华南理工大学

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专业学位硕士学位论文

城市触媒视角下广州市滨水工业遗产的更新策略研究——以广州市文冲船厂为例

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摘　　要

滨水地区由于其自然地理位置毗邻水系，自古以来便是大型工业及相关产业的聚集地。然而，近年来，随着城镇化的快速推进，城市滨水地区的工业项目逐渐外迁，城市滨水工业遗产亟需转型和更新。这些老旧的工业遗产内仍保留着一些结构完好，具有特定时代风格，反映某一时期城市记忆的优秀建筑物和构筑物。在存量发展、城市更新的背景下，提出较有针对性的滨水工业遗产的更新策略面临着诸多挑战。

广州在我国工业发展史上有着举足轻重的历史地位，其中心城区沿江一带聚集了大量年代久远、独具特色的滨水旧工业区，一部分已经被拆除或者改造，但仍有将近半数正面临城市更新的浪潮。在广州市“退二进三”的政策背景下，为满足城市新的功能需求，对广州市滨水工业遗产整体情况的梳理以及对其更新策略路径的探究具有重要意义。

本研究根据城市触媒理论及广州市滨水工业遗产现状分析，首先总结广州市滨水工业遗产具备区位条件、空间利用、文化价值、生态价值等触媒设计潜力。其次构建基于触媒理论的广州市滨水工业遗产更新策略，由触媒角度选取、触媒要素和载体确定、触媒要素激活与重塑、触媒反应控制与引导四部分组成。触媒要素包括功能、文化和生态要素;触媒载体包括点、线、面三种类型；触媒要素激活与重塑策略包括功能植入、文化植入、生态植入、重塑交通系统、重塑公共空间及新建建筑;触媒反应控制与引导包括从整体控制与分期建设两方面控制触媒反应、从政策引导与事件引导两方面引导触媒反应，促进广州市滨水工业遗产朝着积极友好的方向发展，实现与城市街区的友好联系和联动发展，激活原本衰败或闲置的工业园区，促进建筑单体的更新活化。

本研究为广州市滨水工业遗产的保护和更新提供了新的思路，也为其他城市的滨水工业遗产的管理和活化利用提供了有益的经验与启发。

关键词：工业遗产；滨水；城市触媒；广州

Abstract

Waterfront areas, due to their natural geographic proximity to water bodies, have historically been hubs for large-scale industrial and related industries. However, in recent years, with the rapid advancement of urbanization, industrial projects in urban waterfront areas have gradually relocated, creating an urgent need for the transformation and renewal of urban waterfront industrial heritage. Within these aging industrial heritage sites, some well-preserved structures with specific historical styles still exist, reflecting outstanding buildings and structures that encapsulate the urban memory of a particular era. Against the backdrop of stock development and urban renewal, the proposal of targeted renewal strategies for waterfront industrial heritage faces numerous challenges.

Guangzhou holds a significant historical position in the industrial development history in China. The central urban area along the riverbank has accumulated a large number of long-standing and distinctive waterfront old industrial zones, some of which have been demolished or renovated. However, nearly half of them are still facing the wave of urban renewal. Against the backdrop of Guangzhou's 'two out, three in' policy, to meet the new functional requirements of the city, it is of great significance to review the overall situation of Guangzhou's waterfront industrial heritage and explore its renewal strategy path.

The study, based on the urban catalyst theory and an analysis of the current status of Guangzhou's waterfront industrial heritage, first summarizes the catalyst design potential of Guangzhou's waterfront industrial heritage in terms of location, spatial utilization, cultural and ecological value. Secondly, it constructs renewal strategies for Guangzhou's waterfront industrial heritage based on the catalyst theory, consisting of four parts: selection from the catalyst perspective, determination of catalyst elements and carriers, activation and reshaping of catalysts, and control and guidance of catalyst reactions.

Catalyst elements include functional, cultural, and ecological elements, while catalyst carriers encompass point, line, and surface in three types. Strategies for the activation and reshaping of catalyst elements involve functional integration, cultural integration, ecological integration, reshaping the transportation system, reshaping public spaces, and new construction. Strategies for the control and guidance of catalyst reactions include overall control and phased construction, as well as policy and event-based guidance, promoting the positive and friendly development of Guangzhou's waterside industrial heritage, establishing friendly connections with urban neighborhoods, and fostering linked development, activating formerly deteriorated

or abandoned industrial parks, and encouraging the renewal and revitalization of individual buildings.

This study offers a new perspective for the conservation and renewal of Guangzhou's waterfront industrial heritage and provides valuable experience and inspiration for the management and activation of waterfront industrial heritage in other cities.

Keywords: Industrial Heritage；Waterfront；Urban Catalyst；Guangzhou

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Chapter 1 Introduction

1.1Research Background

1.1.1 The Emergence of Urban Industrial Heritage Preservation Concepts and Practices

Industrial heritage, as a unique type of cultural heritage, bears witness to the development of industrial civilization during a specific period. It serves as a significant carrier of urban historical development and is a valuable resource within cities, possessing multiple values. In recent years, both domestically and internationally, there has been a growing interest and emphasis on industrial heritage. Various organizations dedicated to researching industrial heritage have been established, and these organizations have promulgated and implemented a series of related laws and regulations.For instance, international documents such as the "Taltal Charter," the "Dublin Principles," and the "Taipei Declaration on Asian Industrial Heritage" have provided guidance on the definition, value, and preservation methods of industrial heritage. Their content has been progressively supplemented, amended, and refined during practical applications, providing theoretical support for the protection and reuse of industrial heritage worldwide. In terms of practical application, successful examples of industrial heritage reuse have emerged, including the Ruhr Industrial Region in Germany.The release of the "Wuxi Recommendations" in 2006 marked China's increasing attention to the preservation of industrial heritage. Subsequent conference documents such as the "Wuhan Recommendations" and the "Beijing Initiatives" signify that research on industrial heritage in China is continually entering new phases.

