greening, road square, outdoor pipe network system, water and electricity access, pipeline transformation and wall signs and other ancillary facilities.

In the end, Australia's IAPA design company won the scheme among the bidding of a number of international firms. The plan innovatively proposes a dual-track development model of "activation of industrial relics + empowerment of digital economy", and is committed to creating a new territory of fashionable urban life integrating office, hotel, retail, catering, cultural and creative functions.

In order to have a deeper understanding of the overall picture and details of the project, the author invited Mr. Yu Ding, the host architect of IAPA, to conduct an interview on the competition scheme, and summarized the design wisdom and highlights of the whole scheme as follows:

(1) Spatial translation of beer culture - circle-museum roaming

Different from the traditional commercial complex development, the project adheres to the concept of "culture first", and proposes the concept of " circle-museum roaming " on the basis of retaining iconic industrial buildings such as steam engine room, boiler workshop and packaging workshop: the brewing process is placed in the theme space, its function is reshaping and redefining, and the theme commercial function space related to brewing culture is derived.

The design also shows the brewing process with a traceable tour sequence, which allows an immersive experience of the process from the finished wine back to the wheat field.

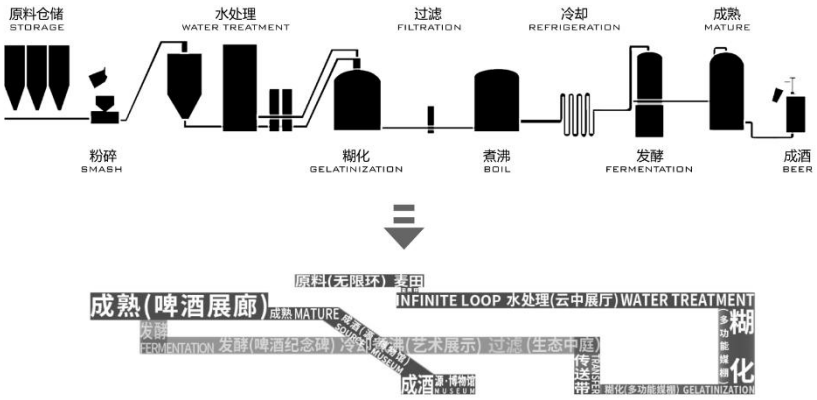
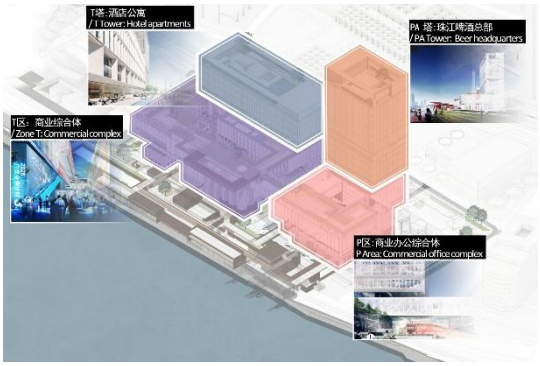


Figure 4- 8 Spatial Translation of Beer Culture
Source: IAPA



（a）Hotel&Office Twin Tower （b）PaTi Functional Zoning
Figure 4- 9 Hotel-Office High-Rise Design Proposal
Source:（a）IAPA（b）Author redrawing

(2) New in the old - hotel office high-rises

The design remodeled the facade and interior space of the original building, inserting two towers and a number of new functional blocks to enhance the vertical connection between the old and new buildings. In addition, it innovatively extracts the bilingual logo word "PaTi" and divides the south plot into east and west sections: the west "Pa Tower" is positioned as the headquarters office building of ZHUJIANG BEER GROUP, and the roof is set up with a sky garden for enterprises to hold various outdoor activities. The junction between the tower and the podium is the structural transformation and refuge floor to optimize its space experience with green plants, and the podium is the theme business; The East "Ti Tower" is a commercial complex of the hotel, and the roof garden is combined with the infinity pool and the sky bar to

create a special activity place for the hotel. The east and west are divided into Mobi Ring (beer cultural center) and Whoops ring (beer creative center), which are metaphors of the space philosophy of Mobius Ring. The two are cleverly connected through the landscape corridor system to build an independent and unified creative cultural display settlement.

(3) City landmark - Pearl River Museum Cluster

In order to enhance the urban image of the core area, improve the urban function and reshape the urban memory of the Pearl River coast, the design not only activates the internal site of the park, improves the public participation and commercial walking experience of the site, but also places the entire Pearl River Creative Park in the scope of urban renewal, and builds a pan-Pearl River industrial culture tour line with Pearl River Beer as one of the plazas. By creating a 360-degree urban commercial continuous interface, the multi-level landscape vision along the river is created, and a linkage of commercial, residential and office urban activity space is formed with the Zhujiang New Town to establish a new urban display surface along the river.

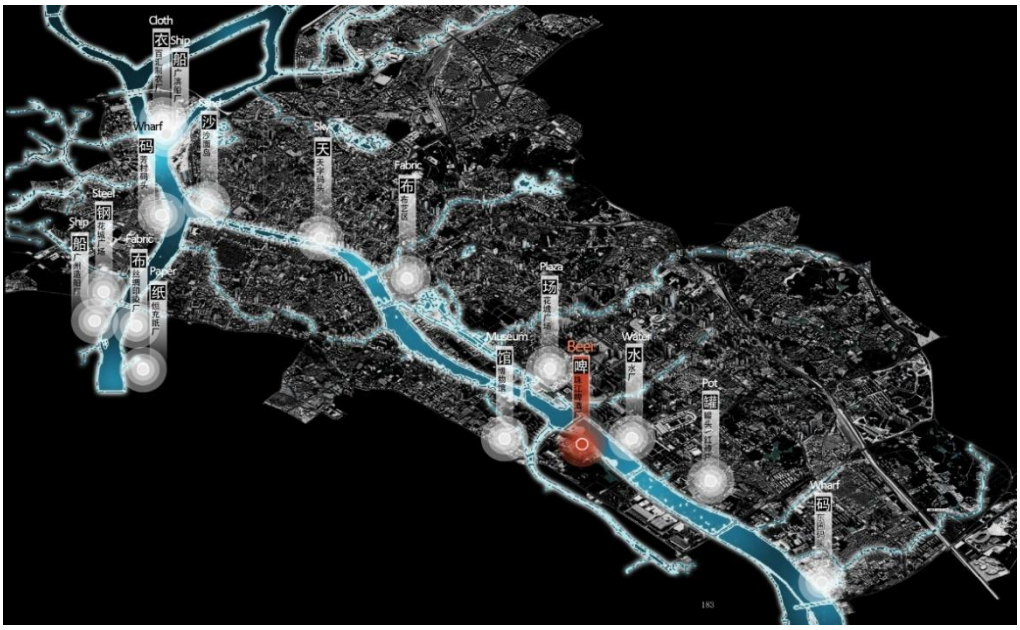


Figure 4- 10 Pearl River Museum Cluster
Source: Author redrawing

4.3.4.2 High-rise Office Construction phase (2024)

In March 2024, the Guangzhou Municipal Regulation Bureau announced on its official website the post-approval document of the renovation and upgrading project of Pearl River · Pa

Tii Beer Cultural and Creative Park, and determined that the beer headquarters office high-rise in the competition plan is about to be constructed and implemented. The construction unit is still ZHUJIANG BEER GROUP. The project construction scale is one high-rise, including 23 floors above ground and 4 floors underground, with a total building capacity of about 45,370 square meters. However, due to various practical reasons, other industrial remains in the plot and another hotel high-rise planned in the competition scheme cannot be continued according to the original scheme.

Therefore, the subsequent update strategy and design scheme for Zhujiang Brewery will be based on the latest control regulation requirements of the 2015 "Urban Design and Control Regulation Optimization of Pazhou West District", combined with the headquarters office high-rise planning scheme determined in 2024, and on this basis, the "symbiotic" renewal scheme of the factory will be designed.

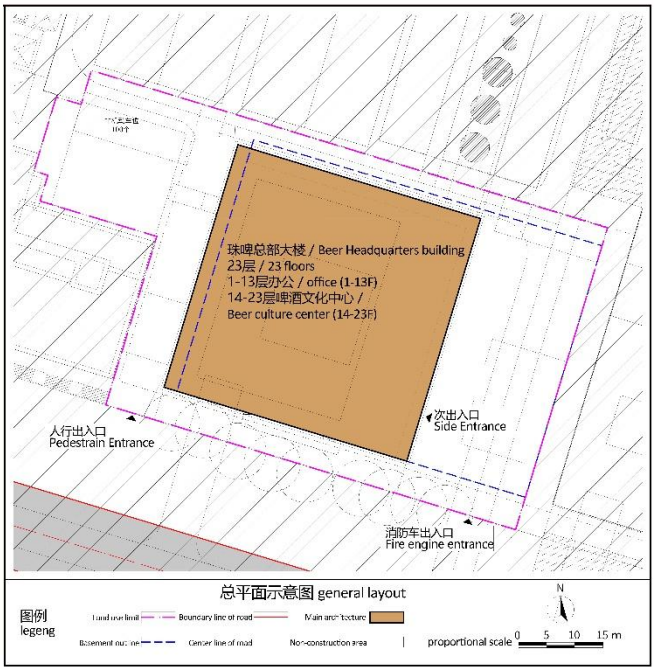


Figure 4- 11 High-rise Office General Layout
Source: Author redrawing

4.4 Site survey of Zhujiang Brewery "Symbiosis system"

4.4.1 Assessment of "symbiotic units "

The core task of urban industrial heritage renewal is to promote the protection and development of industrial land, and the core contradiction is the contradiction between the protection of industrial remains and urban development. Based on the above two points, the symbiotic unit of industrial remains land can be summarized into two parts: industrial remains and modern living facilities, with the former focusing on protection and the latter on development. In the symbiotic system of Guangzhou Pati Industrial area, the symbiotic units include the remnants of Pearl River Brewery and the surrounding Internet business gathering area, landscape park, residential area, etc. The sub-unit of Zhujiang Brewery industrial remains also includes A4A5 coal shed, coal transport gallery & pump room, fermentation workshop, sorting building, malt silo, fermentor cap, water treatment room, packaging workshop, saccharation fermentation plant, sewage treatment room, coal transport gallery and other buildings and structures; Modern living facilities include business offices, commercial, municipal facilities, etc.

4.4.1.1 Industrial remains unit

Carry out site investigation on the "symbiotic unit" of Zhujiang Brewery industrial remains subsystem, delimit the scope of heritage assessment and protection, which is specifically divided into two parts: value assessment and function assessment, and summarize the results into the following table. According to the site investigation and evaluation results, the sewage treatment plant and saccharification fermentation plant in the area to be dismantled under the original control plan still have retained value in terms of industrial culture transmission, while the building body structure is complete and the internal space has the potential for transformation and utilization. Therefore, the "2015 urban design optimization text" proposed to expand the scope of industrial heritage preservation, including the sedimentation tank and aeration tank of the sewage plant, the fermenter base and pipeline of the saccharation fermentation plant, together with the A4A5 coal shed, coal transport corridor, fermentation workshop, selection building, malt silo, fermenter cap and other remains within the scope of Zhubeer private land. All industrial remains to be retained and reused as part of the project plan for the renovation of Pearl Beer.

Industrial Remains	Value Assessment	Functional Evaluation	Façade Assessment	Current Conditions	Dimensional Information	Original State
A4 A5 Coal Sheds	① Riverside industrial factory - unique façade ② Preserved trusses & cranes - industrial character ③ Coal sheds - tells historical story	A4: Multi-purpose hall A5: Music bar	Preserved trusses	Façade renovated; Sloped roof design; Well-preserved structure	A4: 60.5×24×21.1m, 2,165㎡ A5: 48.5×24m, 1,353㎡	
Coal Conveyor	①Witness to industrial production; ②Requires preservation & reuse	landscape feature	Well-preserved structure (concrete)	Paired conveyors (west square); enclosed form	3.5m wide min.clearance=7.5 m	
Malt Silo	①Key riverside landmark; ②Vital brewery remain	Shops (base) + banquet hall (top); Mid-section vacant	White-painted façade	Peeling paint + roof leaks;	L=47m, W=26m; 15 silos (3 rows of 5), 1566㎡	
Refining Building	①Riverside landmark; ②Key brewery remain	1F: Service lobby; 2-11F: Dining floors	Obsolete enclosed façade	Low space utilization; Poor riverside views; 11F	L=24m, W=10.8m, H=43m, 2,681㎡	
Fermentation Tanks & Platform	①Only preserved tanks on site; ②Distinctive industrial design; ②Core brewing process element	Currently inactive	Leaking roof + damaged walls	Low platform clearance (<2m); Poor natural lighting	L=50m, W=21.5m; platform H=4m; 1,125㎡	
Wastewater Treatment Plant	Preserved Structures: IC-AS treatment towers/pipelines; Sedimentation+aeration tanks;	Currently inactive	Reinforced concrete frame; Geometric grid+round bases	In planned brewery park	-	
Mashing & Fermentation Plant	Preserved Structures: Fermentation tank bases/pipelines	Currently inactive	Reinforced concrete frame; Geometric grid+round bases	Standalone street-side lot	-	

Figure 4- 12 Zhujiang Brewery "Symbiosis Unit" Evaluation
Source: Author

4.4.1.2 Modern facility unit

The modern facility units in Pazhou area are divided into the outside and inside of the industrial relic area according to their location. According to the function, it includes four parts: Internet innovation business, culture and commerce, leisure services, municipal facilities and public supporting facilities. For the external units of the industrial relic area, in terms of spatial form, the 2015 version of the plan unified the overall spatial form and style through the construction of the main street arcade, formed a continuous arcade system to enhance the walking comfort and landscape continuity, and made the four external east, west, north and South Pazhou streets into a commercial street integrating shopping, dining, office and entertainment.

Inside the industrial relic area, the modern facility units mainly include commercial retail and public supporting facilities, whose architectural style and facade are relatively modern. The existing external facilities such as air conditioners and pipelines damage the overall style, and the flat and slope roofs coexist, lack unified planning, and the connection with the industrial buildings lacks transition and connection, and their functions are relatively simple. The current

situation of Pati riverside is bar catering, which obstructs the public utilization of river view resources to meet the needs of maximizing commercial value, resulting in a serious shortage of public space utilization along the river, and poor visibility in the direction of the river.

The connection between the interior and exterior of modern facilities is weak and independent of each other. The investigation found that the walls erected on the south side of industrial site block the inner and outer urban life and lack of interaction with each other, which also leads to the low utilization rate of internal living facilities.

Figure 4- 13 Modern facility unit
Source: Author

4.4.2 Assessment of "symbiotic environment"

The symbiotic environment inside and outside the area is divided into two categories: social environment and physical environment. The social environment includes the local population, history, economy and social management system, etc., and the physical environment includes geographical location, climate environment, soil and water features, traffic environment and built environment.

Externally，from the perspective of social environment, the district is located in the financial technology innovation cluster of Guangzhou headquarters, and as the core of the new CBD in Guangzhou central, it carries the dual positioning of inheriting Lingnan culture and beer industry culture. In terms of physical environment, the area is about 800 meters to the west of the new Central Axis of Guangzhou, and to the north of the Pearl River Channel. The area contains many industrial relics and structures, which have certain historical and cultural value. At the same time, there is a strong correlation with the Pearl River, but it still lacks a symbiotic interface. In addition, the surrounding traffic is dense, the flow of people at night, the surrounding buildings are mainly modern style, in the subtropical monsoon climate zone, the

terrain is flat, but the second floor of the Pati bar Street along the river and the industrial heritage area traffic is more blocked.

Internally, from the perspective of social environment, the concentrated distribution of major industrial remains is an important context of urban industrial development and an important spiritual core of regional characteristic development. In terms of material environment, six public plaza Spaces in the area and the important passing streets connected to them are selected for on-site investigation. The specific contents are as follows:

(1) Survey scope and content:

The scope of this survey is shown in the red line in the figure, which is the scope of subsequent renovation design. The specific research objects are two types of plaza space (six public plaza Spaces in the area) and moving space (important passing streets connected to it). The specific contents include: transportation mode count survey, public space user activity category survey, people flow tracking survey and street floor building environment and use survey.

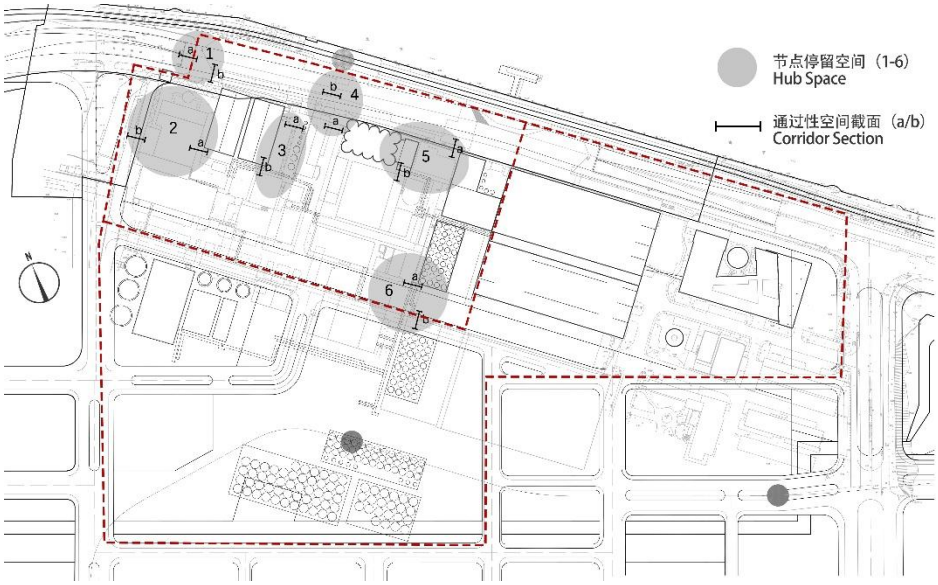


Figure 4- 14 Scope of Investigation
Source: Author

(2) Research method:

Map marking method: Directly mark and record data on the map, including the type, location, size of public space and people's activity areas and paths, so as to intuitively understand the layout of public space and people's activity patterns.

Site counting method: Site counting method is used to count the traffic situation around the site every hour, including the number of pedestrians, motor vehicle flow, and non-motor vehicle flow. Quantitative data are collected, and then the using situation of public space and people's activity types are studied.

Site investigation method: Site investigation method includes the environmental quality of the public space, the condition of facilities, the use of buildings along the street, the evaluation of the facade, people's activities and behaviors, etc., and the observation results are recorded in text for reference.

Questionnaire survey method: Questionnaire survey is carried out on the spot among the people in the park, so as to obtain the real status of the Zhujiang Brewery and the actual needs of people in the future.

(3) Researchers and time

This survey was carried out by 12 students majoring in architecture in South China University of Technology. Each group of 2 students was responsible for plots 1 to 6 respectively. In order to ensure the comprehensive and effective results of the survey, the survey time is selected for three categories of holidays, weekends and weekdays, which are: May 4, 2024, 10:00-24:00 (May Day holiday); May 12, 2024, 10:00-24:00 (Sunday); May 15, 2024, 10:00-24:00 (Wednesday).

(4) Research steps

The specific steps are broken down in one hour as a unit:

① Within 0-10 minutes, a group of 2 students stand at section a and section b of the plot they are responsible for respectively, as shown in Figure 4-14, record the number of people passing through the road on both sides of the section in this 10-minute section, and finally multiply by 6 to get the flow of people passing through the section in one hour.

② Within 10-20 minutes, a group of 2 students stood at the same section position to record the number of motor vehicles and non-motor vehicles passed in this 10 minutes, and finally multiplied by 6 to get the traffic flow through this section in one hour.

③ Within 20-30 minutes, a group of two students recorded the types of public space users in the plots they were responsible for, conducted a tracking survey of the flow of people, and described the environment and usage of the ground floor buildings facing the street with their own section as the reference point . As for the ground floor building environment, it is important to distinguish between the public use part and the private use part, such as the space for consumers in the restaurant and the backstage operation area.