1.1.2 In an era of existing assets, the gradually increasing attention to the value of waterside industrial heritage

Industrial heritage, as a vital component of urban cultural heritage, has garnered international consensus regarding its value and the necessity of preservation and utilization. Currently,

research on industrial heritage has been steadily advancing. Simultaneously, against the backdrop of China shifting towards stock-based planning and advocating urban renewal, industrial former sites, as unique urban historical resources beyond the scope of industrial heritage, have gradually gained attention from various sectors of society. Additionally, urban waterfront areas, due to their advantageous locations and natural resources, have become focal points for urban renewal and development.

In regions with a relatively rapid industrialization process and strong awareness of historical and cultural preservation, some successful cases have emerged in the course of renewal practices. For example, the reuse of the Qijiang Industrial Park former site in Zhongshan, and in the urban planning of the Yangpu Riverside area in Shanghai, historical remnants of industrial heritage are preserved by integrating them with urban waterfront open spaces. Elements such as the original flood prevention walls and old dock textures are retained to create a harmonious integration of industrial heritage within the urban space, achieving regional functional integration and value enhancement.

1.1.3 Urban waterfront industrial heritage urgently requires preservation and renovation

Guangzhou holds a pivotal historical position in the development of industry in China. It was one of the earliest regions exposed to Western modern industrialization, serving as the cradle of China's modern industry and national capital industry. Moreover, it played a crucial role in the birth of modern industrialization in China. Due to its reliance on the Pearl River for transportation, one distinctive feature of the distribution of old industrial areas in the central city of Guangzhou is their linear arrangement along both banks of the Pearl River. These industrial heritage sites along the Pearl River basically cover various stages of Guangzhou's modern industrial development, effectively showcasing the city's modern industrial history.In 2008, the Guangzhou Municipal Government introduced the "Opinions on Promoting the Transformation of Urban Industries," marking a shift in industrial policy. In 2010, the Office

for the Transformation of "Three Olds" in Guangzhou was established, focusing on the renewal of old industrial areas. In 2011, the Guangzhou Municipal Planning Commission reviewed and approved the "Special Plan for the Transformation of Old Factory Buildings in Guangzhou," and in 2012, the "Guangzhou Urban Master Plan (2010-2020)" proposed combining the implementation of the "retreat from two and advance to three" policy with the renewal and transformation of old industrial areas to guide the adjustment and optimization of the industrial structure. This initiative aimed to accelerate the pace of renewal of old industrial areas with low land utilization efficiency, severe environmental pollution, and insufficient public service facilities. The goal was to optimize the functional layout of the central city area and improve environmental quality.Through the renewal and transformation of old industrial areas, space for the development of new urban industries was provided. Industrial land that was relocated was prioritized for municipal and public facility construction as well as the development of urban green spaces. In February 2015, the Guangzhou Urban Renewal Bureau was established, ushering the renewal efforts into a new normal of sustainable development. The implementation of these policies and the establishment of relevant institutions have laid an important foundation for the renewal and reuse of numerous waterfront old industrial areas in the central city area of Guangzhou.

Currently, within the central urban area of Guangzhou, a portion of waterfront industrial heritage has undergone preservation and revitalization, with some undergoing or in the process of renovation. Investigating and analyzing the preserved and revitalized waterfront industrial heritage within this context is crucial. This research aims to clarify the characteristics and development status of waterfront industrial heritage, analyze key issues and development challenges, and explore strategic pathways for future development.

1.2 Conceptual Definition and Research Objectives

1.2.1 Definition of Relevant Concepts

(1) Industrial heritage

Industrial heritage refers to the valuable forms that have been left behind during the urban industrialization process, encompassing two major categories: tangible cultural heritage and intangible cultural heritage. In 2003, the International Committee for the Conservation of the Industrial Heritage (TICCIH) published the "Taltal Charter," which defines industrial heritage as cultural remnants of industry with historical, technological, social, architectural, or scientific value. This definition also includes social spaces, religious places, educational venues, and other sites associated with a range of industrial activities, such as buildings, machinery, workshops, and factories[1]. In 2006, the "Wuxi Recommendations," published by the Chinese Industrial Heritage Protection Forum, defined industrial heritage as cultural remnants of industry with historical, sociological, architectural, technological, and aesthetic value. This encompasses industrial buildings like factories, workshops, mills, warehouses, shops, processing and smelting sites, energy production and transportation facilities, places suitable for industrial activities, transportation infrastructure, social spaces related to industrial production, industrial facilities, as well as material and intangible cultural remnants such as production processes, data records, and corporate archives[2]. In China, the industrial heritage of interest refers to the industrial heritage since the birth of modern industry after the Opium War in the 19th century. This includes both tangible and intangible aspects of industrial cultural heritage.

The industrial heritage studied in this article refers to relatively well-preserved tangible industrial heritage, including industrial buildings, industrial equipment, industrial factory complexes, and intangible industrial heritage such as manufacturing processes and industrial ethos, all of which possess significant historical and cultural value.

(2) Urban waterfront areas / Urban waterfront industrial heritage

Urban waterfront areas are transitional spaces located between urban land and water bodies, typically encompassing the land area within 400-500 meters from the urban edge adjoining water bodies. Urban waterfront areas refer to "land or buildings adjacent to rivers, lakes, oceans,

or parts of towns close to water bodies"[3], and generally consist of three components: water bodies, the water-land interface, and land areas. Urban waterfront spaces comprise both natural and artificial environmental elements, holding a unique position within urban functions. They can enhance urban biodiversity, landscape diversity, and cultural diversity. On one hand, they serve as crucial elements of urban landscapes, and on the other hand, they play a role in the urban green-blue network, contributing significantly to the maintenance and improvement of urban ecosystems.

Urban waterfront industrial heritage refers to the urban former industrial complexes located within a specific range at the interface of urban land and water bodies, which were once occupied by large-scale industrial and mining enterprises for industrial production. Within such waterfront former industrial complexes, there are not only waterfront areas responsible for transportation and shipping, including docks and ports, but also supporting facilities such as warehouses and storage yards. Additionally, these complexes encompass large industrial factory buildings, warehouses, substantial industrial facilities, and other auxiliary structures, characterized by complex architectural features and a distinct industrial character throughout the complex.

(3) Urban catalyst

The origin of the term "catalyst" is a chemical concept. In chemical reactions, a catalyst can alter and influence the rate of the reaction without undergoing any change itself, requiring only essential modifications. Its function is somewhat akin to that of a catalyst.

Any chemical reaction involving a catalyst is known as a catalytic reaction. In such a reaction, the catalyst catalyzes the surrounding environment and substances. The concept of urban catalyst derives from this and introduces the idea of catalytic action from the field of chemistry into urban development. It involves placing catalyst elements within a city, shaping them, and using them as activation points to drive the development and evolution of the surrounding environment and entities. This is achieved through the interaction between the catalyst elements and the urban surroundings to propel urban renewal and development.

A city is composed of interconnected elements with intricate relationships among them, including spatial connections, functional interplays within regions, land utility connections, regional economic interdependencies, and more. Any element that undergoes a change capable of affecting or driving changes in all other elements within a region is referred to as a "catalyst". Urban catalysts can be seen as the "catalysts" of a city. When introduced development projects or the issuance of certain policies can have a positive effect on the surrounding urban activities, these projects are referred to as "urban catalysts." Urban catalysts facilitate continuous, progressive structural transformation in the city, and their impact can be seen in the following aspects:

1. The introduction of new elements alters the surrounding elements.
2. Catalysts enhance the value of existing elements.
3. Catalysts do not compromise the essence of the current environment.
4. The selection and design of catalysts are strategic.
5. Catalysts themselves are identifiable.

Leveraging the interplay among various functions within a city, by introducing new elements or altering existing ones, facilitates self-adjustment of urban functions and achieves the self-evolution of the city. This is the focal point of the urban catalyst theory.

1.2.2 Research Objectives

The primary focus of this study is on "central urban waterfront industrial areas with heritage conservation value." This includes two key terms: heritage conservation, waterfront industrial areas. This article mainly studies the waterfront industrial heritage in the central urban area of Guangzhou.The central urban area of Guangzhou, mainly follows the definition provided in the "Guangzhou Urban Renewal Master Plan (2015-2020)." It encompasses the entirety of four districts: Liwan, Yuexiu, Tianhe, and Haizhu, as well as the area south of the North Second Ring Expressway in Baiyun District, excluding Jiulong Town in Huangpu District. This article primarily investigates the existing waterfront former industrial areas within the central urban area. By organizing the waterfront former industrial areas within the scope of the study, the

research objectives are identified as 42 waterfront former industrial areas, including those that have been renovated and those awaiting renovation[4].

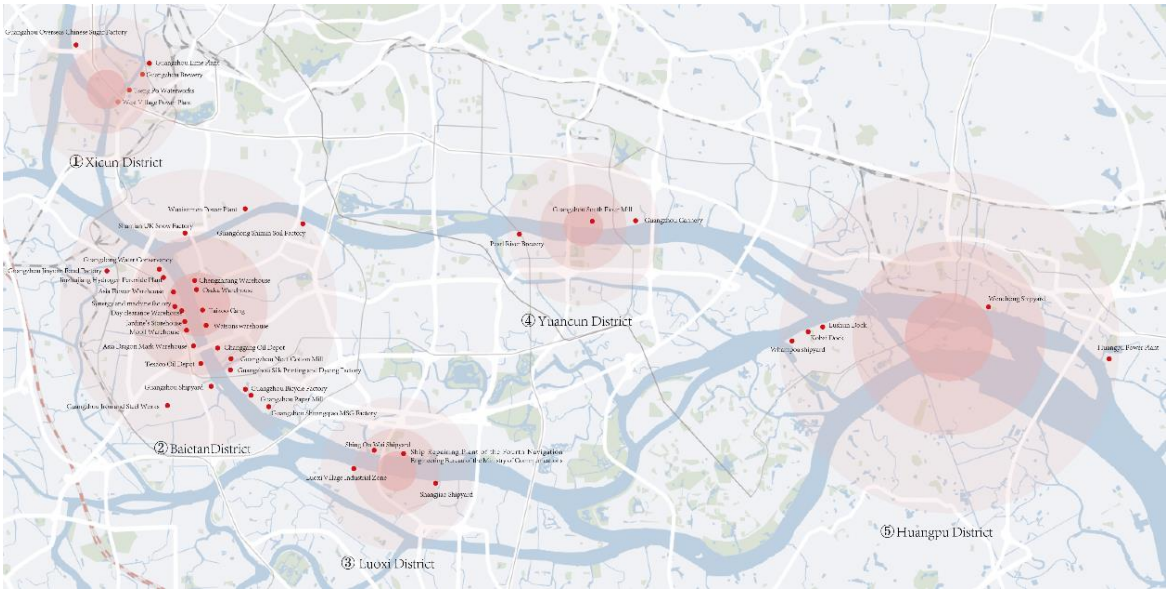


Figure 1-1 Spatial distribution map of waterfront industrial sites in central Guangzhou
(Source: Self-Drawn by the Author)