④Within 30-60 minutes, sort out the obtained data, fill the collected data in the prepared template and input it into the computer to prepare for the next analysis. Wait for a new hour, stay in the same section and continue to repeat steps ①, ②, and ③

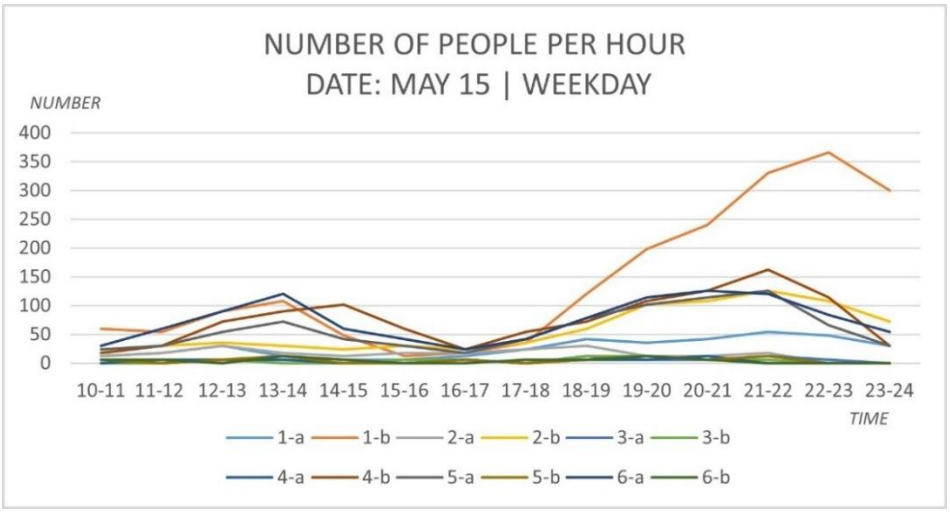
Due to the special nature of the current business in Patii, most bars and other consumption places open after 17:00 p.m., and some restaurants open after 11:00 a.m., so the time range of the survey was from 10:00 to 24:00. The traffic flow, crowd activity category, people flow direction and the use of ground-floor buildings facing the street in each hour of the day are recorded in the template, and the data can be compared horizontally and vertically.

4.4.2.1 mobile space status

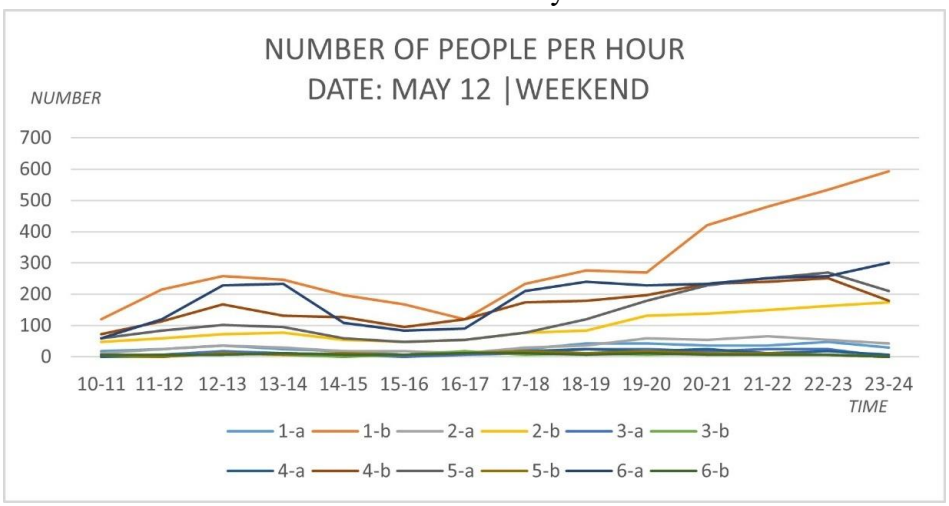
The mobile space in Zhujiang Brewery Park mainly includes five types: motor vehicle road, sidewalk, parking lot, aerial corridor and elevated space. The main type of mobile space is sidewalk, with a width of about 4-7m. The carriageway is only set in the periphery of the plant and part of the internal main road, with a width of 7m; The two centralized surface parking lots are located close to each other, respectively in the open space on the west side of Plaza 2 and the linear open space north of the wall on the south side of the area.

(1) Pedestrian flow

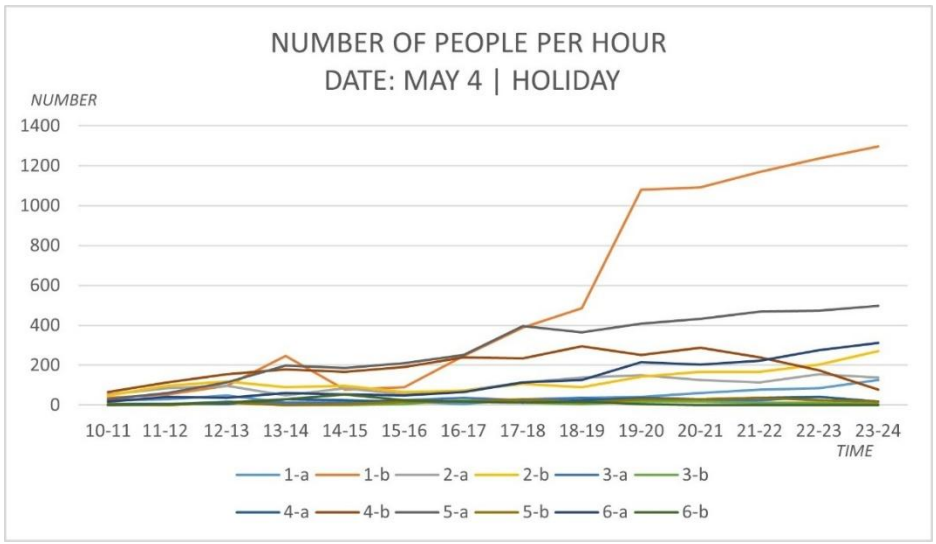
Walking is not only a basic way for people to travel daily, but also plays an important role in public space, injecting vitality into public space and promoting positive social activities. In the industrial park, walking is also the main mode of transportation, therefore, creating a harmonious and pleasant walking environment is essential to enhance the overall environment and image of the industrial heritage area, thereby promoting activities in the transformed public space.



（a）Weekday



（b）Weekend



（c）Holiday

Figure 4- 15 Hourly person flow of the plant
Source: Author

A good walking environment should first guarantee the comfortable experience of pedestrians, among which the most critical element is to avoid the occurrence of congestion. According to Professor Yang Gale's practical research on the design of public space, it can be known that if 12 people pass through a 1-meter-wide street every minute, people will feel crowded [4]. This can be compared to the pedestrian space in this case. Through site mapping, it can be seen that 1b,2a,3b and 5a are all 5m wide sidewalks, and the critical value of congestion is 60 people/minute, that is, 3600 people/hour. 3a, 5b, 6a are 4m wide sidewalks, and the congestion threshold is 48 people/minute, that is, 2880 people/hour; 4a,4b is 7m wide sidewalk, the congestion threshold is 84 people/minute, that is, 5040 people/hour. As can be seen from the following table, the maximum value of human traffic passing through the 12 sections is far less than the above critical value, so the street width does not need to be changed. However, it also reflects that the pedestrian flow in the public walking space of the factory is not large in some periods, and the sidewalks are not fully used. For example, the survey results of the three periods of week, weekend and holiday all reflect the tidal phenomenon that the pedestrian flow in the public walking space of the area at night is much higher than that in the day.

By comparing the 12 sections, it is found that the pedestrian flow of the two ends of the main pedestrian street (1b,5a) and the other two main entrances (4b,6a) located in Pati bar Street and the south side of the factory is higher than that of the main pedestrian sections (2a,3a,3b,4a,5b) inside the factory, and the pedestrian flow decreases from west to east. It is found that the reasons are related to the overall functional positioning and current environment of the factory buildings: The current factory is divided into two parts for analysis. First, Patii's beer business district on the north side of the river is currently in use, has a front-line river view, functions as a dining bar, and is the area with the largest flow of people in the entire Pearl Beer industry area; The second is the industrial relic factory cluster area in the south, with various functions, including catering, office, entertainment, retail, etc., but its popularity is relatively low. It can be seen that some of the pedestrian flow is attracted to the second-floor terrace along the river by the bar area of Pati, and due to the construction of multiple blocks in the current situation, the accessibility of the original packaging workshop and its east, including the beer

museum, is blocked, resulting in the phenomenon that the overall northwest side of the factory is higher than the southeast side. From the time dimension, it can be seen from the daily change of pedestrian flow chart that the peak of pedestrian flow begins at 19:00 in most sections and lasts until 24:00. Thus, it can be seen that the evening dining in this area, especially the consumption places such as bars and live houses, bring a significant increase in the number of people in this area, and the growth is more rapid during holidays.

In summary, the renovation design of public space in the factory should consider more space utilization at different times, that is, increase the use scene of the park during the day, and break the tidal effect. At the same time, do a good job of traffic connection and people flow guidance between Pati and the south factory area, by enriching the function of the factory to meet the needs of multi-time and multi-type people.

(2) Means of transportation

By comparing the percentage diagram of the overall traffic categories from 10:00 to 24:00 in the research area, it can be seen that walking accounts for the majority of the three modes of transportation, which confirms that the internal transportation mode of the current planning of the park is mainly walking, so it is necessary to focus on the humanized design of the walking space type, environmental comfort, accessibility and other aspects inside the plant.

According to Figure 4-16, 12 sections are compared. Among them, 1-a and 6-b belong to the sections of roads adjacent to the main entrances and exits outside the plant, so the proportion of vehicles is the largest. Among the remaining 10 sections, only 4-a, 2-b, 5-a and 6-a sections have a very small proportion of automobiles and non-motor vehicles. The analysis found that the roads of the four sections were located at the edge of the entire plant, near entrances and plazas, and the surrounding buildings were mostly offices, basic services and other functions, and the cars and non-motor vehicles in the survey were mostly work vehicles and takeout electric vehicles in the plant. Therefore, in the subsequent renovation design, the adaptability of function zoning and traffic design should be considered to prevent the interference between the flow of people, motor vehicle flow and non-motor vehicle flow to different destinations.

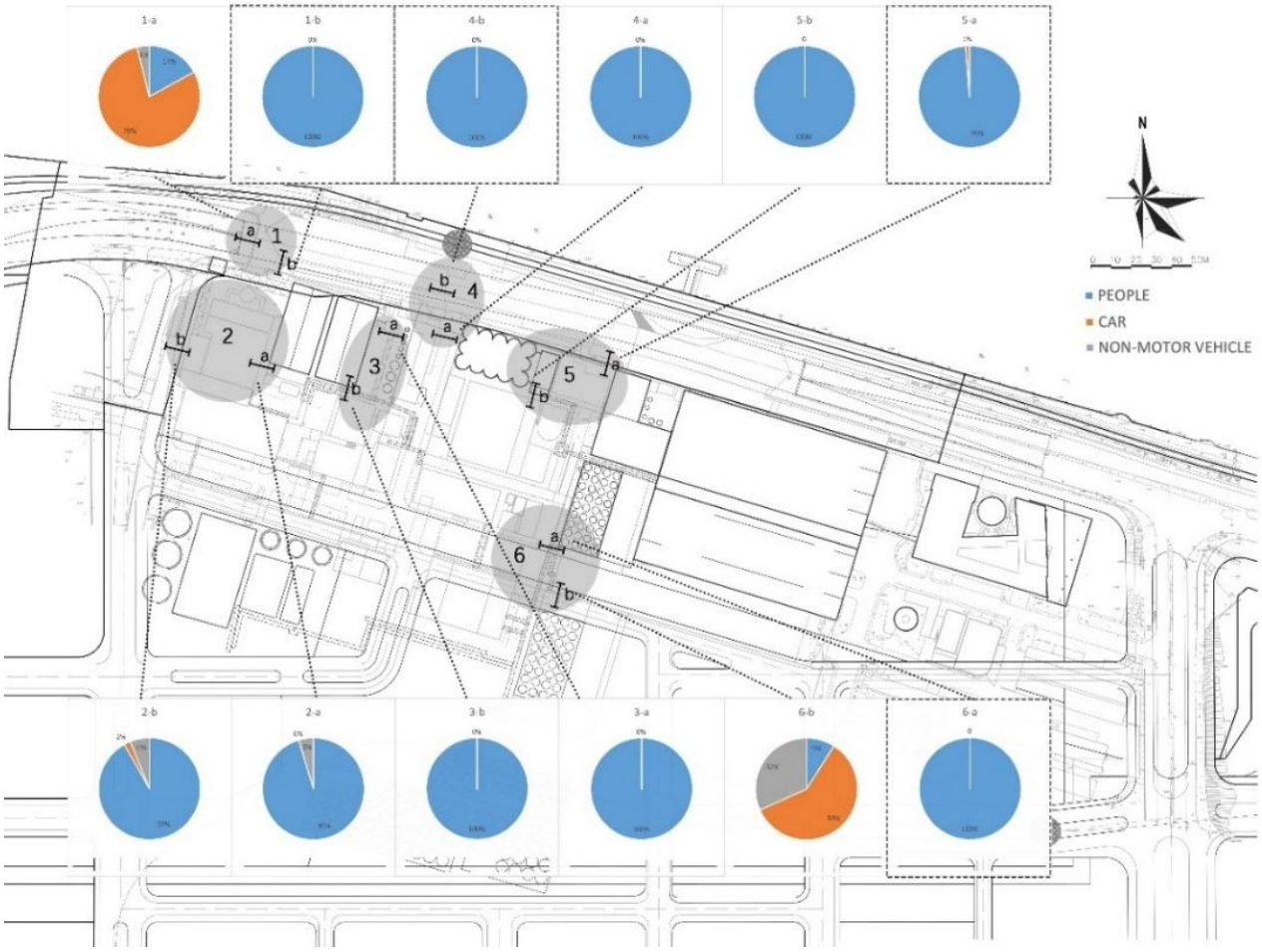
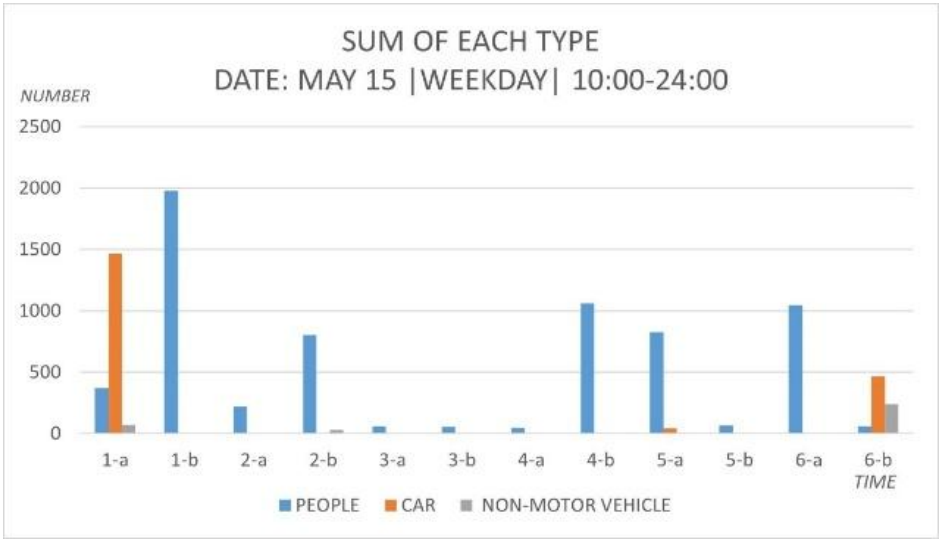
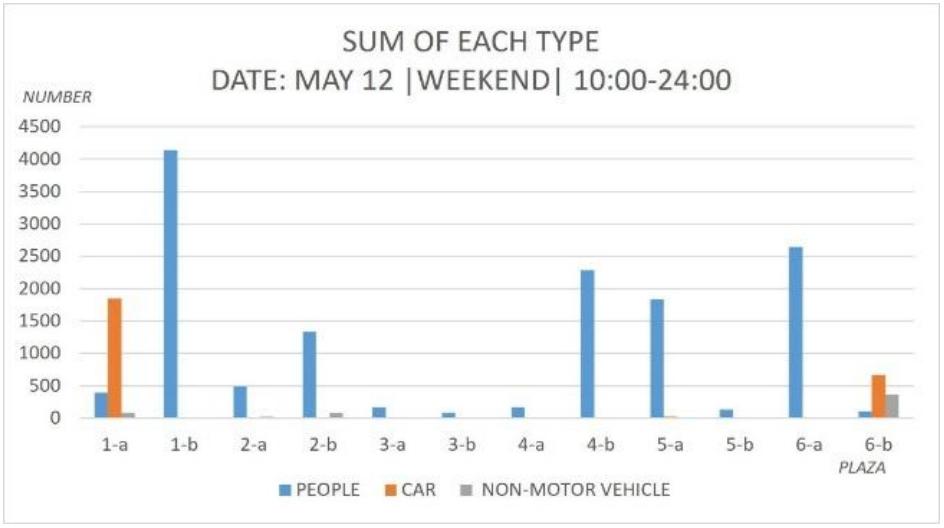


Figure 4- 16 Traffic Types in 6 Plaza
Source: Author

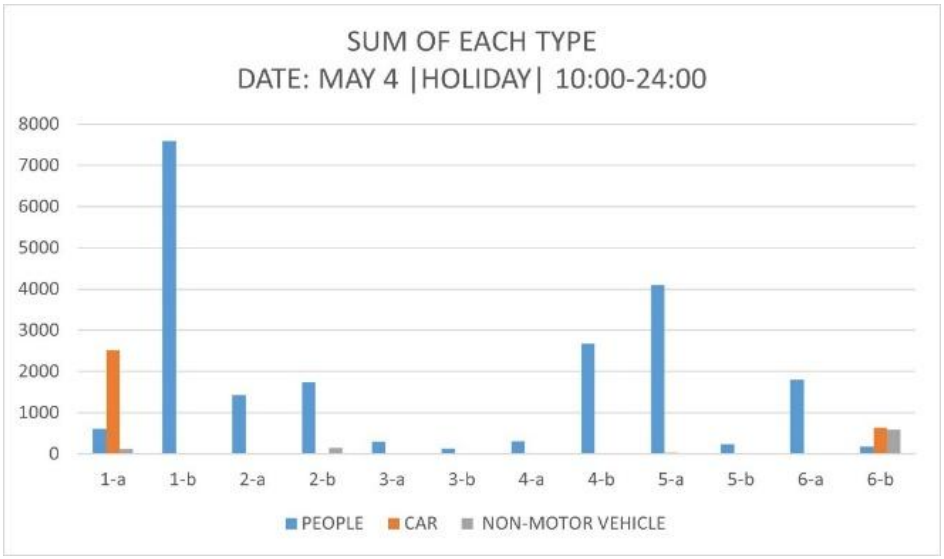
According to Figure 4-17, comparing the three periods of holidays, weekends and weekdays in the factory from 10:00 to 24: the peak of pedestrian traffic flow (top four) all appeared in the four sections 1-b, 4-b, 5-a and 6-a, and the pedestrian flow of section 1-b ranked first in the three survey periods. Therefore, the subsequent design should focus on the renovation design of these four sections and the space of the plaza where they are located (especially the entrance No. 1). Improve spatial detail and quality; However, the pedestrian flow data of sections 3-a, 3-b, 4-a, and 5-b all performed poorly in different periods, mainly due to problems such as the imperfect function, poor facilities and environment of the space where these sections are located and the surrounding buildings, and their lack of attraction to tourists. Therefore, the subsequent renovation should strengthen the design supplement of basic road facilities such as street lights, signs, health environment, green landscape, etc.



（a）Weekday



（b）Weekend



（c）Holiday

Figure 4- 17 The Number of Different Traffic Types

Source: Author

(3) Walking path and patency

① Walking path

When we look at what drives human behavior, we find that the tendency to take shortcuts is similar to the tendency to pursue other good things, which reflects an inherent human nature. For example, when pedestrians choose to cross the road, their fundamental motivation is to seek a more direct and faster path to reach the destination; Similarly, the act of crossing lawns often stems from the practical need for easy paths. In examining these behaviors, we should not simply place the blame on pedestrians, but also consider whether road designers have fully considered the actual needs and habits of pedestrians in their planning. If the road is designed from the pedestrian's perspective, then the so-called "shortcuts" mentioned above may be a reasonable path that designers should incorporate in their planning. Therefore, the rationality of the road and the setting of zebra crossings and traffic lights should be based on a deep understanding of the behavior habits and needs of pedestrians, so as to ensure that these facilities can truly meet the actual needs of pedestrians.