1.3 Research Purpose and Significance

1.3.1 Research Purpose

Systematically reviewing the value of Guangzhou's urban waterfront industrial heritage, assessing its current status, and summarizing its shortcomings in terms of revitalization and reuse form the basis of this research. On this basis, this study proposes renewal strategies for Guangzhou's waterfront industrial heritage from the perspective of urban catalysts, aiming to effectively address the aforementioned issues. This article centers its discussion on Guangzhou's waterfront industrial heritage, with research objectives primarily involving the following aspects:

(1) Validating the feasibility of introducing the urban catalyst theory to Guangzhou's waterfront industrial heritage

This research attempts to explore the connections between Guangzhou's waterfront industrial heritage and the city from the perspective of urban catalysts. Through effective design strategies, it seeks to transform abandoned industrial sites into new spaces that adapt to and serve urban

residents, promoting spatial vitality regeneration and sustainable development. This validates the possibility of introducing the urban catalyst theory to Guangzhou's waterfront industrial heritage.

(2) Proposing renewal strategies for Guangzhou's waterfront industrial heritage from the perspective of urban catalysts

Through case studies of successful introductions of the urban catalyst theory to waterfront industrial heritage, this study takes Guangzhou's waterfront industrial heritage as a spatial object and urban residents as the user base. It aims to provide targeted and focused design renewal strategies, offering more insights and possibilities for the reuse of waterfront industrial heritage spaces.

1.3.2 Research Significance

The research significance of this paper is discussed from both theoretical and practical perspectives, as outlined below:

(1) Theoretical Significance

Through the investigation of the current status of Guangzhou's waterfront industrial heritage and the organization of diverse industrial heritage information, this research provides valuable foundational data for subsequent studies on Guangzhou's waterfront industrial heritage.

The application of the "urban catalyst" theory to the renewal strategy research of Guangzhou's waterfront industrial heritage expands new perspectives for its revitalization. This strategy solidifies the theoretical foundation for the revitalization of Guangzhou's waterfront industrial heritage, complementing and enhancing the theoretical research in the field of industrial heritage renewal.

(2) Practical Significance

Studying the renewal strategy of Guangzhou's waterfront industrial heritage from the perspective of the "urban catalyst" can help avoid losses in terms of manpower and resources caused by large-scale demolitions and constructions. It also showcases the value of Guangzhou's waterfront industrial heritage, enhancing the vitality of this type of industrial heritage and the surrounding areas. This has a positive impact on Guangzhou's urban development, contributes to the continuation and inheritance of industrial heritage culture and urban historical context, and brings economic and cultural benefits to urban development, promoting sustainable urban construction.

The renewal strategies proposed in this study from the perspective of the "urban catalyst" for Guangzhou's waterfront industrial heritage can also serve as a reference for the renewal of waterfront industrial heritage in other areas.

1.4 Literature Review

1.4.1 Literature Review on Urban Waterfront Industrial Heritage in China and outside China

(1) Literature Review on Waterfront Industrial Heritage outside China

Research on waterfront industrial heritage abroad originated from the practicality of renewing urban dock industrial areas[4]. Examples include London's Canary Wharf, New York's Battery Park City, Vancouver's Granville Island, Sydney's Darling Harbour, or San Francisco's Mission Bay projects. Historically, urban waterfronts have always been transit points for goods import and export. With the development of the economy and society, technological advancements and transformations have reshaped the relationship between transportation and industry. Since the 1960s, the renewal and development of urban old industrial waterfront areas have been a focal point of academic attention. In 1999, experts from various fields including politics, planning, and finance participated in a conference themed "Post-Industrial Waterfront Cities," with major participants including cities like Amsterdam, Bilbao, Genoa, Havana, Las Palmas, Shanghai,

Sydney, and Vancouver. The conference discussed the challenges currently faced by these urban waterfront areas and incorporated them into a broader discussion of contemporary urbanism[5].

Foreign scholars have conducted research on the practice and theory of urban waterfront industrial areas, covering multiple fields. R. Timothy Sieber conducted research on the revival of post-industrial port city waterfront areas in North America, proposing theories of waterfront redevelopment. His research explores strategies for waterfront area revival from the perspectives of the relationship between the city and nature and the relationship between the past and the present[6]. Ann B. suggested that abandoned urban old industrial areas should undergo rational renewal and utilization to create vibrant waterfront public spaces[7]. Brian Hoyle and others discussed methodological approaches to the strategic assessment of three major naval port cities in the UK based on waterfronts. Through critical analysis of results and issues, they proposed a heritage-based revival assessment framework for naval city ports in a broader context[8].David L.A. Gordon analyzed the case of the renewal of the Boston Navy Yard and explored the mechanisms and development patterns of urban waterfront redevelopment within a historical context[9]. Aspa Gospodini established a framework for the reconstruction of Greek urban waterfront areas from the perspectives of Greece's development prospects, urban design methods, and urban spatial characteristics[10]. Richard Marshall examined the reconstruction of relationships between old cities and water from four aspects: their connection to the waterfront, reshaping urban images, the relationship between ports and cities, and new waterfront areas in historical cities. Through case analyses of multiple cities, he explored methods for rebuilding relationships between old cities and water, adaptive development patterns, and the mechanisms of industrial waterfront area redevelopment[5].Carie Grassi used Brooklyn's post-industrial waterfront area as an example to analyze how community history, residents' experiences, and external development interests interact with urban waterfront planning methods, exploring dynamic approaches to waterfront area planning and design[11]. Luis Loures examined the design principles of the left bank of the Arade River's

post-industrial landscape from the perspective of utilizing the value of industrial heritage[12]. Zeynep Gunay discussed the contribution of a culture-led approach to waterfront regeneration in Istanbul using the "Golden Horn Cultural Valley" project as an example[13]. Irene Curulli conducted research on the transformation of the Brabant Stad industrial canal landscape loop connecting five Dutch cities, studying the layered structure of industrial canal areas and proposing high-quality solutions for the harmonious coexistence of old and new buildings[14].Brennan Guse, through case studies and community development analysis, presented a landscape-based approach using phased development strategies to provide recommendations for the revitalization of the southern waterfront in Parry Sound's post-industrial era[15]. Ece Kaya, from a spatial perspective, explored the transformation paths of Australian waterfront industrial areas and the economic and social factors behind consumption phenomena through the study of two objects,the Rocks and Darling Harbour[16].

(2) Literature Review on Waterfront Industrial Heritage in China

In recent years, research on waterfront industrial heritage in China has become a focal point for scholars, with an increasing amount of related research content and a broader scope. Numerous theories and practical projects related to the revitalization of waterfront industrial heritage have been developed.

In terms of practical case studies, various research efforts have been undertaken. For instance, a study by Tian Yan et al. examines the revival of industrial heritage in the Left Bank area of Paris and explores models and methods for the revitalization of urban waterfront industrial areas, considering the current development status of Wuhan city[17]. Yan Bo et al., using the example of Shanghai Jiangnan Shipyard, investigate the revitalization path of urban waterfront industrial heritage from the perspectives of cultural continuity, landscape reuse methods, organic building renewal, and waterfront ecological restoration[18]. Zhu Rong analyzes the transformation of Dilworth Dock in the UK and explores the urban revitalization strategies of waterfront industrial heritage as catalysts for urban vitality[19]. Zhang Qiang delves into the renewal of Shanghai's Yangpu waterfront industrial heritage, focusing on historical continuity, spatial

quality enhancement, and spatial service level improvement[20]. Chen Fei et al. study the historical characteristics and construction history of Japan's Keihin Coastal Industrial Zone, summarizing experiences and lessons in industrial heritage renewal and proposing development strategies for coastal industrial areas[21]. Yao Peng analyzes the design concepts, spatial structures, and other aspects of the Hudson River Park in New York to investigate reuse methods for urban waterfront industrial areas based on open space patterns[22]. Zhu Xiaoqing et al. use the industrial heritage buildings along the Hangzhou section of the Beijing-Hangzhou Grand Canal as an example to explore landscape design and reconstruction strategies for urban waterfront industrial landscapes, focusing on the permeation of architectural and external spaces[23]. Wang Min analyzes the elements, characteristics, and values of urban waterfront industrial heritage, investigating protection and activation models for various types of industrial heritage[24]. Wang Jun et al. use the Yantai Shipyard Repair Plant as a case study to discuss design methods for the renewal of waterfront industrial heritage, considering spatial texture maintenance, historical and cultural inheritance, building renewal, and external space creation[25]. Zhu Demin evaluates the transformation and reuse of waterfront industrial heritage in the historical district of Hangzhou's Qiaoxi, considering factors such as the dynamics of reuse, characteristics, and current issues, ultimately proposing activation strategies within the context of historical districts[26]. Chi Fang'ai et al. use the industrial heritage within the Jing-Hang Grand Canal corridor in Gongshu District, Hangzhou, as an example to establish a symbiotic system between the city and waterfront industrial heritage based on the concept of architectural "recycling"[27]. Zhu Yichen et al. explore strategies for the transformation of various types of waterfront industrial heritage using Suzhou River as a case study[28]. Zhang Hong provides an overview of the historical background and renewal characteristics of Guangzhou's central urban waterfront industrial areas, summarizes renewal experiences and lessons, and offers optimization suggestions for the renewal of Guangzhou's central urban industrial areas[4]. Liu Yifei discusses practical models and strategic methods for the spatial transformation of industrial heritage along both sides of the Shiqi River, emphasizing a humanistic approach, and

proposes an implementation framework for heritage renewal and related urban spatial development strategies[29].

1.4.2 Literature Review on Catalyst theory in China and outside China

(1) Literature Review on catalyst theory outside China

In recent research related to catalyst theory and industrial heritage conservation, scholars have explored several key areas, including fundamental theoretical research, urban design, and industrial heritage preservation.

① Fundamental Theoretical Research

American architects Wayne Atton and Donn Logan started with the issue of using European architectural theory in the United States, addressing problems in American urban development. They introduced the concept and behavioral patterns of urban catalyst to adapt to the needs of localized urban development in the United States [30]. American scholar Bohannon and Cermetrius Lynell considered urban catalysts as a new urban revitalization strategy composed of a series of projects that drive and guide urban development. They defined and explained the mechanisms behind urban catalysts, using multiple cities in Tennessee, USA, as case studies to demonstrate the role of catalyst theory in urban revitalization[30]. Maria Cerreta and Ilaria Salzano conducted a multi-level analysis of factors influencing urban transformation. They explored the positive impact of "green urban catalysts" in urban planning[32]. Juliet Davis used Thames River Riverside Park as a case study to analyze the mechanisms by which catalyst theory affects urban spaces and extended the conceptual content of catalyst theory[33]. Colornio et al. analyzed the feasibility of large-scale urban development over the past thirty years, focusing on the city of Milan, Italy. They emphasized the role of large-scale project selection and construction as catalysts for driving socioeconomic development[34].