The pedestrian road planning of Zhujiang Brewery along the river is coherent and smooth. The platform system on the second floor of northern Pati and the walking system inside the industrial area are both accessible and smooth. However, in the vertical direction of the river, due to the current tram crossing and the complexity of the vertical transportation system, pedestrians from the industrial heritage area to the riverside and Paju Beer Street will be inconvenient. Only one (4-b) section in the industrial area leads to the waterfront space along the river, and the whole connection between Pati Bar Street and the industrial area is cut off. In addition to the large staircase leading to the second floor at the entrance, there are few vertical evacuation stairs connecting the middle and end of the second floor to the ground floor, resulting in a more rigid connection between Pati Bar Street and the industrial area.

Therefore, how to consider the Pati district and the industrial area as a whole, and focus on planning the walking path experience in the vertical direction of river, is a problem that needs to be considered in the next stage of renovation.

② Patency of walking

Pedestrian patency covers two core elements: First, build a multi-level pedestrian network with interconnected public Spaces, ensure a pleasant walking environment and attractive streetscape along the way, so that people walking in it feel comfortable and satisfied, and avoid choosing other modes of travel due to poor environment; The second is to eliminate all physical barriers to access, while paying attention to barrier-free walking design.

In terms of building a comfortable pedestrian network, the focus is on the scale, connectivity and greening of different streets. For the elimination of walking barriers, the narrow sidewalk can be properly widened, and the part with a height difference gives priority to the use of gentle slope transition and connection. In addition, the design of areas such as parking lots, building entrances and exits also needs to be carefully considered to ensure that they do not interrupt the continuity of the sidewalk.

In terms of walking smoothness, the overall performance of the survey area is good, there is a coherent and smooth walking network, and no facilities and items that hinder walking smoothness are found. However, 2-b section has the problem that the entrance and exit of the parking lot interrupt the continuity of the sidewalk, and 2-a section has the problem that non-motor vehicles and people mix.

4.4.2.2 current situation of plaza space

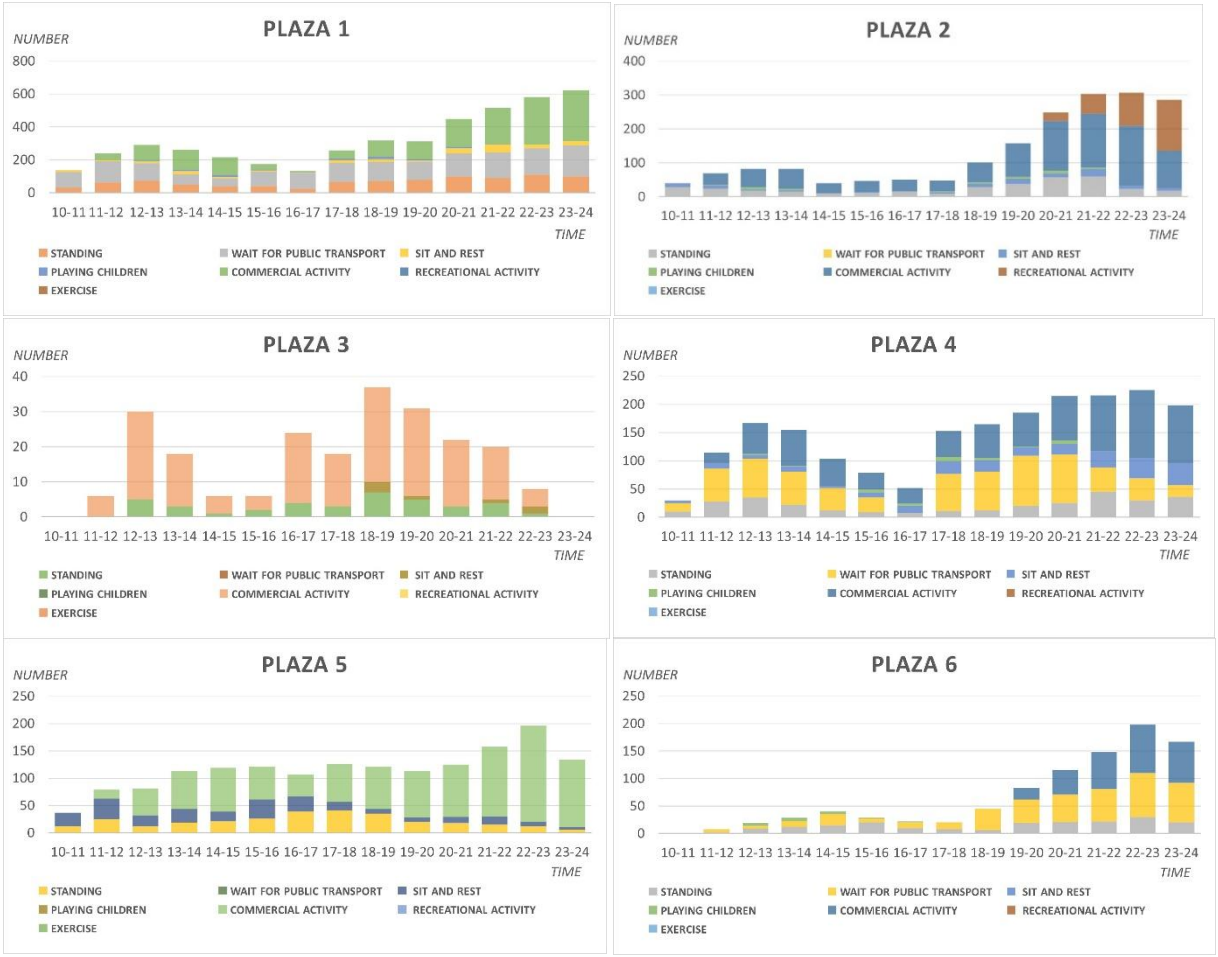
Plaza space refers to the space that can attract the public to stay and may generate activities here, and is also an important space carrying urban public life and activities. According to different types of public activities in the space, the plaza space is subdivided into two categories: necessity space and choice space.

The number of different activities in six plaza spaces of the current park was calculated from 10:00 to 24:00 on weekends, and the trend chart of plaza space activities was made (Figure 4-18). It can be seen that the peak of crowd activity at all six plazas occurs in the afternoon and evening. Plaza 1 has the largest number of crowds, plaza 1 and plaza 4 have the richest types of activities, and plaza 3 has the least number and type of crowds. According to the types of activities obtained by statistics, there are few cultural activities and children's entertainment

activities, mainly commercial activities. Some plaza spaces lack public seats, making it difficult to provide temporary rest space for the public.

(1) Necessity space

The plaza space can be divided into two categories: necessity and non-necessity. Necessity refers to activities that require a short stay, such as waiting for a bus or taking shelter from rain. The occurrence of such activities depends on the surrounding environment and functions of facilities. For example, in this survey, only plaza 1, 4, and 6 have the activity type of "waiting for buses", because they are close to the vehicle parking roundabout at the entrance, the bus stop and the main intersection on the south side respectively. Therefore, such spaces should focus on creating a good climate environment, with plants that can shade the sun and seating for rest.



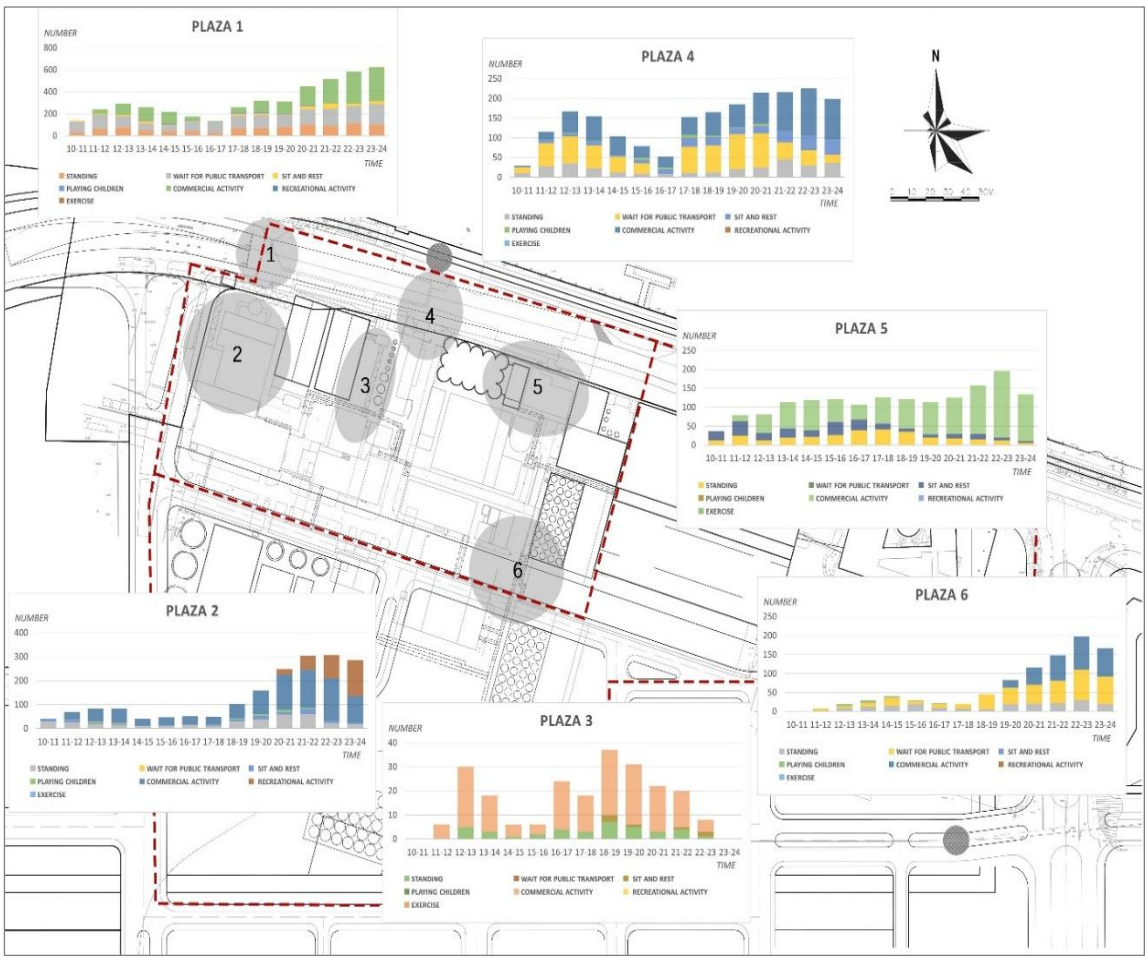


Figure 4- 18 Activity Type in 6 Plaza
Source: Author

(2) Selective space

The occurrence of activities in selective space is closely related to the design of public space. For example, shops along the street choose to display their products in front of the store in order to attract the attention of pedestrians, and in the process of watching and selecting, an active public space atmosphere is generated; It is the same for cafes and some restaurants to set up open-air seats in the streets of appropriate size. The commercial activities in this survey mainly take place in the east-west main street where plaza 1 and 4 are located. Due to the particularity of business in the park, the business hours of most catering businesses are mainly in the afternoon and evening, which also results in the tidal phenomenon of public activities. Meanwhile, the survey results show that there are almost no cultural entertainment and sports activities. To sum up, re-planning the business form and function of the park and enriching the

activity time and type of public space for people are the inevitable requirements for creating a good symbiotic environment.

Figure 4- 19 Selective Space In Site
Source: Author

4.4.2.3 Results of questionnaire survey

This questionnaire was sent out in the form of offline questionnaires, a total of 200 questionnaires were sent out, and 195 valid questionnaires were obtained. The questionnaires are attached at the end of the paper, see Appendix I for details.

(1) Information about respondents

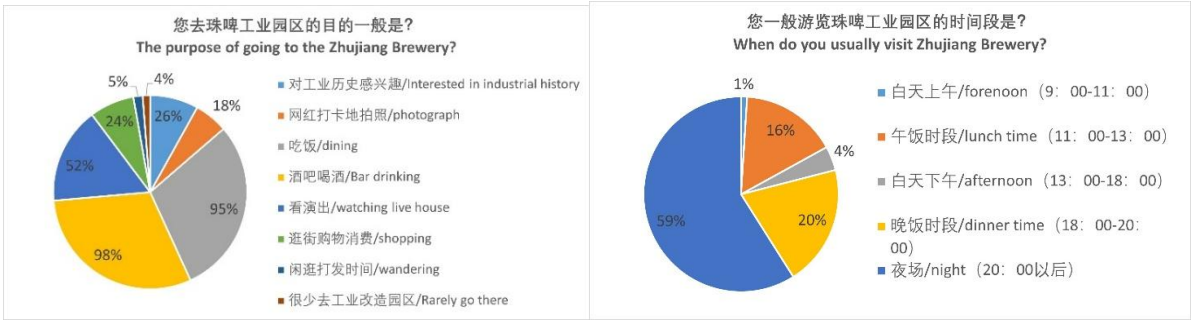
According to the survey results, 56% of the respondents were male and 44% were female. The majority of people are aged 18-30 years old, and the occupation range of the people is wide, mainly concentrated in the Internet occupation group, and the sources of the people are mainly local residents of Guangzhou (not limited to the residents around Patii) and office workers in the surrounding area.

(2) Time and purpose of visiting Zhujiang Brewery

When it comes to people's preferred time to visit Pati, 59% of people choose night (after 20:00), 20% of people choose dinner (18:00-20:00), 16% of people choose lunch (18:00-20:00), On the other hand, only 5% of the people went in the morning (9:00-11:00) and afternoon (9:00-11:00) during the day. The purpose of people visiting the industrial park is also highly concentrated in "eating", "drinking in bars" and "watching shows/live house".

The above results are very consistent with previous site survey results. It shows that the functions and types of businesses in Zhujiang Brewery Industrial Park are relatively simple at present, and public activities are concentrated in the evening after dinner, which is because the

current positioning of the Zhujiang Brewery is still dominated by the nightlife mode of Pati Beer Street.



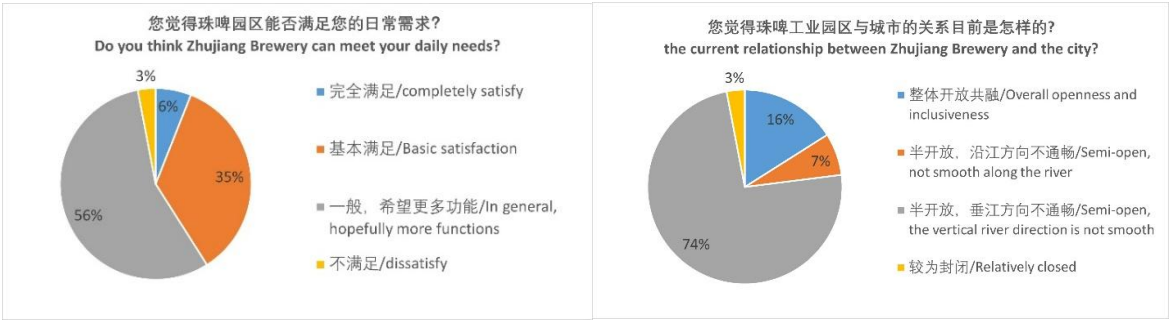
（a）Purpose　　（b）Time

Figure 4- 20 questionnaire of Site

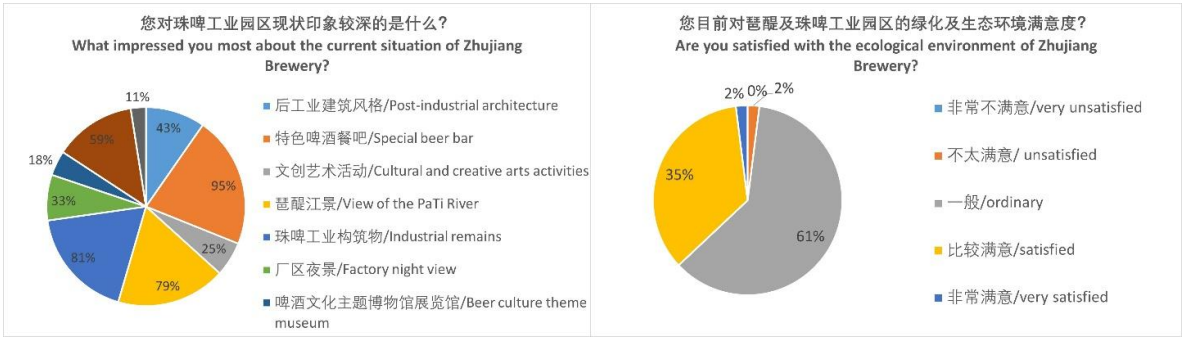
Source: Author

(3) Satisfaction survey

The questionnaire mainly investigates from four aspects: satisfaction elements, daily functional needs, traffic environment and landscape greening environment satisfaction.



（a）Daily functional needs　　（b）traffic conditions



（c）Industrial element impression　　（d）landscape planting

Figure 4- 21 Current satisfaction questionnaire

Source: Author

In terms of satisfaction elements, 95% of people think that the special beer restaurant bar in the park is a major characteristic element, while nearly 80% of people are attracted by the

industrial structures of Pearl Beer and the river view of Pati, and some people also say that the setting of Pati's tram station provides great convenience for travel.

In terms of daily functional needs, the vast majority of people said that the current Zhujiang Brewery Park can only meet the needs of daily meals and night entertainment, and there is still room for optimization in the richness of functional formats and the construction of open space.

In terms of traffic environment, 74% of people reported that the connection between the Zhujiang Brewery Park and Pati is weak, and the patency of the direction of the Pearl River needs to be enhanced.

In terms of landscape environment, most of the respondent showed a "general" result on the overall satisfaction of greening in the park, which proves that the current greening construction in the park needs to be improved.

(4) Suggestions for future development

Based on the above survey results, the following conclusions can be drawn: ① People have high requirements for the openness of the park to the city, and hope that it can be open to people's daily life all day long; ② As for the functional forms of the park, some respondents suggested that commercial and leisure cultural, entertainment and art activities could be increased; ③ People have a great demand for public leisure open space in the park, especially green open space and child-friendly activity space; ④ Most people expressed the expectation that the renewal of the park in the future can make use of the existing industrial relics and integrate industrial memory into modern urban life.

4.4.3 Assessment of "symbiotic model"

The assessment of the current symbiosis mode is based on three aspects: style coordination, spatial system structure and functionality.

From the perspective of style coordination, the display path of the existing industrial relics is not smooth, and the single industrial relic buildings and structures lack connections and exist only as independent individuals. At the same time, there is a lack of transition and connection between the industrial buildings, modern facilities and new buildings. From the functional point of view, according to" the land use layout plan of the original control regulation in 2014",

there are sharp contradictions between land use planning and heritage preservation, which are reflected in the following three aspects:

First of all, regarding the planning indicators, the industrial land covers an area of 44,948 square meters, and the plot ratio is limited to 7.0. According to the comprehensive calculation, its total development needs to reach 314,636 square meters. If the existing industrial remains is included in the scope of preservation (taking into account the need for fire spacing), the land area required will be approximately 19,870 square metres. In addition, in accordance with the *Guangzhou Urban Planning Technical Management Regulations*, the building density of such land must be maintained at a level below 55%. Taking into account the above multiple constraints, if we try to strike a balance between the preservation and development of the industrial old site, the remaining space available for construction of the plot will only be about 4851 square meters, which is obviously far from enough to meet the established planning and development needs.

Secondly, under the current land policy framework, the space development rights and use rights within the land red line are exclusively owned by the owner. In the face of the rigid requirements of high development volume and the value orientation dominated by economic benefits, the concrete implementation of industrial old site reservation area and the guarantee of public attributes in the subsequent utilization process are facing severe challenges.

Thirdly, from the perspective of spatial form, if the existing industrial remains are included in the retention plan, the remaining land available for construction will show the characteristics of irregular shape, which will undoubtedly bring great design difficulty and complexity to the subsequent plot design scheme.

In the face of the above problems, the urban design plan of the 2015 edition realizes the symbiosis between industrial remains preservation and urban land development by dividing industrial remains land and commercial development land and combining the optimization strategy of the function conversion of the former site of urban public land.

However, within the industrial relic area, the functional relationship between the relic units and the systematic thinking between the relic units and the newly built units have not been properly handled. At the same time, there is a large demand for public infrastructure construction in the industrial relic area. How to balance the relationship between the internal new buildings and the industrial relic, and how to balance the contradiction between the commercial demand and the public landscape resources are still to be solved.

It can be seen that the internal spatial structure of the industrial relic area should follow the planning requirements, open up the two main roads in the vertical direction of the river, and further activate the two slow walking paths along the river to enhance the vitality of the streets. Meanwhile, the public space inside the industrial relic area should pay attention to the construction of spatial vitality, ensure the symbiosis of internal and external spaces and the construction of transitional spaces, so as to integrate the old site into the urban public space system. Finally, a systematic spatial structure is formed.