② Urban Design

T. S. Chapin assessed the ability of major sports facility projects in Baltimore and Cleveland to promote urban revitalization. Major sports projects increased vitality in urban core areas and catalyzed improvements in regional social functions[35]. Grodach Carl studied the role of well-known museums in attracting visitors and conducting commercial activities in Los Angeles and San Jose, California. He proposed that embedding cultural strategies, such as museums, as urban catalyst elements can promote urban revitalization[36].Juliet Davis analyzed the catalyst role of architectural projects in urban revitalization[37]. Tseng Y. N. suggested that major events play a significant catalyst role in urban sustainability development[38]. Beck D. discussed the positive catalyst role of urban heritage in community and public activities[39].

③ Industrial Heritage Preservation

Hentil H-L highlighted the importance of abandoned industrial areas built in the late 19th century or former transportation hubs on the edges of old urban areas in urban transformation. He demonstrated the positive role of abandoned industrial sites in urban culture and economy by analyzing the development potential of remaining urban spaces[40]. Fetters D. addressed the increasing abandonment rates of railways in the United States since 1980 and their connection to urban issues. Using the case study of the Burbank abandoned railway branch line's revitalization, he proposed that these abandoned railways could be transformed into public spaces to catalyze the revitalization of surrounding areas[41]. Loures L. pointed out that abandoned industrial land within cities can be reshaped through renovation to create unique industrial landscapes. These spaces can serve as public areas meeting the needs of socioeconomic development and public social life, acting as catalysts for urban revitalization[42]. Peters D. studied large railway projects in Germany as catalysts for driving urban socioeconomic development[43]. Ashima Krishna analyzed the role of Lucknow, an Indian historical and cultural city, as a catalyst in preservation through politics, economics, and public participation[44].

(2) Literature Review on catalyst theory in China

After the introduction of urban catalysis theory from abroad to China, scholars actively applied it to research on social development and urban construction. Research on industrial heritage-related topics mainly focuses on three aspects: basic theoretical research, urban design, and the preservation and revitalization of industrial heritage.

① In terms of basic theoretical research

Research on catalysis theory in China primarily involves summarizing the mechanisms and conceptual content of catalysis theory. Jin Guangjun analyzed the catalytic role played by large-scale urban construction projects in strengthening the urban functional structure, enhancing urban quality, and shaping urban image. They proposed strategies for site selection, positioning, and harmonizing with the surrounding environment for large-scale projects, making them a driving force for urban development[45]. Yang Jimei studied the role and mechanisms of cultural catalysis in the process of urban regeneration, proposing cultural catalysis strategies in three aspects: environmental, economic, and social aspects[46]. Rong Yuefang extended urban catalysis theory to urban event catalysis theory, elucidating its theoretical foundation and key points. They illustrated their points using examples of the catalytic role of major urban projects and events in urban development[47]. Wang Jinwen researched the relationship between public art and urban catalysis, using the theory and practice of public art from the 1990s as the research object to analyze the mechanisms by which art catalyzes urban development[48]. Wang Xinyi analyzed the catalytic effects of major urban events such as the Beijing Olympics, Shanghai Expo, and Kunming World Horticultural Expo on urban development. They summarized strategies for hosting and preparing for major events, particularly in terms of site selection[49].

② Research on Urban Old City Renewal Design

The core of catalysis theory is to generate favorable responses without fundamentally altering the essence of the original entities. Therefore, it is widely applied in the field of urban old city renewal design. Hu Wantai analyzed the formation and development process of cities, where urban catalysis originates from government macro policies, regional resources, and market demands. They proposed an operational model for the restoration and development of historical

sections in old cities, aiming to attract tourists, stimulate surrounding commercial development, and support ecological landscape restoration with commercial profits[50]. Zhu Jianwei, using Chengdu's "Eastern Suburb Memory" as a case study, conducted a catalytic-style analysis of the potential for renewal and development in old industrial areas. They propose three renewal design strategies: functional catalysis, spatial catalysis, and cultural catalysis[51]. Zhu Xiaole explored the application mode of urban catalysis theory in the renovation and transformation of old urban areas, using Xi'an's Shuncheng Lane as an example to illustrate catalytic activation strategies[52]. Pan Yate, based on the practice of preserving and revitalizing old cities in Chengdu, discussed the fundamental principles and methods of urban catalysis protection and activation. They proposed that urban catalysis theory can revitalize the vitality of historical spaces[53].

③ In the field of industrial heritage preservation and revitalization

Zeng Ying analyzed and summarized industrial heritage "catalytic-style" preservation and revitalization practices in the Taiwan region, providing catalytic practical strategies for domestic industrial heritage preservation and renewal[54].Shang Wei proposed transforming urban heritage into different modes such as commercial facilities, cultural facilities, and open spaces as urban catalytic effects[55]. Zhao Xing developed a strategy for industrial heritage catalytic preservation and revitalization consisting of five steps and three elements[56]. Li Xingxi analyzed the characteristics and operational mechanisms of industrial heritage as urban catalysts, using the example of the reuse of the Shuicheng Cement Plant industrial heritage for practical demonstration[57].Ye Fang Lv analyzed the current status of industrial remnants on Xiamen Island, summarized the catalytic potential of these industrial remnants, and proposed six catalytic design principles.This formed the basis for an updated strategy for Xiamen Island's industrial remnants based on the catalyst theory[58].

In summary, in the research on the transformation and renovation of waterside industrial heritage, foreign countries have developed a relatively mature and comprehensive theoretical research system for its renewal and revival. Research in this field is highly diversified, with

extensive practical exploration and numerous successful cases worth emulating. In contrast, there is relatively limited research on the transformation and renovation of waterside industrial heritage in China. While there are some successful practical cases, the overall research focuses more on planning, policy, economic development, and functional integration in waterside areas, and there is still room for improvement in terms of research on the unique characteristics of waterside areas.

In the research on urban catalysts, the international community has started to apply catalyst theory to industrial heritage preservation and revitalization practices, establishing research methods based on catalyst theory for the preservation and activation of industrial heritage. Many research achievements have been made by combining theory and practice. Internationally, catalyst theory in industrial heritage research primarily focuses on using industrial heritage preservation and revitalization as a catalyst for urban rejuvenation, driving the benign development of surrounding areas. However, research on the catalyst-based preservation and activation of the essence of industrial heritage is relatively limited. In China, catalyst theory in industrial heritage research mainly focuses on the integration with the transformation of old urban areas. Through the urban design process, catalyst elements are incorporated to create a catalytic effect, thus shaping the historical and cultural characteristics of the city.

Given the current trends in the development of waterside industrial heritage and the importance of waterside industrial heritage and the research gaps, this study takes Guangzhou's waterside industrial heritage as the research subject. It explores the characteristics and current status of activation in this typical industrial heritage, and, in conjunction with the urban catalyst theory, further investigates the activation strategies for Guangzhou's waterside industrial heritage from the perspective of an urban catalyst.

1.5 Research Methods and Framework

1.5.1 Research Methods

(1) Literature Review Method

Using databases such as CNKI(China National Knowledge Infrastructure), Wanfang, Web of Science, etc., a search was conducted using three key terms: industrial heritage, urban catalysis, and waterfront industrial heritage. The aim was to compile the current research status and achievements in the fields of industrial heritage, urban catalysis theory, and waterfront industrial heritage. Additionally, research outcomes related to the combination of urban catalysis with industrial heritage and waterfront industrial heritage were collected to provide theoretical support for the paper's framework.

(2) Field Investigation Method

On-site inspections were carried out in the central urban area of Guangzhou. Data was collected through methods such as on-site photography and note-taking to investigate transformation examples of waterfront industrial heritage. Relevant photographic materials, including the external and internal environments of industrial factory areas, site layouts, facades, spatial forms, environmental details, etc., were collected to understand and analyze the surrounding environment and site conditions. This included industrial remnants, architectural spaces, vegetation status, etc. The objective was to identify and summarize the issues present on the site.

(3) Case Study Method

A review of examples of the application of catalysis theory in architectural design and planning, as well as instances of the preservation and reuse of waterfront industrial heritage, was conducted. This aimed to understand the adaptability of industrial heritage preservation and reuse in various geographical and cultural contexts. The findings served as valuable references for the research conducted in Guangzhou. Furthermore, a principle of learning from and applying the strengths while avoiding the weaknesses of the cases was followed.

1.5.2 Research Framework

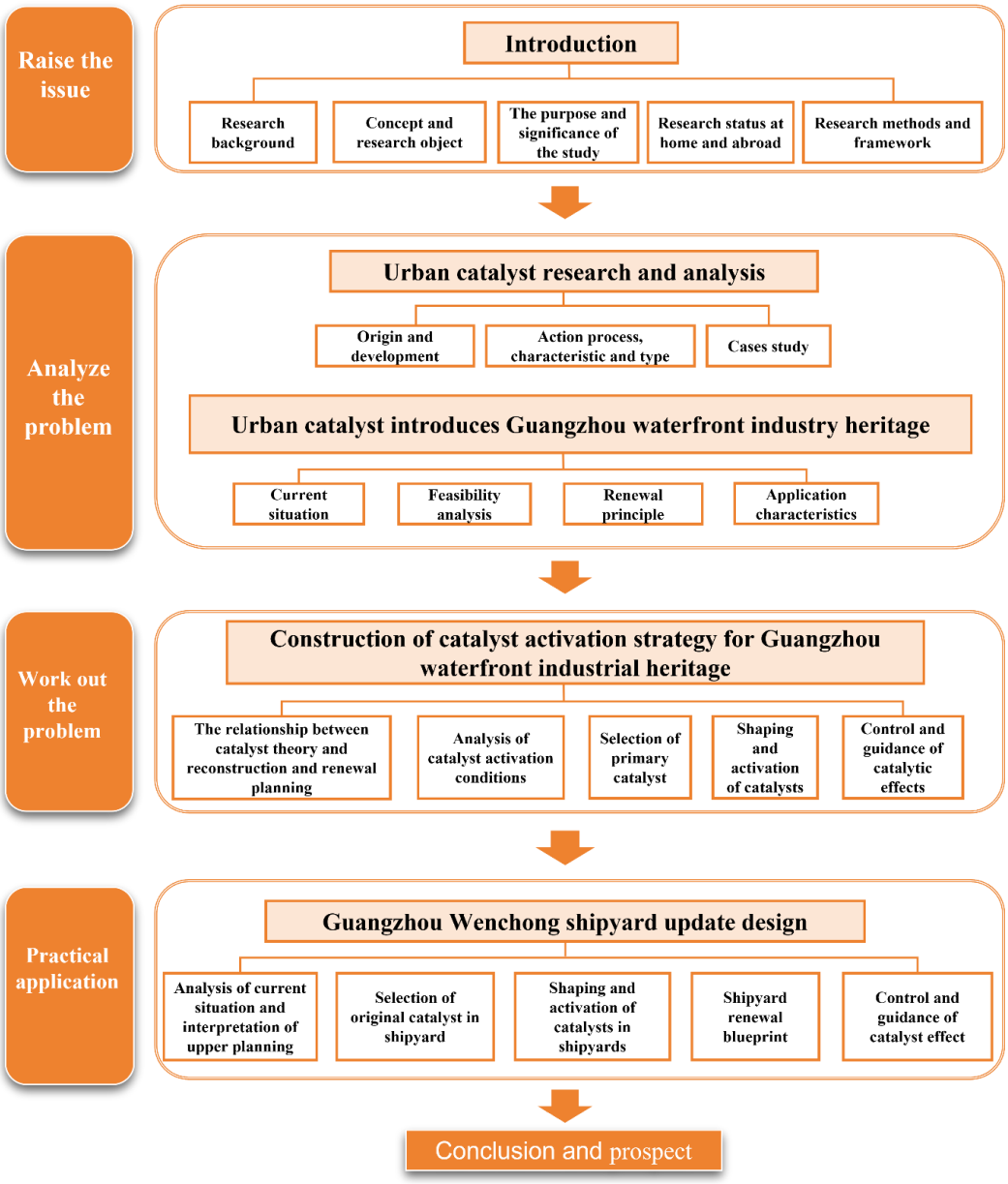


Figure 1-2 Research Framework

(Source: Self-Drawn by the Author)