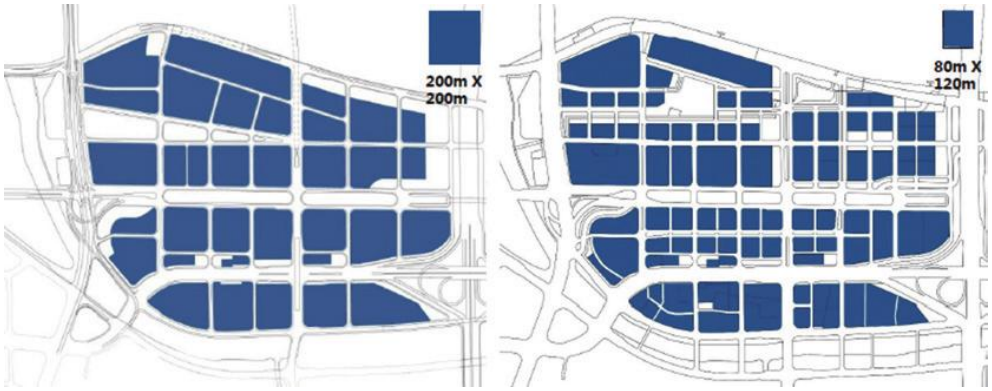


Figure 4- 22 Network Density Improvement
Source: 2015 Guangzhou Urban Planning Technical Management

From the perspective of spatial structure, the compact development mode of "dense road network of small blocks" is proposed in urban design. Considering the current road conditions and the structural foundation of the old road network, 80m×120m grid is superimposed on the original 200m×200m scale, which is used to divide the land reserved for industrial remains and the new development land. At the same time, the density of the branch road network was increased from 11.07 km/km² to 12.85km/km², forming a compact and suitable block scale. Therefore, for the construction of internal public space system, an interrelated and symbiotic

public space system should be formed on the basis of the overall spatial structure by integrating various elements in the old site, including preservation of relics, open space plazas, internal corridors of the plot, and active architectural interfaces. According to the survey results, there is still a large room for improvement in the construction of internal public space system.

4.4.4 Site current problems

According to the quantitative investigation results, the main problems in the physical environment of this area are as follows:

First, the land use and transportation planning in the area is still lack of rationality, which cannot meet the needs of the display of industrial remains value and the problems of smooth traffic and connection in the vertical river direction, which is not conducive to the establishment of the symbiotic relationship between the inside and outside of the system.

Second, the area has a low utilization rate during the day, a serious tide phenomenon during the day and night, a small number of people in the day, an outbreak of growth at night, and a relatively simple type of visitors.

Third, the architectural functions and spatial forms of the area are relatively simple, the internal industrial remains resources have not been well utilized, the infrastructure features are chaotic, and the public space is lacking and of poor quality.

Fourth, the river view resources are occupied by commercialization, while the green space in the industrial area is insufficient. The riverside Pati bar area, the southern industrial remains area and the outer city border are blocked. The lack of communication channels between each other prevents the symbiosis among the various parts.

4.5 Summary

This chapter takes Zhujiang Brewery as the research object, and makes a comprehensive assessment of the current site by systematically sorting out its renewal process and deeply investigating the current conditions. The study starts with the basic factors such as location characteristics, climate conditions and transportation network to provide the spatial background for the subsequent evaluation. Through the research on four development stages of Zhujiang

Brewery, it is found that its renewal process presents obvious stage characteristics: Starting from the early landscape renovation along the river, followed by the regional transformation under the guidance of urban design, then the renovation of the "BREWERY" with cultural branding, and finally the construction of the current headquarters complex, this evolution process fully reflects how the industrial remains respond to the needs of urban development in different periods.

Based on the three elements of "symbiotic system" proposed in chapter 2, the present site is investigated in detail from three parts: "symbiotic unit", "symbiotic environment" and "symbiotic mode". In the aspect of "symbiotic unit", the industrial relic unit shows remarkable cultural value and spatial potential, but there are problems such as single function and chaotic style. The modern facility unit shows the characteristics of weak internal and external links, serious homogenization of business forms, and insufficient utilization of public space, which leads to the uneven distribution of vitality in the area. The analysis of "symbiotic environment" reveals the prominent problems such as the low efficiency of vertical river traffic organization, the lack of walking continuity, the excessive commercial occupation of river landscape resources, and the uneven quality of greening. The results of further questionnaire survey also verified the public's urgent demand for functional diversification and environmental quality improvement. Finally, in the evaluation of "symbiosis model", the research focuses on three dimensions of style coordination, spatial system structure and functionality, and reveals the interaction and existing contradictions among various elements.

Based on above analysis, this chapter completes the "Step 1" proposed in Section 3.4: analyzing the current "symbiosis system", which provides an important basis for the subsequent "symbiosis" renewal design of Zhujiang Brewery. The results show that the renovation of the district should focus on the optimization of the traffic system, the diversification of functional formats, the improvement of the quality of public space and the organic integration of industrial remains and modern life, so as to achieve the balance between the protection of industrial remains and urban development, and promote the sustainable regeneration and value enhancement of the district.

Chapter 5 Zhujiang Brewery "Symbiosis" Renewal Design

5.1 Design Conditions

The design object is the 1#4# plot and the Patii area of the Zhujiang Brewery in the west district of Pati. The total land area of the project is about 30,200 square meters, the height limit of high-rise buildings in the site is no more than 120m, and the planning proposes that the large area of the ground floor parking lot will be changed into an underground parking form. The existing industrial buildings and structures in the site are mainly concentrated in the private land of ZHUJIANG BEER GROUP. It is planned to retain the coal transport corridor, A4 A5 coal shed, steam engine room, malt silo and selection building, fermentation workshop and fermenting tank, as well as the sewage treatment plant and saccharation fermenting plant in the government collection and storage land on the south side. The site is mainly used for cultural facilities, compatible with commercial and business facilities. The planning limits the construction position of the corridor that the adjacent buildings need to be connected in the air and the requirement of a net height greater than 4.5m. At the same time, it is proposed that the design scheme should pay attention to the connection with Pati area and strengthen the connection in the vertical river direction, that is, the walking connection between the industrial site and the platform on the second floor of Pati.

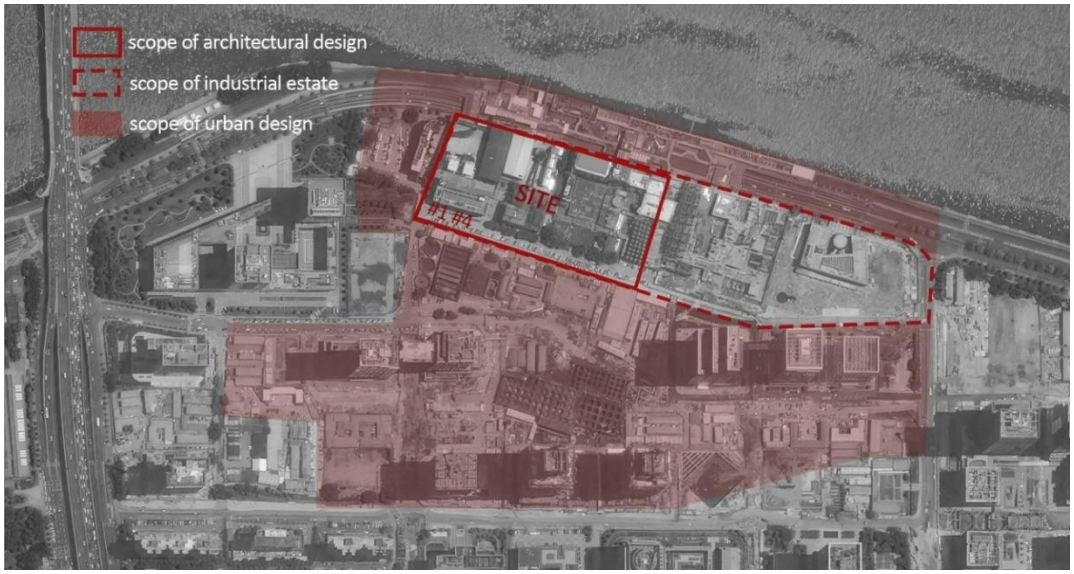


Figure 5- 1 Site Design Scope

Source: Author

5.2 Design Objectives

According to the investigation and summary of the current site "symbiotic system" in Chapter 4, combined with the arrangement of design conditions in Section 5.1, the design objectives of the project are summarized as follows:

(1) Create an open and integrated urban waterfront public space: protect and improve the spatial environment of Zhujiang Brewery Industrial Zone, open up the vertical river traffic, optimize the square plaza, and build a citizen activity space with beautiful environment and accessible to everyone.

(2) Establish a new image of a modern industrial park: follow the principle of "old and new symbiosis", integrate the trend of the new era and IP while retaining the industrial cultural memory, and plan the operation of park activities to continue attracting people and connect tourist attractions along the river.

(3) Create a green and ecological natural oxygen bar: protect and improve the ecological environment of Zhujiang Brewery Industrial Zone and maximize the sight scope of the landscape along the river. Increase green facilities to create a comfortable walking experience in the park, use new technologies to shape a low-carbon green park, and achieve environmental sustainable development goals.

(4) Establish a multi-functional area integrating "new cultural education, comprehensive experience and interactive exploration" : build a comprehensive education base by means of spatial streamline optimization, scene design, function planning and technical intervention. The base includes Pearl Beer cultural research, creative art exhibition, and future new business experience, which conform to the direction of the development of The Times.

Finally, by preserving the industrial memory and improving the waterfront ecology, it will create a multi-dimensional symbiotic space with open leisure experience and industrial cultural background in the Zhujiang Brewery area, making it a new local landmark and a new highland for cultural and artistic development.

5.3 Design Scheme

According to the design path of symbiotic renewal of industrial remains proposed in Chapter 3, there are three steps to realize symbiotic renewal. Section 4.4 completes "Step 1: Analysis of the current symbiosis system" and summarizes the current situation of the base; Section 5.2 further puts forward the corresponding design objectives and completes the second step. Next, in Section 5.4, "Step 3: Symbiotic Design Strategy" will be analyzed in detail. This section first gives an overview of the specific scenarios:

In terms of urban design, the plot of Zhujiang Brewery is integrated into the spatial pattern of Pazhou West District through an open spatial structure. According to the latest urban plan(2015), the line of sight corridor in the direction of Zhuijiang is opened, and the two boundary Spaces between Zhujiang Brewery Factory and the city and Patii are mainly optimized. By introducing the characteristic elements of Guangzhou Arcade, the originally closed and inactive south street frontward road is transformed into a slow- friendly and popular urban public space, realizing the restoration of "Dao".

In terms of space environment, it focuses on the symbiosis of old and new space and the optimization of ecological environment. In industrial site, three new and old space plazas are mainly shaped as vitality points; Ecological environment optimization is mainly achieved through different types of sponge city measures, and the newly built terraced space in the park also add material carriers for vertical greening and roof greening.

In terms of architectural symbiosis, three groups of important industrial remains retained in the site are selected for renewal design, and targeted transformation strategies are proposed according to the characteristics of the remains, so as to maximize the preservation of their historical and cultural values, integrate into the multi-dimensional needs of the new era, and create a harmonious and integrated "Sacred Domain".

Figure 5- 2 Master Plan
Source: Author

5.4 Urban-scale symbiotic renewal design strategies

5.4.1 Open spatial framework

(1) Planar spatial configuration

The current spatial layout of the site area is relatively closed, the traffic connection between Zhujiang Brewery and Pati is weak, the boundary between the south side and the urban public space is not friendly under the barrier of continuous walls, and the street interface is also very simple and lack of vitality.

Firstly, the design aims to integrate the factory into the urban public space system and make a unified planning of the spatial structure in combination with the surrounding important plazas. At the urban design level, the landscape space is extended to the riverside in combination with the Zhujiang Brewery Industrial Area planned on the south side to form a landscape corridor; Strengthen the connection between the site and the surrounding land to the north and the Pati Riverside, while connecting the main urban road of Pazhou Street to the south, and

interacting with the landmark of Guangzhou Tower to the west to create a dynamic axis of urban space.

The public space system inside the factory continues the overall block grid after optimization of the latest version of urban design control regulations, complies with the urban texture, integrates various elements in the factory, and forms an interconnected public space system by creating internal corridors, open space plazas, active building interfaces, and three-dimensional walking systems.

Figure 5- 3 Space Structure
Source: Author

(2) Multi-level skyline

In terms of urban three-dimensional spatial form, Pazhou West District gathers Internet innovative office high-rise and residential buildings, which has formed a staggered spatial form of "high in the middle and low on both sides". According to the requirements of spatial form control, the urban design divides Pazhou West District into three levels of skyline according to the distance from the Pearl River, among which the commanding heights of the first group of close-up levels fall in the Zhujiang Brewery industrial area. According to the requirements of the 2015 planning for the height limit of this area, two new high-rise towers of no more than

100m are finally determined in the plot, and then three groups of scattered and rhythmic urban skyline are formed with the whole.

Figure 5- 4 Skyline Design
Source: 2015 Guangzhou Urban Planning Technical Management Regulations

5.4.2 Convenient and smooth traffic system

Urban Design and Control Planning Optimization of Pazhou West District proposes to optimize road system and increase rail transit stations in the district. Firstly, the density of the road network is improved by adding branch roads, and the road is graded to form a compact and appropriate block scale and increase the diversity and flexibility of travel paths. Secondly, the plan determines to add 3 rail transit lines and 2 stations in Pazhou West District, as well as 6 LRT tram stations, one of which is located in newly-built city park in the south of the site, promoting the interchange of public transportation in the area as a whole.

Therefore, in order to solve the existing problems such as poor traffic in the vertical river direction of the site and obstructed sight lines of the riverside landscape, the block network is designed to continue the current planning proposal. The road in the southern side of the site is extended to the north until it connects with Pati, forming a main and secondary landscape sight corridor, which serves as an important traffic corridor connecting the urban hinterland and the riverside waterfront. At the same time, the new and old LRT rail stations are also cleverly opened up, which helps to improve the flow of people and relieve traffic pressure.

For the boundary road space, the design is optimized for two linear boundary Spaces on the north side and the south side respectively.

Figure 5- 5 Traffic System
Source: Author

The first is the border space on the north side, adjacent to Pati. At the same time, it is also the walking road with the largest flow of people in the current factory and the core road connecting multiple site entrances and exits. In the direction of the river, the smooth flow is better, but the problem is that in the vertical direction of the river, the connectivity with Pati is poor, resulting in the current situation of Pati Bar street and the southern industrial plant area is more separated. Therefore, by softening the linear boundary, the design introduces steps, ramps, and green Spaces as a transition between Pati and the factory, while simultaneously planning functions and adding a vertical transportation system to connect Pati and the factory. In terms of function, multiple types of public activity Spaces are also added to improve the utilization rate and use scenarios of the space

The second is the boundary road adjacent to the city block on the south side. Its current function is to serve as the ground parking lot. The design removes the linear wall and opens up the boundary space completely, combining with the continuous commercial functions, turning the road into a multi-level commercial street for daily life. In the vertical space, a multi-

dimensional space of " street - semi-underground space - half-level platform - second-floor space" is presented, and the space is effectively enclosed by greening, thus effectively managing and dividing the use scene of commercial space, increasing the variability of space and the richness of the interface along the street.


（a）Border between Pati and factory(current) （b）Border between Pati andfactory(design)


（c）Border between factory and city(current)（d）Border between factory and city(design)

Figure 5- 6 Boundary Space Design

Source: Author

5.4.3 Riverside open landscape interface

Due to the particularity of its geographical location, the waterfront industrial area can better integrate the urban natural ecological landscape into the hard cultural landscape of the old industrial area, so that the old industrial area can better integrate into the city in terms of visual style and promote the symbiosis between the old industrial area and the city.

Zhujiang Brewery industrial area is adjacent to the Pearl River, and the north side is close to the city's tram station and freight terminal. Together with Guangzhou Tower, Haixinsha and other scenic spots along the river, it forms the tourism route along the river in Guangzhou. However, due to the influence of Pati second-floor commerce, the waterfront view in the area

is blocked, and ordinary citizens cannot enjoy and experience the river view closely, and the public activity space is seriously insufficient. Therefore, the design adopts the internal extension and horizontal diffusion of the ecological landscape, and uses the design of the vertical greening of the platform space and industrial components in the factory to open the landscape interface along the river, optimize the green design of the public space on the second floor of Pati, and return the river to the people. As a major landscape plaza, the renovated Zhujiang · Patii, together with the new park on the south side and four other green space plazas, constitute a balanced landscape spatial structure in Pazhou West District.

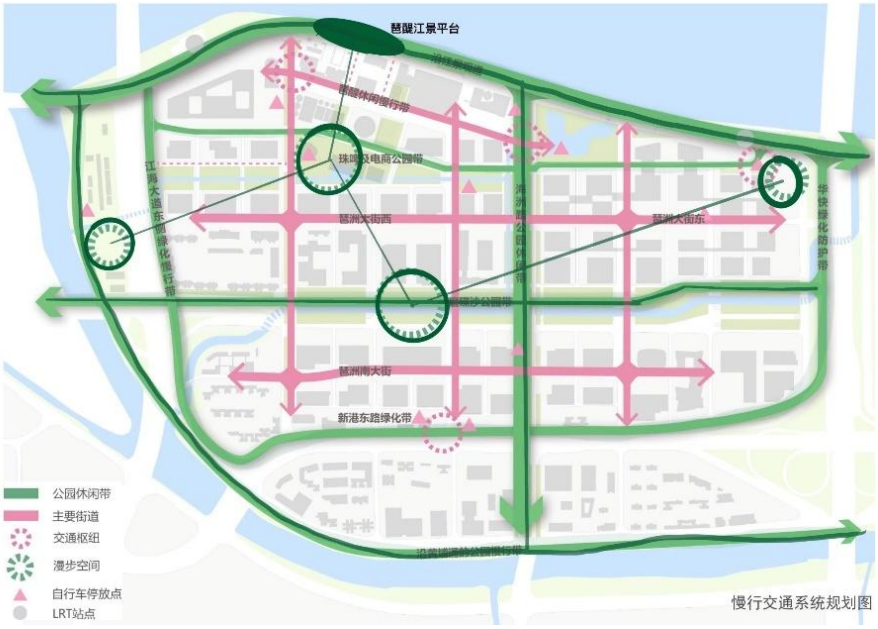


Figure 5- 7 Landscape Planning
Source: Author redrawing

5.5 Cultural translation symbiotic renewal design strategies

5.5.1 Spatial narration of industrial memory

According to the investigation and analysis of the "industrial remains unit" of Zhujiang Brewery in Chapter 4, the industrial buildings and structures in the factory have unique features and architectural space experience, but the distribution among different industrial relic units is scattered, unable to form a complete spatial sequence and coherent experience. Therefore, the design adopts the transformation strategy of "integration, intervention and connection", first of all, the scattered building units are classified and integrated, and a unified base is formed by

placing a new block. For example, the A4, A5 coal shed and adjacent old buildings are connected through the base and integrated into a group. In the same way, all the industrial remains in the factory are partitioned and integrated, and finally the traffic is reorganized by placing the air corridor system, connecting various industrial groups in series, and combining functional planning to form a spatial narrative line, which provides a place for urban tourism, education and research base. After the transformation, Zhujiang Brewery takes the chimney preserved in the entrance square on the northwest side as the first stop of spatial narrative, and after the series of A, B, C, D and E reconstruction, it ends at the fermenter. At a later stage of planning, the axis can be opened to continue to the east to connect the packaging workshop and the beer museum, and to the south to connect the preserved sewage treatment plant and the new park area, thus forming a closed loop of cultural circulation.

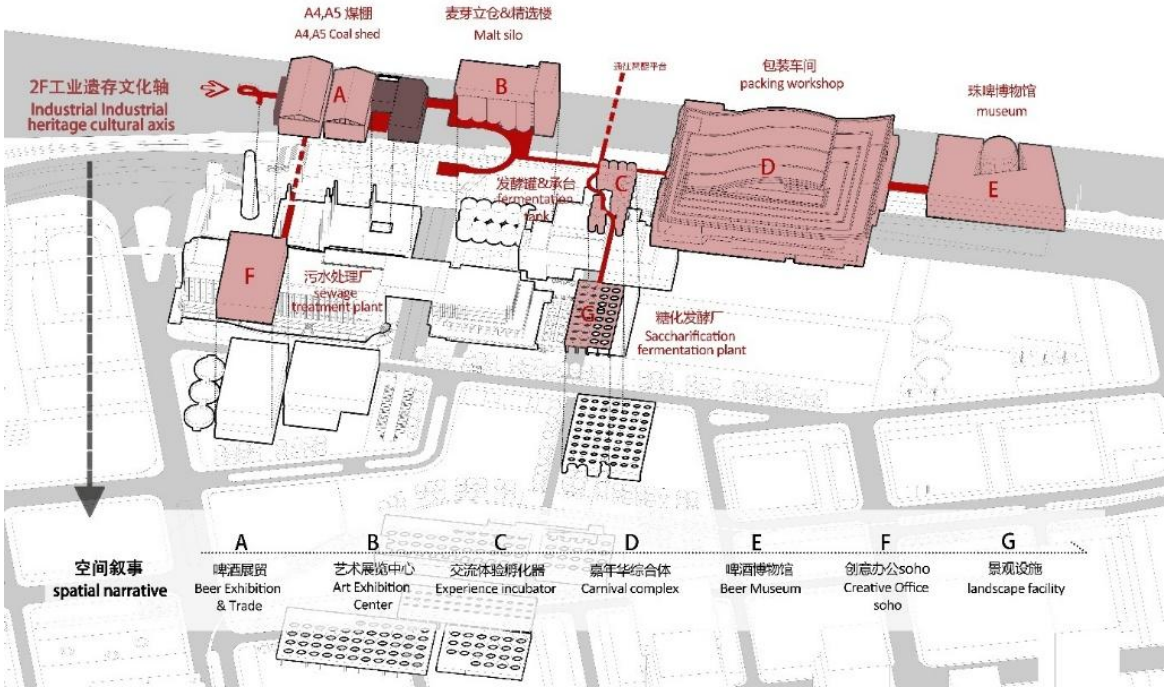


Figure 5- 8 Cultural Axis Design
Source: Author

5.5.2 The continuation of arcade regional culture

The planning and design of Pazhou West District takes "compact, intensive, efficient and complex" as the core concept, and constructs a complete block space system through refined and humanized urban design strategies, realizing the transformation from "car-oriented" traffic

road to "people-oriented" quality street. The area is known for its Lingnan characteristics and open charm, and is committed to creating a unique image of the headquarters commercial trade zone in the future.

In terms of architectural design, the office high-rise of Pazhou West District fully integrates the elements of Lingnan Arcade. The main streets are distributed with three different scales of arcade buildings, which are connected by green belt and activity square to form a continuous arcade system, greatly increasing the comfort of walking and the continuity of the landscape. The ground floor, through the prominent "eaves" design, provides a functional space for pedestrians to shade from the sun and rain, reflecting the adaptability to regional climate characteristics. In addition, the construction of the two-story corridor system organically connects multiple high-rise buildings to form a three-dimensional pedestrian network, further enhancing the spatial connectivity and experience of the region.

Therefore, Zhujiang Brewery area continues the small-scale arcade design of urban planning, which not only conforms to the design language of the overall urban arcade system, but also realizes the symbiotic integration of industrial remains and urban function. To preserve the historical memory while injecting new vitality into the region.

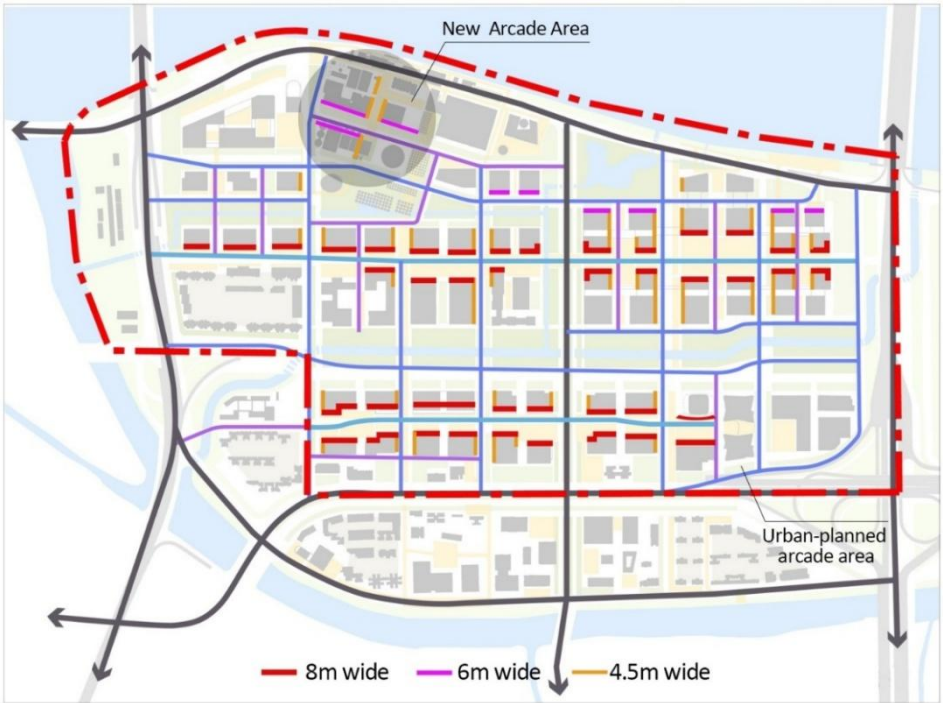


Figure 5- 9 Arcade Planning
Source: Author Redrawing

5.5.3 New culture carrier: 'CUREMARKET' Experience Market

Zhujiang Beer is not only an important industrial heritage of Guangzhou, but also an important carrier of Guangzhou's food culture and urban memory. As one of the earliest modern industrial enterprises in Guangzhou, Zhujiang Beer has gradually developed into an important symbol of food culture in Guangzhou and even in southern China since its establishment in 1905. It not only produces beer, but also dabbles in the field of food processing, producing many products closely related to Guangzhou's food culture, such as food and beverages related to Cantonese snacks. In Guangzhou food culture, Zhujiang beer is closely integrated with the traditional Cantonese food, becoming an important companion of Cantonese food. Its beer has a rich variety and refreshing taste, which can perfectly match the sour, sweet, bitter and hot of Cantonese food, and has become an indispensable part of Guangzhou People's Daily food. In addition, Zhujiang Beer has also integrated with Guangzhou's food culture and launched many products related to local food traditions, such as cooperating with Guangzhou's well-known "morning tea" brand to launch customized morning tea drinks, further consolidating the connection between beer and Guangzhou's food culture.

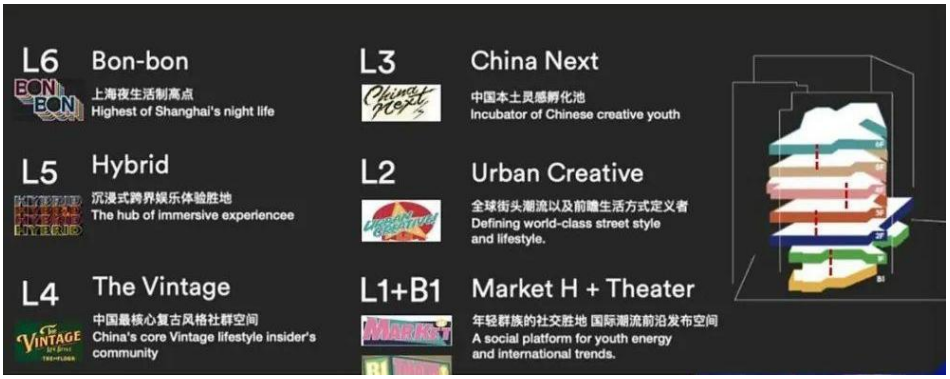
At the same time, Zhujiang Beer has also witnessed the historical process of Guangzhou's transformation from traditional handicraft industry to modern industry. Its factory buildings have a typical industrial architecture style of the early 20th century, showing the characteristics of China's modern industrialization. These buildings are not only a testament to technology and craftsmanship, but also an important part of Guangzhou's urban image. The factory of Zhujiang Beer is not only a production base, but also an indispensable part of the life of Guangzhou citizens and an important carrier of Guangzhou's urban cultural memory.

Therefore, how to fully tap and utilize the significance of beer diet culture and industrial heritage, so as to give Zhujiang Brewery a new era significance, is a major focus to achieve cultural symbiosis.

Finally, after studying relevant cases at home and abroad, the author plans to transform the A4,A5 coal shed and its additional buildings in the original Zhujiang Brewery into a beer exhibition and trade complex Market: 'CUREMARKET' ="Curated+Market", a new experience complex integrating exhibition, commerce, catering and leisure, education and research. This design concept is similar to "exhibition commerce" in essence, that is, emphasizing experience: creating a social atmosphere for commercial space through functional enrichment and immersive space experience. In the interaction between people and things, people and people, and people and space, new consumption is not only the exchange of property, but also the completion of self-sublimation, and breeds more new categories and new business forms. In terms of spatial layout, referring to the Turin Eataly renovation project, the main street is connected with the "island" themed with different food raw materials to create a characteristic market space.

（a）Eataly market space

（b）Shanghai TX Huaihai exhibition



（c）Shanghai TX Huaihai Theme Spaces

Figure 5- 10 Cases of "Exhibition Commerce"

Source: Internet

Eataly renovation project focuses on the life concept of "slow food + nature", combines the three formats of catering, retail and experience (food course) with the model of "eating +

shopping + learning", and presents the production, transportation and processing links to customers in a complete and transparent manner, constructing a complex of food scenes.

The core of the transformation of pearl beer is to further develop the value of Guangzhou food culture. For example, the factory can set up Cantonese dining area, fresh shopping area and Pearl River beer theme restaurant; Regularly hold the Pearl River Food and Culture Festival, international beer trade exhibition, etc., to create unique IP and cultural brands; At the same time, interactive courses such as beer brewing technology class and food class are introduced to integrate the heritage of craft culture into the real experience. Zhujiang Beer will become an important part of Guangzhou's urban cultural brand and an important bridge connecting the past and the future.

5.6 Internal environment symbiotic renewal design strategies

5.6.1 Old and new space environments

(1) The integrity and unity of spatial form

For the overall renewal of the old industrial zone, the spatial form regulation should be carried out according to the principle of the overall coordination and unity of the industrial zone and the city. Specifically, starting from the existing industrial buildings in the old industrial zone and taking them as the main plazas, the original isolated and scattered building monomer is integrated and connected by means of addition and demolition of building volumes, so as to form an overall coherent comprehensive space system on a macro level, so that it can be integrated with the external urban spatial structure and style. Then the specific details of different monomers are transformed to activate the old industrial buildings and promote the harmonious coexistence of new and old buildings.

The overall control of spatial form in this design is mainly carried out through three aspects: First, the integration and connection of scattered industrial remains are carried out by using the additional building volume, and then the internal spatial pattern of "five plaza square, four landscape axes, and three walking corridors" is created, and is adapted to the urban spatial structure. Secondly, through the architectural design method of "terrace", it maximizes the open

landscape view along the riverside, while reducing the horizontal occlusion of the river view under the condition of meeting the high-rise construction standards on the south side of the factory, and uses the terraced shape to carry out vertical greening construction, meeting the planning and positioning of "Patii Industrial area as one of the urban ecological green space plazas". Finally, combining the space shape of the original packaging workshop and the architectural form of the Pearl Beer Museum, the curve element is properly applied in this renovation plan, which is specifically reflected in the high-rise building form and the air corridor form, and finally achieves the consistency of the overall spatial form and elements of the old industrial area in Pazhou West District.

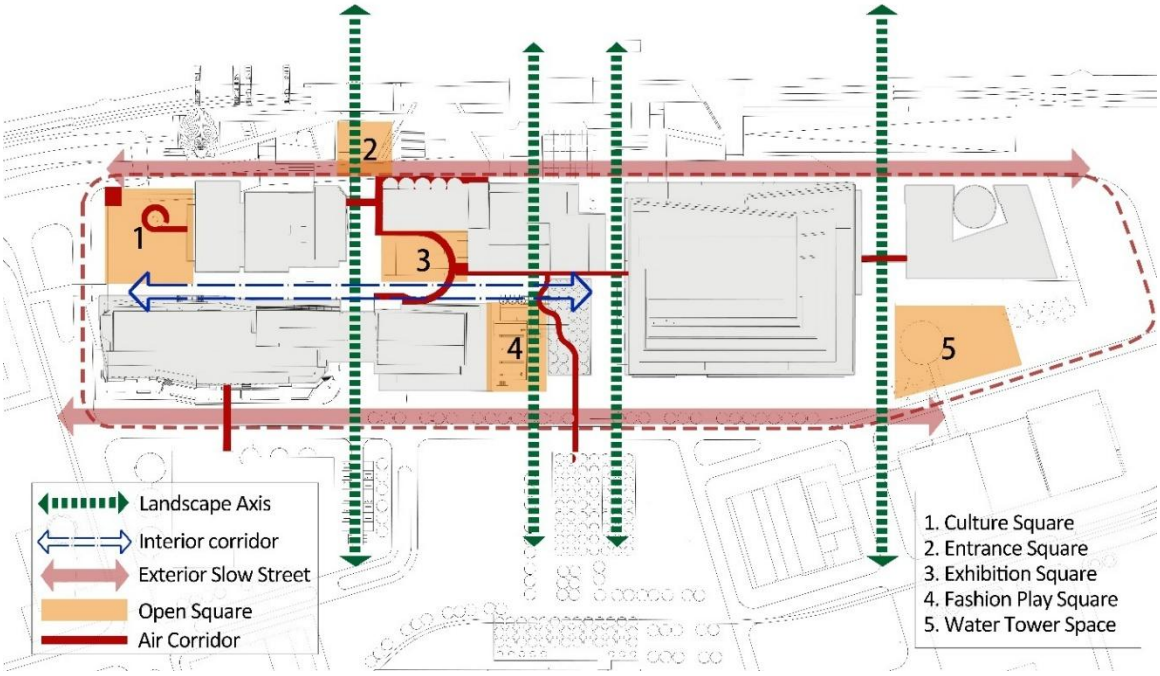


Figure 5- 11 Spatial Structure Design
Source: Author

(2) Rich spatial experience

The design fully considers the current ground floor walking path of the site, the daily activity needs of the future urban public, and the tour path of tourists. Combined with the relevant requirements of the urban design to strengthen the connection between the site and the second floor of Pati, a three-dimensional space path scheme is proposed. The ground floor is for daily city residents and tourists to visit normally; The industrial remains preserved by the main path in the air layer provide customized flow lines for cultural education and artistic

activities as the narrative path of industrial culture; The partial semi-underground space, combined with the greening landsacpe, provides a gathering leisure place for external spatial activities and becomes one of the core plazas in the factory.

In addition to the three-dimensional space design, the staggered layout of the internal and external space is also a major consideration of this design, aiming to break the phenomenon of "traditional industrial buildings closed and single experience. Through the staggered combination of the old factory building, the newly added building, the overhead space and the outdoor space, the design forms a rich space sequence and experience. The transition and staggered combination of interior and exterior spaces also provide visitors with an interesting and rich tour experience.

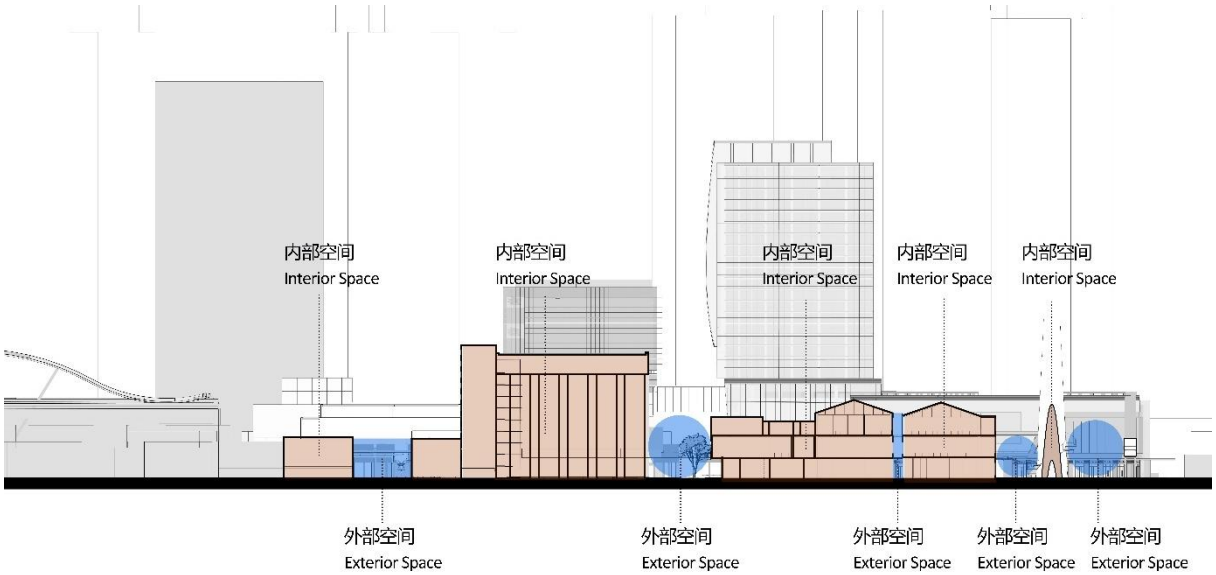


Figure 5- 12 Interior and exterior space design
Source: Author

(3) Spatial function reconstruction

According to the 2015 planning, the nature of the site is mainly for cultural facilities, compatible with commercial and business facilities. Therefore, on this basis, the design is divided into five functional areas through block integration: ①beer exhibition and trade comprehensive market, ②cultural and creative art experience area, ③commercial office complex area, ④green square rest area, ⑤Pati landscape platform area. Through three-dimensional traffic design, all functional areas are connected in series to improve the functional diversity of the park space and the accessibility of traffic between buildings.

In addition, according to the particularity of the current use time of the Zhujiang Brewery, the design also adds a retail space along the main street interface, and increases the merchants of 24h food and beverage supermarkets to enter, so as to meet the need of frequent night use in the area. From infrastructure to space experience and time-sharing utilization, the different needs of tourists and local residents are met in many aspects, and the spatial functions present a complex and symbiotic state.

Figure 5- 13 Spatial function layout
Source: Author

(4) Symbiosis between old and new

The design mainly adopts two methods of "material, volume and color echo" and "setting connection" to achieve the connection and echo of the old and new in the space level.

First of all, as the starting point of the spatial narrative of the industrial cultural axis, the entrance square(Figure5-14-①) adopts the method of "contrast of material, volume and color" to carry out a dialogue between the old and the new coal conveying corridor of the characteristic industrial structure and the newly built corridor around the chimney. Standing on the escalator to Pati, looking back to the square, the old and new materials are interwoven, the coal corridor tells the historical memory, and the steel staircase leads the visitor directly to the CUREMARKET experience market, thus starting the first stop on the industrial memory tour.

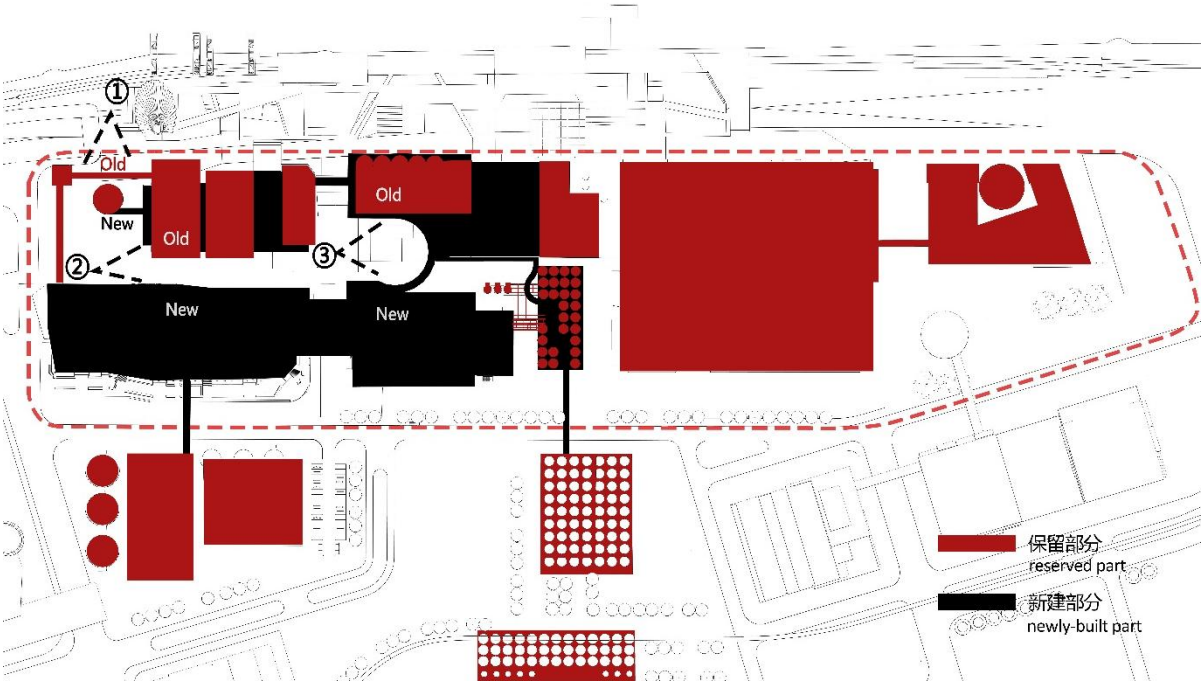


Figure 5- 14 New and old building plan location
Source: Author

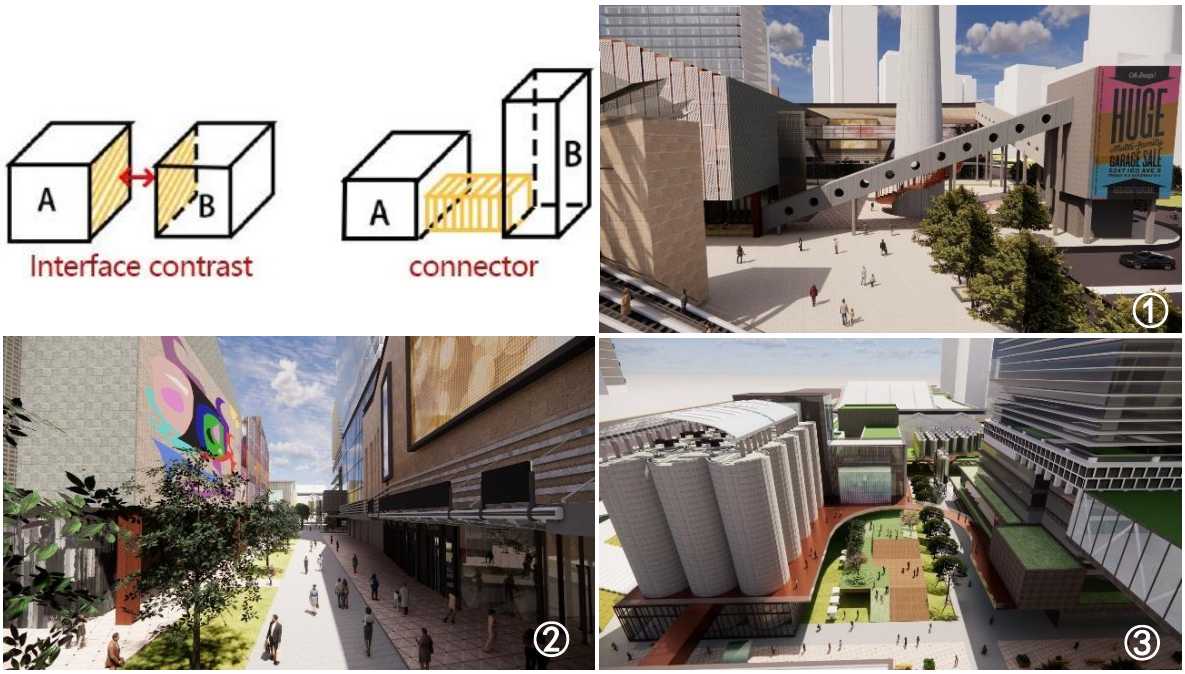


Figure 5- 15 New and old contrast plaza space design
Source: Author

Secondly, the main pedestrian street along the river inside the factory is a natural dividing line between the old and new Spaces on the south and north sides, and its good pedestrian space experience depends on the symbiotic treatment of the old and new Spaces on both sides to a certain extent. This design divides the walking axis(Figure5-14-②) into two sections, the west

section near the entrance adopts the contrast of facade materials and colors, retains the distinctive concrete truss structure of A4 and A5 coal shed and the gable material with strong industrial flavor. Through the graffiti wall painting on the facade, the facade is unified and continued to create a facade style that matches the current function and industrial flavor. In contrast, the new commercial complex on the south side adopts the traditional practice of modern commercial facades, highlighting the commercial atmosphere and contrasting with the old industrial buildings, so as to highlight the development of The Times and historical changes.

In the east part, a connection bridge(Figure5-14-③) is inserted to create a dialogue between the old and new buildings. A circular aerial bridge not only connects several scattered groups of new and old buildings, but also encloses the semi-underground public landscape. Placed on the covered Bridges, the old and the new shine in the square, integrating and symbiosis.

5.6.2 Ecological landscape environment

(1) "three-dimensional forest" reshapes landscape structure

The landscape of the old industrial zone is mostly humanistic landscape and has a strong industrial atmosphere, which often leads to the split between the landscape of the old industrial zone and the urban external space landscape, while the continuity and ecology of the urban landscape space are relatively stronger. Therefore, the design aims to weaken the greenery boundary, connect the landscape streamline of the old industrial zone with the urban interface, use the form of terrace building to create three-dimensional landscape greening of the factory, integrate the urban natural ecological landscape into the humanistic landscape of the factory, and build the old industrial zone into a "three-dimensional forest", which itself is the connection and transition between the waterfront ecological landscape and the urban hinterland landscape. At the same time, it is more visually integrated with the city.

(2) Sponge city sustainable scheme

The concept of sponge city emphasizes that cities should have the elastic adaptability similar to sponge, which can effectively mitigate the negative impact of urbanization process on natural hydrological system and ecological environment, and realize the natural storage,

penetration and purification functions of water resources. In the industrial zone, especially in production plants with a large area, sponge city construction has become a key development direction in recent years.

Guided by the concept of "sustainable integration", this design achieves multiple value reconstruction through innovative design strategies: one is to activate the value system of historical industrial space, the second is to restore the ecological network of abandoned sites, and the third is to expand the value-added chain of related industries. This three-in-one collaborative development model aims to transform traditional industrial sites into comprehensive carriers of sustainable development, thereby giving new vitality to abandoned industrial remains and enhancing the spatial value connotation of the site. The specific approach is: The whole plant is divided into three major group systems of "roof, road, greening plaza" to carry out targeted design of green infrastructure.

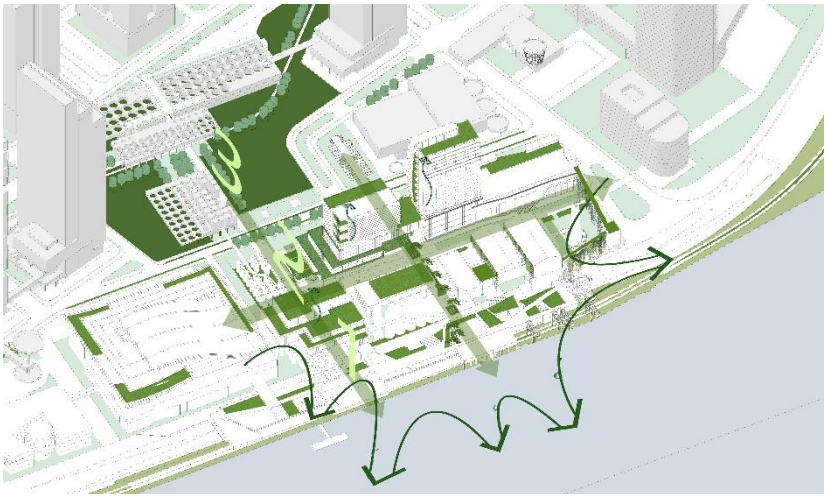


Figure 5- 16 "three-dimensional forest" structure
Source: Author

In the landscape greening cluster system, the design mainly planned the slope rainwater collection and the sunken green space, which integrated the ecological strategy on the basis of preserving the landscape value. The slope rainwater collection takes into account the reality that the platform of the second floor of Pati has a weak connection with the direction of the river of the industrial relics. By linear separation of the slope green space and the large steps, the functional value and ecological value are integrated and unified.

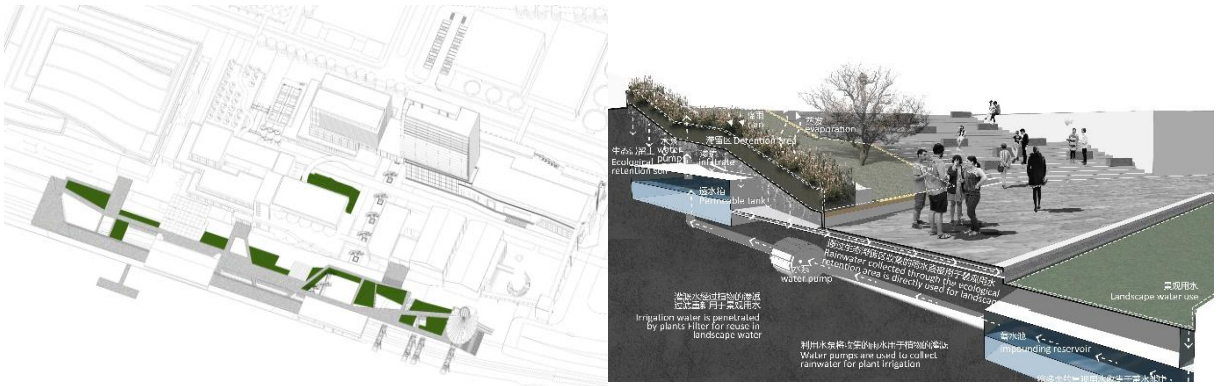
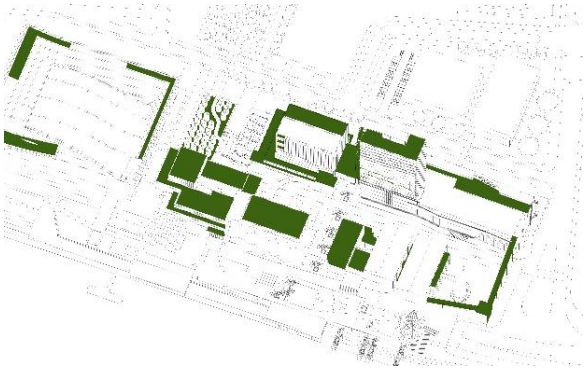


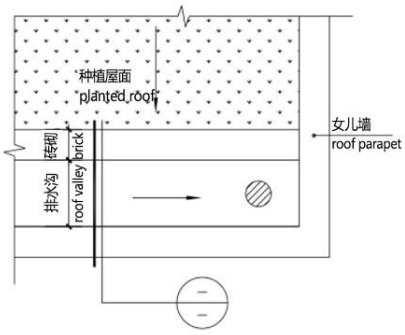
Figure 5- 17 Sponge Measures - Landscape greening system
Source: Author

In the roof system, the new terrace buildings in the site are roofed with green botany, and together with the high-rise vertical greening to create a three-dimensional ecosystem. The slope roof is combined with the ground plant bed and ecological retention facilities for rainwater collection and purification. The rain barrel transformed from the beer fermenter is also an important embodiment of the sustainable integration of industrial value and ecological value.

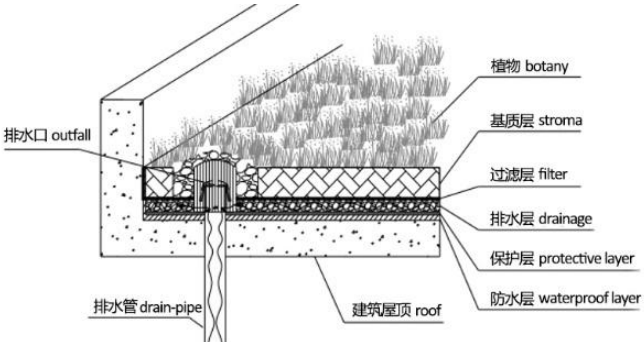


（a）Roof System Scope

（b）Green Roof Intention Effect



（c）Flat Roof - Green Roof Plan

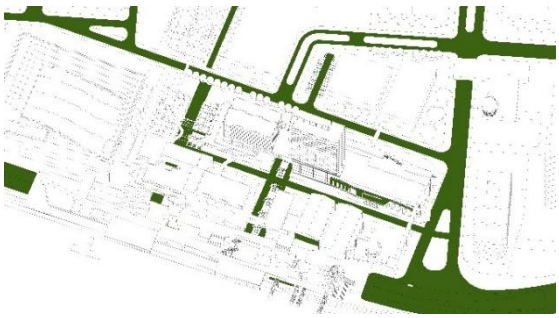


（d）Green Roof Detail Drawing

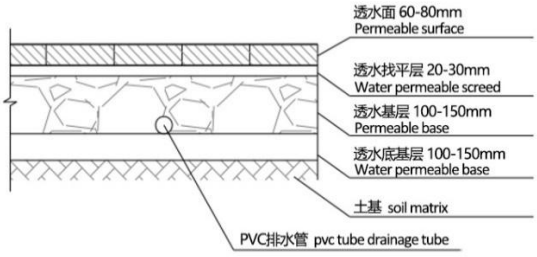
Figure 5- 18 Sponge Measures - roof system
Source: （a）（c）（d）Author（b）Internet

In the road group system, the combination of "ecological grass ditch + rain garden" is designed for the municipal road and the main road in the park to collect and reuse rainwater.

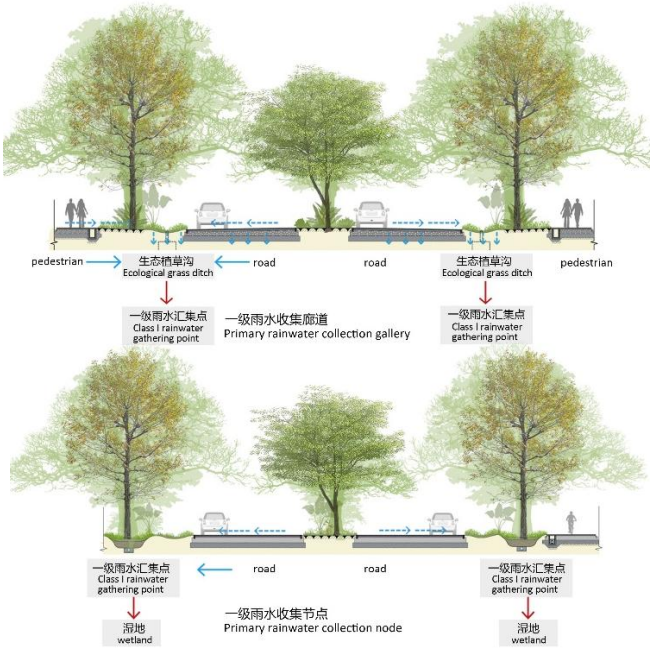
The first-level rainwater collection corridor and rainwater collection points are arranged in the way of "line + point". ①The first-level rainwater collection corridor - through the rainwater collection trench on both sides of the road and the municipal rainwater pipe network, the road rainwater collection and discharge are organized. ②Level I rainwater collection points - small rain gardens are arranged along the road to collect rainwater and then enter the park landscape green space and wetlands.



（a）Road system scope



（b）porous pavement detail drawing



（c）Sponge road design

Figure 5- 19 Sponge Measures - road group system

Source: Author

5.7 Architectural-scale symbiotic renewal design strategies

5.7.1 A4 A5 coal shed

(1) Integration of old and new

A4 and A5 coal sheds are the only two existing industrial remains of sloping roofs on the site, and the internal structure is completely reserved. The two buildings are adjacent to each other but independent, and there is only less than 2m gap between the east and west sides. At the same time, the newly-built volume

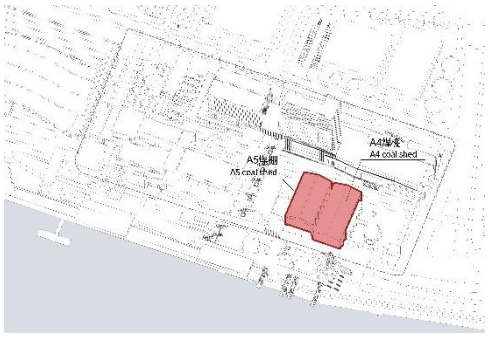


Figure 5- 20 A4 A5 coal shed

Source: Author

and two coal sheds along the internal main street on the east side continue the orderly but scattered current layout. Therefore, by placing a new volume base in connection and integrating the three building volumes, the design merges the old and new spaces and forms a complex with rich spatial changes, relying on its good geographical location, as the spatial carrier of the new culture 'CUREMARKET'.

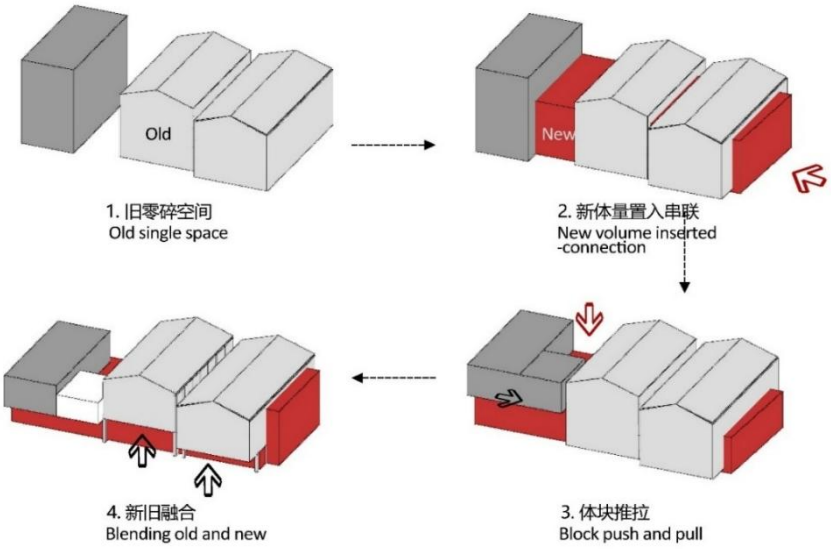


Figure 5- 21 A4 A5 coal shed renewal process
Source: Author

(2) Function replacement

Inside the building, the design organizes various functions by strengthening the urban character of the interior spaces. Using the main street to connect different food raw materials as the theme of the "island" to create a unique market space. The first floor provides citizens with a comprehensive market integrating daily dining, shopping and leisure. The second and third floors are combined with industrial cultural narration. As the first stop of the industrial memory axis, the company regularly holds large-scale activities such as beer trade exhibition and Guangzhou Food and Culture Festival to create unique IP and cultural brands, and introduces interactive research courses such as beer brewing technology class and food class. Integrate the heritage of craft culture into a real experience.

Figure 5- 22 Interior display "Box" Design
Source: Author

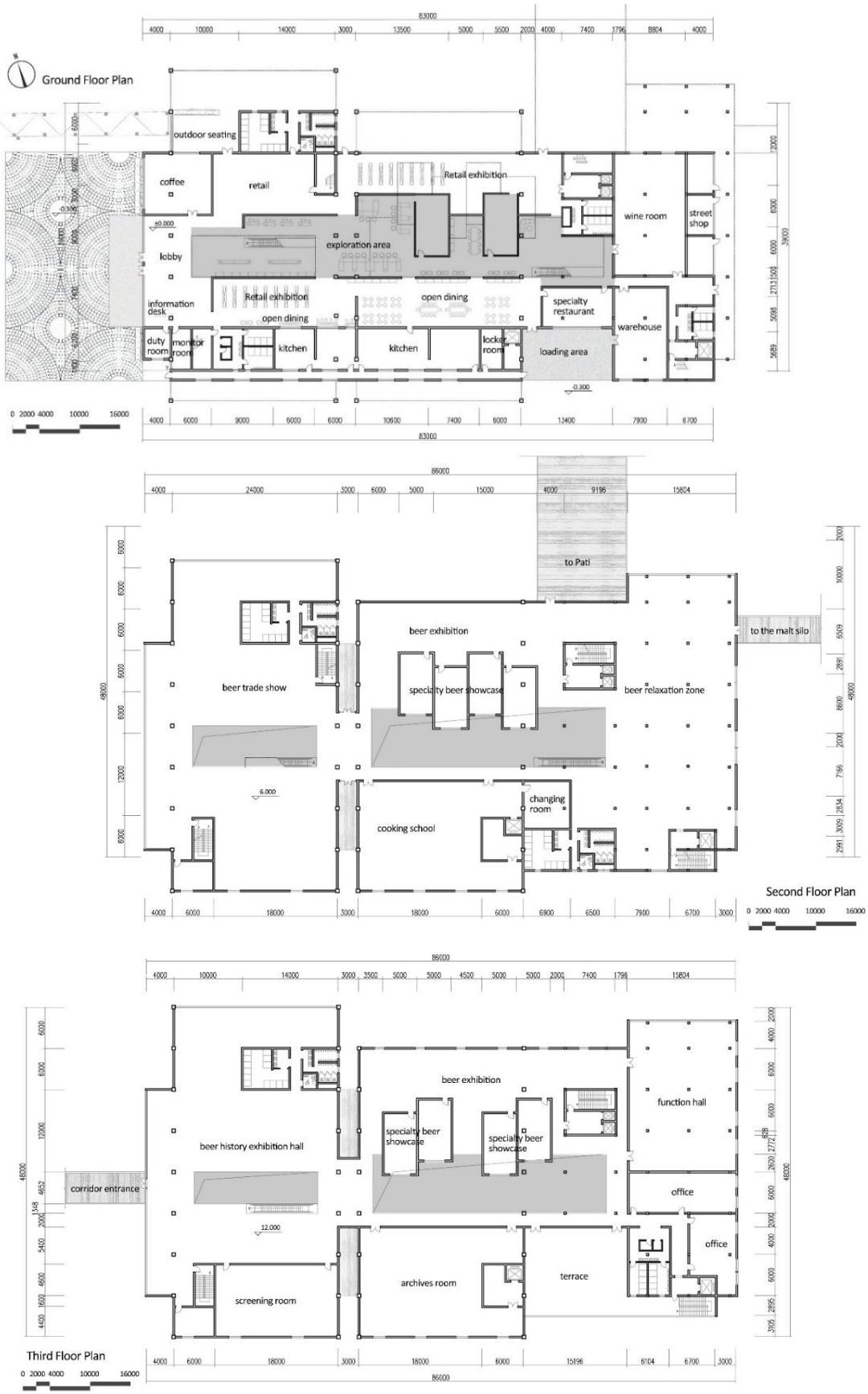


Figure 5- 23 'CUREMARKET' 3F Plan
Source: Author

(3) Facade upgrading

The volume that shielded the facade view of A4 A5 coal shed was removed, and the building interface along the river was extended to maximize the use of river view resources. On the basis of retaining the material of the facade of the old industrial building, by laying the concave and convex metal mesh, the industrial memories and traces are not only preserved, but the facade is also successfully protected and "renovated". In addition, the facade of the new building uses reflective glass curtain walls to contrast with the old material, while Led screens are added to the gables to increase the commercial value of the area.

Figure 5- 24 A4 A5 coal shed Facade
Source: Author

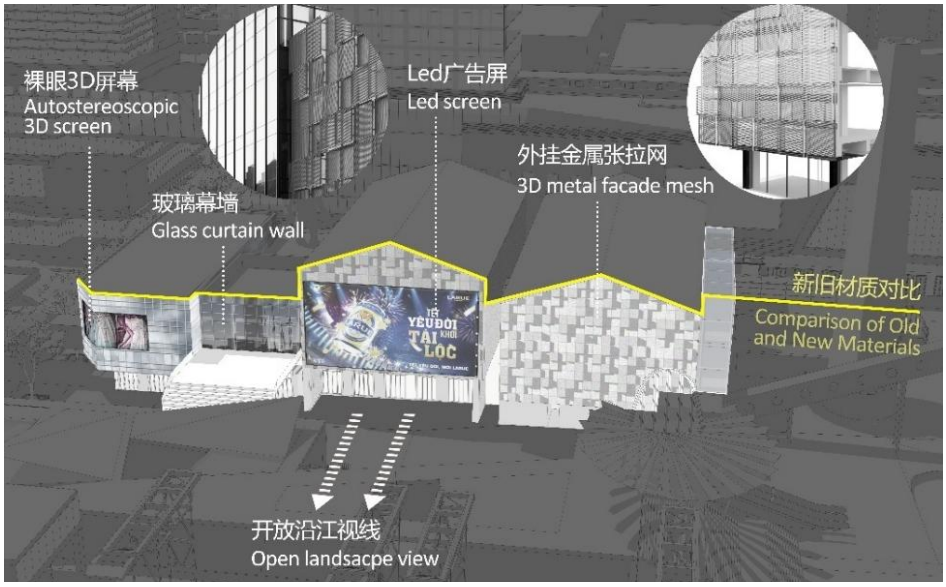


Figure 5- 25 Façade Reconstruction Strategy
Source: Author

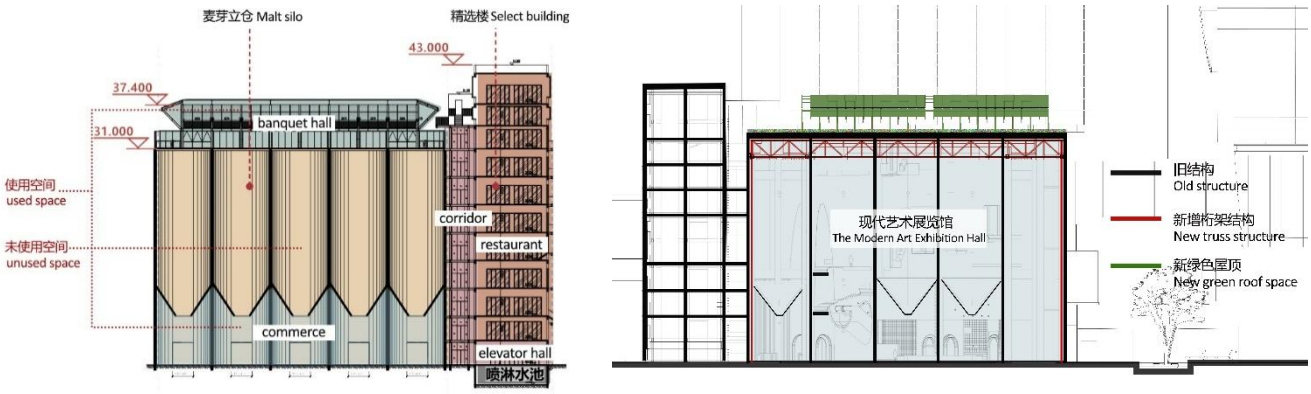
5.7.2 Malt silo and Selection building

The construction area of the malt barn is about 1566 square meters. The bottom function of the interior is the business, the top is the banquet hall, and the middle part of the silo space is unused. The current facade is closed and only the commercial entrance along the street is opened to the public.

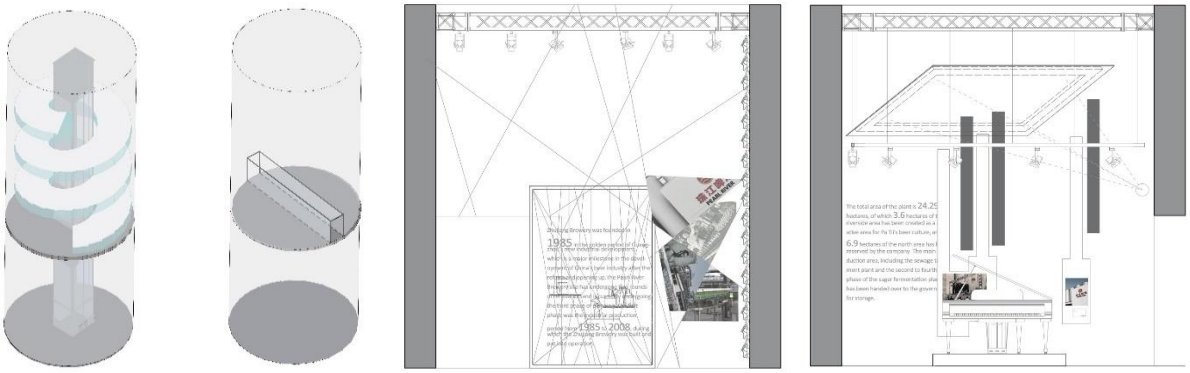
（a）Malt silo position （b）Malt silo facade （c）Malt silo interior space

Figure 5- 26 Malt silo current situation

Source: Author



（a）Low utilization of internal space(before) （b）Internal space reuse(after)



（c）Silo internal traffic improvement （d）Technology empowers spatial experience

Figure 5- 27 Internal transformation strategy of malt silo

Source: Author

The heritage rating of the Malt silo is ranked as "traditional architectural clues", and experts propose a conservation strategy that "the main facade should not be changed, and other parts should be allowed to change". Therefore, the design retains the authenticity of the facades along the river, focusing on improving the utilization of the internal space of the building and the reuse of the roof.

(1) Virtual-real symbiosis empowers spatial experience

The design increases the stability of the building by adding the truss long-span structure, and provides the structural foundation for adding new space inside the silo. After the transformation, the space functions as a modern art exhibition hall. By placing a new space in the vertical direction, the utilization rate of the middle and upper space of the original silo is improved. The traffic is organized by two kinds of intervention methods, one is to add vertical elevator and spiral staircase as the connection of vertical traffic, and the other is to connect adjacent silos as the horizontal traffic connection.

In terms of spatial experience, technology is used to enable the reproduction of historical production scenes and create a spatial experience of symbiosis between virtual and real. The interactive experience device is applied to research system projects such as history exhibition, music experiment, culture and education. For example, through immersive movement and touch of sensitive environment and interactive projection, the exhibition experience is created for each participant, turning the participant into the creator of the scene and story.

(2) Reuse of roof space

The steel structure of the original silo was partially demolished on the roof, and the urban green viewing rooftop was created by taking advantage of the excellent viewing of the malt silo along the river. The gaps between silos are sewed by skylights to create a clever light and shadow change for the interior exhibition space. The rooftop ceiling adopts ETFE flexible inflatable film, ultra-lightweight materials can effectively reduce structural load and construction costs, and partially lay solar photovoltaic panels, further improving the sustainability and energy efficiency of the building.

Figure 5- 28 Malt Barn Roof Reconstruction Strategy
Source: Author

5.7.3 Beer fermenter and cap

(1) Internal structure symbiosis

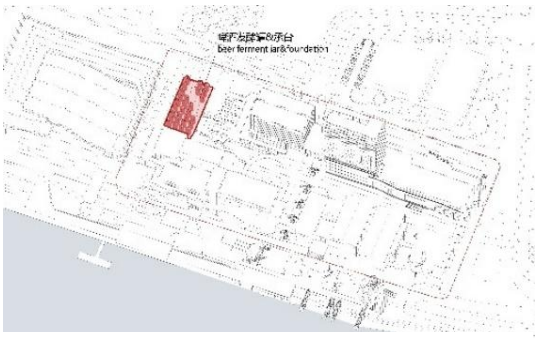


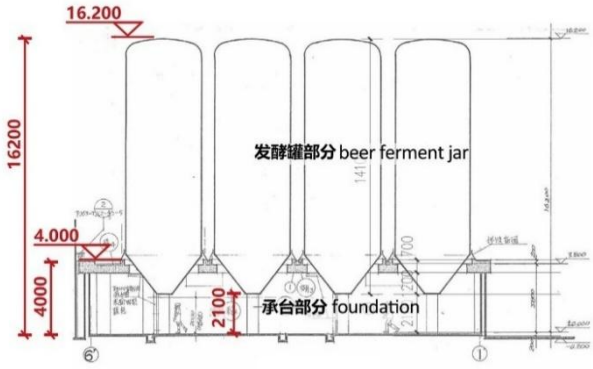
Figure 5- 29 Beer fermenter and cap
Source: Author

The beer fermenter and cap are located on the southeast side of the site, with closed and disorderly facade and dense pipelines. According to the survey and mapping, the current situation of the fermenter internal cap space is relatively short, the lowest part of the bottom of the tank is less than 2m, and the space utilization rate is low. The fermenter is the only existing tank at the former site of Pearl Beer with the most complete industrial memory element, which is iconic and unique and worth preserving. Therefore, the design retains the original fermenter tank as a continuation of the industrial memory, and carries out partial renovation, rebuilding the original cap structure to increase the internal space clearance height, and adopting a modular extensible structure to facilitate installation and control the cost. The renovated interior space of the ground floor serves as a daily activity center, providing convenient places for citizens to rest, exercise and communicate.

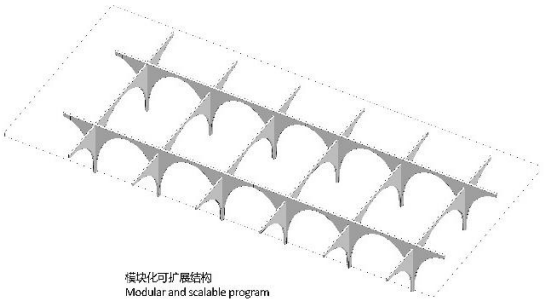
(2) Green and sustainable technology

Secondly, the fermentation tank building unit makes full use of sustainable green technology, the overall continuation of the "three-dimensional forest" greening strategy of

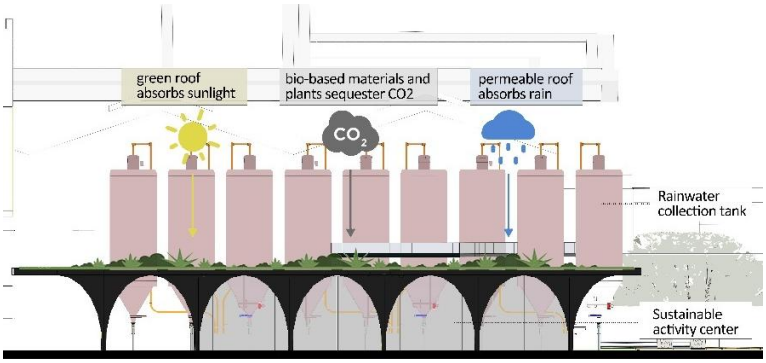
environmental symbiosis, the top of the new cap as the roof greening, laying permeable materials and bio-based green plants; At the same time, the beer tank body is transformed into a rainwater tank, which together acts as a green infrastructure for the roof system of the sponge city.



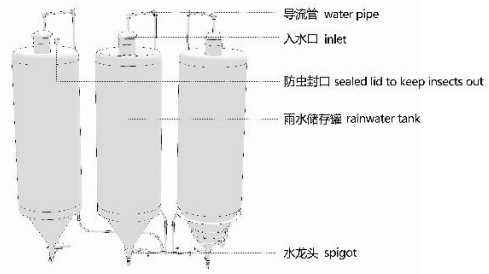
（a）Fermenter size(before)



（b）Modular extensible structure



（c）Ecological landscape roof(after)



（d）Beer cans -- rain tanks

Figure 5- 30 Transformation strategy of beer fermenter and cap

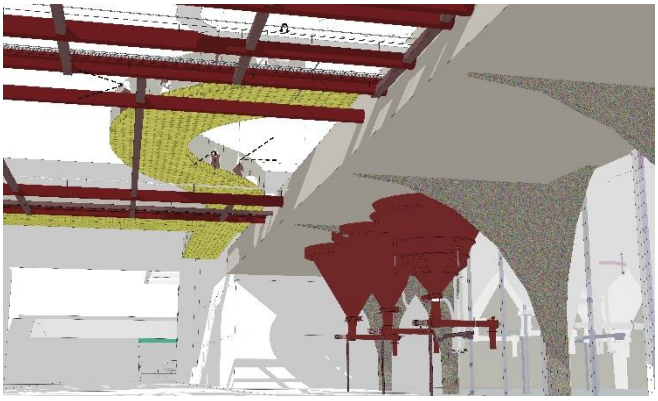
Source: Author

(3) Industrial space narrative plaza

Fermentation is an important part of the beer production process and an important embodiment of the industrial memory of Zhujiang Brewery. The fermentation tank building has also become a landmark presence in the park because of its unique shape, and is also the last plaza of the narrative axis of the industrial memory space in the site. The design allows visitors to experience the old industrial atmosphere at close range by partially retaining the industrial equipment pipeline and setting up an aerial corridor over the pipeline and beer can forest, thereby evoking historical memory and reshaping the symbiotic relationship between the industrial giant and the scale of urban life. The 40 fermenters were designed for partial

extraction and displacement according to the aerial corridor path, and were displayed as landscape installations in the park.

（a）Beer fermenter (before)



（b）Reserved pipeline below new corridor

Figure 5- 31 Before and after renovation of beer fermenter and cap

Source: Author

5.8 Summary

Based on the symbiosis theoretical framework and combined with the investigation results of the current "symbiosis system" of Zhujiang Brewery, this chapter completes the two steps of the symbiosis renewal design path in sequence: "Step 2: Determine the design objectives" and " Step 3: Develop a symbiotic design strategy ".

According to the current situation and design conditions, the renovation of Zhujiang Brewery mainly established four core design goals: to create an open and integrated urban waterfront public space, to establish a new image of a modern Pearl beer factory, to create a green ecological natural oxygen bar, and to establish a new cultural and educational comprehensive experience base. According to the four types of design expression (city, culture, environment and architecture) summarized in the translation of industrial remains by symbiosis theory, the corresponding design strategy is proposed.

In terms of urban symbiosis, the industrial area is opened up in terms of spatial pattern and traffic planning, and the two boundary spaces are reshaped. In terms of cultural symbiosis, the integration and symbiosis of industrial culture, regional culture and new era culture and their landing operations in architectural and spatial design are considered comprehensively. In terms of environmental symbiosis, a new model of ecological industrial recycling production is

established by maximizing the sight line of riverside landscape, increasing greening facilities and using low-carbon technologies. In terms of architectural symbiosis, the three groups of important industrial remains retained in the site are designed in detail, and technology and artistic techniques are used to achieve a "new life" across time, transforming the factory into a comprehensive education base integrating cultural research, art exhibition and new business experience.

This chapter verifies the operability of the design path and strategy of industrial remains symbiotic renewal in specific project practice, hoping to provide a certain research basis for the renewal design of the same type of projects in the future through the practice of the industrial remains renewal design project of Zhujiang Brewery.

Conclusion and Outlook

1. Research Conclusions

From the perspective of "symbiosis theory", this paper discusses the new mode of urban industrial remains renewal. By studying relevant theories and combining case studies of industrial remains renewal at home and abroad, this paper proposes the needs, principles and strategies of industrial remains renewal, and applies them to the design practice of Zhujiang Brewery. The main research results are as follows:

In terms of theoretical research, the related concepts and theories such as industrial remains and symbiosis theory are summarized. Starting from the origin and development of symbiosis theory, this paper deeply analyzes the ideas and connotations of each stage of Kurokawa's symbiosis theory, and defines the three elements and necessary conditions for realizing symbiosis development in the field of architecture and urban design. Through the critical analysis of symbiosis, the practical enlightenment and optimization direction of symbiosis theory in the new era are put forward. Finally, the philosophical connotation of the symbiosis theory is disintegrated and summarized, and the concrete design performance of the symbiosis theory in the renewal of industrial remains is summarized into four categories: city, culture, space environment and architecture. The research finds that the concept of "heterogeneous coexistence" emphasized by the symbiosis theory is highly consistent with the inclusive and mixed characteristics demonstrated in the urban development process of Guangzhou. Especially when dealing with the relationship between industrial heritage and modern cities, the symbiosis theory provides an intermediate path that respects historical stratification and is oriented towards future development, which offers a new idea for solving the binary opposition predicament of "protection and development" that is prevalent in urban renewal in Guangzhou.

In terms of case study and strategy proposal, the domestic and foreign case studies are placed in the framework of basic elements proposed by the previous symbiosis theory: That is, the symbiotic design strategy in the case was analyzed based on the framework of the three

elements (symbiotic unit, symbiotic environment and symbiotic mode). Combined with the corresponding questionnaire survey results, the connotation and demand for the renewal of industrial remains from the symbiotic perspective were summarized as: an open and transparent urban interface, a harmonious blend of cultural genes, a coordinated spatial form inside and outside, and a structural function of the new and old symbiosis. Based on this, it puts forward the renewal principle and design path of industrial remains from the perspective of symbiosis - " ①Analyze the current symbiotic system, ②Determine the design objectives and ③Develop symbiotic design strategies ".

In terms of design practice, taking the industrial remains renewal project of Guangzhou Zhujiang Brewery as the object, this paper firstly makes a comprehensive review of its renewal process, and makes it clear that the prerequisite for this design is based on *the 2015 urban design control regulations of Pazhou West District* and the 2024 Zhujiang Brewery office high-rise project. The analysis and assessment of the symbiosis status of the base were carried out through site investigation, questionnaire survey and architect interview. Based on the logic of the three elements of symbiosis, the two types of symbiosis units, symbiosis environment and symbiosis mode of the base were studied respectively, and the current problems including unreasonable traffic planning, single functional business mode, commercial occupation of river view resources and insufficient green space were summarized. Based on above research conclusions, combined with the previous theoretical research and strategy summary, the practice of symbiotic renewal of industrial remains in the district is carried out successively. Specific design schemes are proposed from four aspects: industrial remains and city symbiosis, industrial remains and culture symbiosis, industrial remains and environment symbiosis, and industrial remains and architectural symbiosis:

Urban symbiosis level: Proposes an open space system in line with the spatial pattern of Pazhou West District, carries out hierarchical design of the overall traffic system in the park, and focuses on the renewal design of the boundary space in Zhujiang Brewery and Pati and the city respectively, so as to improve the traffic patency of the Pearl River and activate the vitality of the boundary space. In the aspect of urban landscape, Zhujiang · Pati is regarded as a major

landscape plaza and other landscape plazas in Pazhou West District to form a good landscape spatial structure system.

Cultural symbiosis level: The new air corridor connects the preserved old industrial remains as a spatial narrative carrier of industrial memory, while the main street shops at the bottom continue the regional elements of the arcade, providing a new material space carrier for the inheritance of industrial culture and regional culture through the introduction of a new commercial experience mode.

Environmental symbiosis level: Focus on the new and old symbiosis design of the three plaza Spaces and the ecological sustainable landscape design of the whole park. According to different types of park landscape, sponge city strategies are proposed.

Architectural symbiosis level: Put forward targeted renewal strategies for the three groups of old industrial relic buildings retained in the park. A4A5 Coal Shed integrated as a "new culture carrier Curemarket" comprehensive experience market, complex business, exhibition, research, experience and other functions; The Malting Silo and the Selection Building solve the problem of low utilization rate of the internal space; Beer Fermenter and Cap combined with their own characteristics to transform into a sustainable green civic activity space.

Through the research of every step from theory to practice, the author has actively explored the design of symbiotic renewal of industrial remains, and finally formed a design result that closely combines theory and practice. It is hoped that this paper can provide a reference methodology for the renewal design of industrial remains in urban environment, transform industrial remains from the urban "gray" area into an opportunity for urban development, and finally form a reliable path conducive to sustainable development.

2. Innovation points of the paper

The innovation of this paper mainly includes the following two aspects:

(1) Innovation Of Research Perspective: Expanding the research perspective to more widely existing urban industrial remains has universal research value.

Different from the existing studies, which mostly focus on industrial heritage with outstanding historical value, this study extends its vision to industrial remains more widely existing in cities, and selects Guangzhou Zhujiang Brewery as a typical representative, whose value features show the universal characteristics of industrial remains: There are not only buildings with preserved value, such as saccharification workshops, which witness the development of Lingnan beer industry, but also a large number of ordinary production plants and infrastructure. This mixed state is the general picture of urban industrial land in China, and a systematic study of it can provide a general strategy for the renewal of more extensive industrial lots.

(2) The Close Combination Of Theory And Practice: the connotation of symbiosis theory is deeply studied and translated into the design performance of industrial remains renewal, and then the renewal path and strategy based on symbiosis are proposed.

The pluralistic and hybrid characteristics of industrial remains are intrinsically consistent with the core proposition of symbiosis theory. By exploring the connotation of symbiosis theory, the paper translates "Sacred Domain", "Dao" and "Intermediate Zone" into the specific design performance of the industrial remains renewal field, and classifies them as the basis for the subsequent strategy. In the case study and the analysis of the current situation of the site, the three-element structure of symbiosis is fully guided by the framework, and the analysis is carried out from the symbiosis unit, symbiosis environment and symbiosis mode. It presents a close combination of theoretical research and practical strategies, and provides an effective implementation path and strategy for the symbiotic renewal strategy of industrial remains.

3. Limitations and Prospects

Industrial remains renewal is a research topic involving a wide range and complex content. Due to the limitation of article length and subject research, this paper mainly studies its renewal strategy from the perspective of architecture and urban design. However, as a complex systematic engineering, industrial remains renewal should not be limited to the field of architecture and urban design. It also involves the cross-integration of management, economics,

sociology and other disciplines. So there is room for further integration and content expansion. In terms of design strategy, this paper mainly focuses on the specific design solutions, and has not yet deeply involved the implementation parts such as construction management and operation and maintenance. These contents also have an impact on the symbiotic development of industrial remains, so it needs to be supplemented and improved by subsequent studies.

Although this paper has obtained some research results with reference value through theoretical analysis and practical exploration, it must be recognized that there are significant differences in historical background, regional characteristics and spatial types in China's huge industrial remains, which makes the universality and applicability of design strategies still need to be verified by more extensive empirical research.

With the continuous development of related theories and technologies and the in-depth advancement of multi-disciplinary research, the research of industrial remains renewal will step in a broader development prospect. The author will continue to pay attention to the latest progress in this field, through theoretical learning and practice accumulation, and constantly improve the research ability, in order to make more valuable exploration of this topic.

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Appendix I: Questionnaire on Zhujinag Brewery Industrial Remains Renewal

Dear Sir/Madam,

Thank you for your participation! This survey aims to understand your perspectives on industrial remains regeneration and your overall impression of industrial-themed park redevelopment. Your input is invaluable, and all provided information will remain strictly confidential.

1. Your Gender? ( ) [Single-choice]*

A. Male

B. Female

2. Your Age? ( ) [Single-choice]*

A. Under 18

B. 18-30

C. 31-50

D. 51-70

E. Over 70

3. Your current profession/field of study? ( ) [Single-choice]*

A. Architectural Design

B. Urban Planning

C. Other Architecture-related Fields

D. Non-Architecture-related Fields

4. Your familiarity with industrial remains regeneration (theory/practice)? ( ) [Single-choice]*

A. Highly familiar (theoretical knowledge or extensive practical experience)

B. Moderately familiar (basic knowledge or some practical exposure)

C. Unfamiliar (no theoretical knowledge or practical experience)

5. Are you a resident near Pati Pier? ( ) [Single-choice]*

□ Yes □ No

6. Do you work near Pati Pier? ( ) [Single-choice]*

□ Yes

□ No

7. What openness level do you prefer for industrial remains in urban contexts? ( ) [Single-choice]*

A. Fully closed (isolated from the city)

B. Semi-open (moderate separation)

C. Fully integrated (open to the city)

8. How important is cultural value in industrial remains regeneration? ( ) [Single-choice]*

A. Not important

B. Moderately important

C. Very important

9. Which aspect matters most to you in industrial remains regeneration? ( ) [Single-choice]*

A. External spaces & environment

B. Internal spatial layout & exhibits

C. Circulation & visitor experience

D. Architectural façade design

10. What interests you most in regenerated industrial parks? ( ) [Single-choice]*

A. Industrial history/cultural exhibitions

B. Industrial space experiences

C. Preservation/reuse of old structures/materials

D. Creative workshops

E. Modern retail

F. Themed dining/bars

G. Sports/recreation facilities

H. Social media photo spots

I. Green/ecological spaces

J. Educational/research spaces

11. What is your primary purpose for visiting the Pearl River Brewery industrial park? ( ) [Matrix Scale Question]*

	1	2	3	4	5
Interested in industrial history	○	○	○	○	○
Interested in industrial history	○	○	○	○	○
Take photos in influencer spots	○	○	○	○	○
Dining	○	○	○	○	○
Bar-hopping/drinking	○	○	○	○	○
Attending performances/live shows	○	○	○	○	○
Shopping	○	○	○	○	○
Hanging out	○	○	○	○	○
Exercising	○	○	○	○	○
Rarely visit industrial site	○	○	○	○	○

12. When do you usually visit the Zhujiang Brewery industrial park? ( ) [Single-choice]*

A. Morning (9:00-11:00)

B. Lunchtime (11:00-13:00)

C. Afternoon (13:00-18:00)

D. Dinnertime (18:00-20:00)

E. Evening (after 20:00)

13. What impressed you most about the current Zhujiang Brewery industrial park? ( ) [Multiple-choice]*

□ Post-industrial architectural style

□ Themed beer bars

□ Cultural/art events

□ Party Pier riverscape

□ Brewery industrial structures

□ Night views

□ Beer culture museum/exhibitions

□ Tram station

□ Others

14. Does the brewery park meet your daily needs? ( ) [Single-choice]*

A. Fully meets

B. Mostly meets

C. Average (needs more functions)

D. Doesn't meet

15. Which aspects need improvement in the brewery park? ( ) [Multiple-choice]*

□ Architectural style

□ Industrial atmosphere

□ Dining/commercial options

□ Landscape/ecology

□ Cultural/art activities

□ Educational activities

□ Accommodation services

□ Transportation

□ Recreational sports facilities

□ Children's playgrounds

□ Public gathering spaces

16. How would you describe the current relationship between the brewery park and the city? ( ) [Single-choice]*

A. Fully integrated

B. Semi-open (poor riverside connectivity)

C. Semi-open (poor perpendicular connectivity)

D. Relatively isolated

17. What relationship should the future brewery park have with the city? ( ) [Single-choice]*

A. Fully integrated

B. Semi-open

C. Relatively isolated

18. How satisfied are you with the greenery and ecological environment? ( ) [Single-choice]*

A. Very dissatisfied

B. Somewhat dissatisfied

C. Neutral

D. Satisfied

E. Very satisfied

19. Which industrial structures left the deepest impression? ( ) [Multiple-choice]*

□ A4/A5 coal sheds

□ Malt silos

□ Coal conveyor

□ Chimney

□ Fermentation workshop

□ Water treatment plant

□ Steam engine room

□ Beer tanks/platforms

20. What additional functions/spaces would you like to see if the park becomes an internet-based leisure hub? [Open-ended]*

_____

Appendix II: Architect Interview – B.I.G Haizhu Bay Creative Park Renewal Project

I. Introduction

Interview Topic - Case Study of B.I.G Haizhu Bay Creative Park Project

Interviewee - Prof. Zhong Guanqiu – Co-founder of Atelier cnS & Lead Architect of B.I.G Haizhu Bay Creative Park

Date - January 24, 2025

Location - Atelier cnS, Guangzhou

Interviewer - Wu Junsha – Master's Candidate, School of Architecture, South China University of Technology

Background - This interview serves as empirical research for the thesis section "3.1 Case studies of industrial remains renewal at home and abroad – 3.1.4 Guangzhou B.I.G Haizhu Bay Creative Zone" Through a one-on-one discussion with the lead designer, it delves into the renewal design details and extracts symbiotic design approaches to inform subsequent strategy formulation.

Confidentiality State - The content is only for academic purposes, with all cited viewpoints properly attributed.

II. Interview Transcript

Opening Remarks

"Prof. Zhong, thank you for participating in this interview. I'm Wu Junsha, a graduate student from SCUT's School of Architecture. Having outlined the interview's framework, let's now proceed formally."

Q&A

Q1: Could you briefly introduce the regeneration context and design concept of this project?

"The site is located along the Pearl River's back channel with direct waterfront access. Previously, it served as the Zhonghua Group's Dagangwei Warehouse Complex - a raw material storage and production base for state-owned chemical enterprises. In 2017, we were commissioned to regenerate Haizhu's Dagangwei warehouses into a multifunctional cultural-creative district integrating 'art + sports + waterfront' elements."

Q2: Does the renewed creative park preserve industrial heritage from the original warehouses? How are old and new elements connected?
"Primarily through retaining two 1950s red-brick factories with pitched roofs. During site investigation, we discovered the river-facing facade's exposed aggregate coating concealed original brick textures. By removing this layer, we revealed the authentic structural character - a process we call 'eliminating the false to preserve the genuine.' This ensured the single-story warehouse maintains its complete historical style and façade features."

Q3: How does the project embody "symbiosis" across different dimensions?
"Symbiotic principles manifest throughout. For the pitched-roof warehouses, we preserved the original tile arrangement's rhythmic beauty while addressing waterproofing. We restored original tiles and installed transparent polycarbonate ceilings underneath - any minimal leakage would channel water to side gutters without affecting the basketball courts below. This achieves 'old-new symbiosis' by showcasing industrial aesthetics through preserved materials like purlins and tiles.
From an urban design perspective, we maintained the original spatial layout and open stacking yard areas while introducing contemporary functions. The juxtaposition of historic textures with trendy IP elements creates vibrant scenes - youths playing basketball beneath rugged red-brick roofs exemplifies this successful regeneration."

Q4: How do you respond to critiques about insufficient greenery and shading in summer?
"We preserved most existing trees but intentionally minimized planting in the waterfront plaza to retain the original stacking yard's expansive character, only adding partial turf coverage."

Q5: Comparing B.I.G's waterfront design with Pati Pier's, what are key differences in industrial waterfront regeneration approaches?
"B.I.G's simpler waterfront context emphasizes panoramic river views as a natural backdrop, which has attracted film and advertising productions. Pati Pier's waterfront required more complex interventions."

Q6: What criteria determined preservation or demolition of warehouse structures?
"Policy constraints defined this as a light-touch renovation. Later-built high-rise warehouses with white walls and dark window frames were adapted for modern leasing, while historically

significant single-span warehouses received heritage-sensitive preservation."

Q7: Was the Yi Jianlian Basketball Center planned from the outset? How was the sports-oriented programming determined?
"Yes, the client pre-negotiated with Yi Jianlian. We excavated floors in red-brick buildings to achieve required court heights. The 'sports + office' program leveraged the waterfront's open spaces - 'playing basketball beside historic riverside warehouses' became our signature scenario."

Q8: What represents the project's greatest success and regret?
"They stem from the same issue: poor peripheral connectivity. While our traffic solutions initially succeeded, the northern access road remains disconnected - an unresolved challenge."

Appendix III: Architect Interview - Pearl River Pati / Turbine Workshop Renewal Project

I. Introduction

Interview Topic - Research on the Zhujiang Brewery's Successive Regeneration Projects

Interviewee - Prof. Zhong Guanqiu – Co-founder of Atelier cnS & Lead Architect of the Pearl River Pati / Turbine Workshop Renewal

Date - January 24, 2025

Location - Atelier cnS, Guangzhou

Interviewer - Wu Junsha – Master's Candidate, School of Architecture, South China University of Technology

Background - This interview serves as empirical research for "Chapter 4: Survey on the symbiosis system of current Zhujiang Brewery. " The brewery's regeneration underwent multiple phases, including Mr. Zhong's 2009 coal conveyor wharf renewal and 2018 steam engine house adaptation—both benchmark examples of industrial remains regeneration in China. The discussion aims to extract first-hand design insights from the architect's professional perspective.

Confidentiality State - The content is only for academic purposes, with all cited viewpoints properly attributed.

II. Interview Transcript

Opening Remarks

"Prof. Zhong, thank you for participating in this interview. I'm Wu Junsha, a graduate student from SCUT's School of Architecture. Having outlined the interview's framework, let's now proceed formally."

Q&A

Q1: According to public records, the Zhujiang Brewery regeneration underwent multiple phases. How would you position your team's 2009 Pati Pier renewal and 2018 Turbine Workshop renovation within the macro process? What differentiated considerations guided their positioning?

"The 2009 Pati Pier renewal was driven by Guangzhou's Asian Games context. Located opposite Haixinsha Island with the brewery still operational and poor riverscape conditions,

we prioritized waterfront landscape improvements first. By the Turbine Workshop renovation, production had ceased completely, marking the beginning of Pati Pier's comprehensive transformation - initially serving as Zhujiang Brewery Group's offices. These two renewals represent pre- and post-production cessation stages, with Pati Pier being more reactive and the Turbine Workshop initiating proactive transformation."

Q2: Are you satisfied with both projects' outcomes compared to initial design expectations?
"Generally yes. Both the Turbine Workshop and Pati Pier achieved short-term alignment with design intentions. However, with ongoing urban development and environmental changes, Pearl River Pati Pier now needs to evolve to keep pace with the city's progress."

Q3: The 2009 Pati Pier project proposed "landscape-architecture integration" through continuous folded terrain design, but currently commercial elements dominate the waterfront. How is your perspective?
"The original landscape design operated as planned for about three years. As Pati Pier's bar district gained popularity, developers gradually added structures for commercial benefits. While the overall riverside profile remains visible, the details and user experience differ significantly now."

Q4: Site surveys show weak perpendicular connectivity between Pati Pier and the brewery's retained areas. What considerations guided this aspect of the design?
"During Pati Pier's renovation, the brewery was still operational, so north-south connections weren't considered."

Q5: Could you introduce the background and overview of the Turbine Workshop project?
"After production relocation, Zhujiang Brewery Group planned to transform the site into a 'Beer Factory' cultural-commercial landmark for Guangzhou. In 2018, we renovated the most complex and representative structure - the boiler/ Turbine Workshop and connected equipment - for their office needs."

Q6: How were industrial remains reused in the Turbine Workshop? How was old-new balance achieved?
"We preserved original machinery and overhead trusses. The entrance was set back to create a

public exhibition area showcasing brewing history. Added mezzanines and flexible workspaces modernized the traditional SOE office layout, receiving positive feedback like 'more relaxed meetings' from staff."

Q7: How were post-renovation functions determined for the Turbine Workshop?
"The client established core functions initially, with operational details co-developed during design."

Q8: Did these projects embody "symbiosis"? Please provide examples.
"Pati Pier achieved urban symbiosis by enhancing public waterfront access while minimizing visual impact through landform design. The steam engine house demonstrated material and spatial old-new symbiosis."

Q9: Any advice for my upcoming symbiotic renewal study of the brewery?
"Conduct thorough research to identify the site's authentic challenges and future needs."

Appendix IV: Architect Interview - Zhujiang Brewery Office& Hotel High-rise Project

I. Introduction

Interview Topic - In-depth Discussion on the Winning Competition Proposal for the Pearl River Brewery Office Tower & Hotel Complex

Interviewee - Prof. Yu Ding – Executive General Manager & Lead Architect, IAPA Design Consultants Pty Ltd (Australia)

Date - January 25, 2025

Location - IAPA Design Consultants Pty Ltd, Australia

Interviewer - Wu Junsha – Master's Candidate, School of Architecture, South China University of Technology

Background - This interview serves as empirical research for "Chapter 4: Survey on the symbiosis system of current Zhujiang Brewery. – 4.3.4 Stage 4: Office high-rise project of ZHUJIANG BEER GROUP. "As the latest regeneration phase (Plot #4 competition), insights from the winning team's lead architect will provide first-hand design rationale and technical references.

Confidentiality State - The content is only for academic purposes, with all cited viewpoints properly attributed.

II. Interview Transcript

Opening Remarks

"Prof. Zhong, thank you for participating in this interview. I'm Wu Junsha, a graduate student from SCUT's School of Architecture. Having outlined the interview's framework, let's now proceed formally."

Q&A

Q1: What were your team's design positioning and objectives?

"The renewal vision is clear: to serve Pazhou CBD's e-commerce zone as a youth-oriented fashion hub. Anchored in the Greater Bay Area, it will blend commerce with local culture to create an international-grade urban living room showcasing Guangzhou's identity, the Pearl River, and the brewery's legacy."

Q2: What secured your proposal's winning bid?
"First, we distilled brewing culture and process into an immersive visitor circuit—using narrative sequences to link heritage structures as experiential anchors.
Second, 'heritage curation + contemporary insertion' achieved old-new symbiosis.
Third, as a civic landmark, we rigorously controlled riverfront massing to maximize public sightlines and open spaces."

Q3: Any regrets or optimizations needed?
"As for design-wise, I think it's refined. Constraints like the tram line limited some interface openings—that's the only compromise."

Q4: How does the project manifest "symbiosis"?
"As summarized earlier: mainly two aspects-Material symbiosis (e.g., repurposed beer tanks as hotel lobby centerpieces); Cultural continuity (industrial museum loop as narrative device)"

Q5: Who is the target audience? What about accessibility?
"All-age friendly, mainly CBD workers. We maximized openness to boost daytime footfall."

Q6: How did you address waterfront and urban connectivity?
"Enhanced perpendicular links via second-level platforms and public nodes. Future southern perimeter removal will further integrate the site with the city."

Q7: How did you balance commercialization and heritage preservation?
"Industrial elements like beer tanks were leveraged to elevate commercial appeal—preservation and value creation aren't mutually exclusive."

Q8: What ecological strategies were employed?
"We conducted tree surveys, developing protection protocols where design conflicted with existing greenery."

Q9: Advice for my symbiotic renewal study?
"Research global industrial adaptation trends, but ground solutions in local realities. Prioritize public accessibility."

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