Chapter 2 Analysis of Urban Catalysis Theory

2.1The Origins and Development of Urban Catalysis

After World War II, the rapid economic development in the United States led to a transformation of the economic landscape, shifting from the dominance of the primary and secondary sectors to a rapid growth of the tertiary sector, primarily composed of finance and services. Cities were no longer just industrial bases, and a surplus of abandoned or disused properties from the secondary sector emerged. However, the rapid urbanization in the United States resulted in a continuous decline in the vitality of the original central urban areas. The rapid decline of the secondary sector led to the accumulation of numerous abandoned factories within cities, severely affecting regional economies and the environment.The widespread use of automobiles led to the expansion of urban suburbs and the contraction of city centers as the focal point of citizen life, causing a phenomenon of vacant city centers with lost vibrancy. Urban renewal became urgent. On the other hand, in the late 1980s, the United States began to introduce more traditional urban design theories from Europe, such as functionalism, humanism, formalism, and systemic theory. These theories were widely and indiscriminately applied to urban planning and construction, neglecting consideration and research of local urban characteristics and regional differences, resulting in a uniform urban image lacking personality. In this context, in 1989, American architects Wayne Attoe and Don Logan proposed the "Catalysis Theory" in their book "American Urban Architecture - The Catalyst for Urban Design." They believed that many urban renewal practices in the United States at the time were employing a transplant approach similar to organ transplantation, which was detrimental to the historical and cultural patterns of many cities. Traditional urban elements and atmospheres were disappearing along with the physical spatial forms, which was not conducive to the long-term development of cities. Therefore, they advocated that the introduction of "new elements" required a certain degree of strategic planning. By constructing catalytic points, they could guide the changes of the surrounding elements progressively and organically, promoting renewal and transformation. This catalytic approach to renewal was based on in-depth research

and exploration of the internal structure and historical culture of the renewal areas. It avoided past blind practices and emphasized a gradual balance between preservation and renewal, promoting the sustainable development of historical and cultural resources.

2.2 The Process, Characteristics, and Types of Urban Catalysis

2.2.1 The Process of Urban Catalysis

Based on the analysis and summary of the "Urban Catalysis" theory, the application principles of catalysis theory can be summarized as follows:

Within a regional or urban context, introduce certain catalytic points. These catalytic points can involve the revitalization of existing resources or the introduction of external elements. As these catalytic points interconnect and interact with each other, they give rise to larger catalytic nodes and even catalytic field domains. These catalytic sources continue to influence the surrounding old spaces and environments, thereby altering the city's original spatial characteristics. They guide and drive the development of spaces towards vitality, ecological friendliness, and contemporary advancement. Ultimately, these efforts contribute to achieving the goals of sustainable development and renewal for the entire area and even the city as a whole (Figure 2-1).

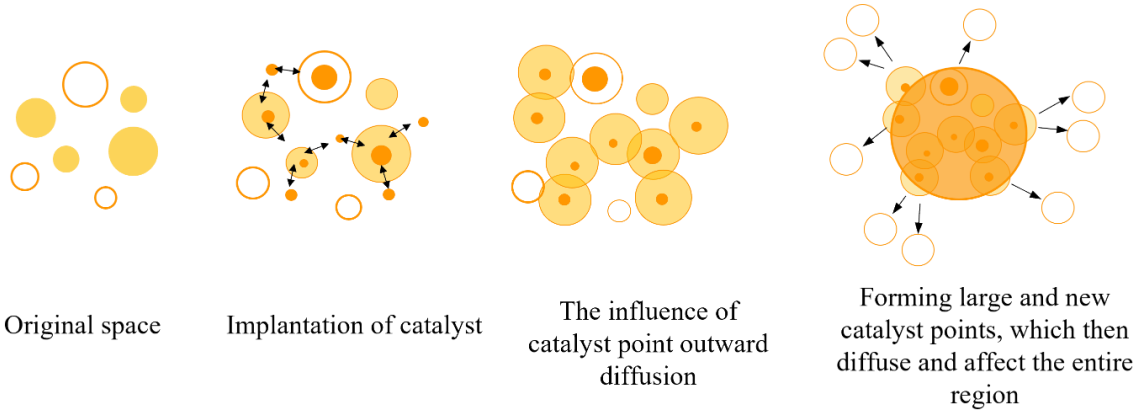


Figure 2-1 Illustration of the application principle of catalyst theory
(Source: Self-Drawn by the Author)

2.2.2 Characteristics of Urban Catalysis

According to the summary by Wayne Attoe and others, as well as the analysis of the concept and process of catalysis theory, catalytic reactions have the following characteristics:

(1) Holistic Interconnectivity

Catalytic reactions are an ongoing process of catalyzing the surrounding region, instigating a chain reaction of development by introducing updates to elements, establishing deep connections, and facilitating coordinated coupling among these elements. This process attracts more capital, forms industrial clusters, and draws more people to congregate, thereby igniting spatial vitality. Additionally, catalytic reactions require macro-level control to make timely adjustments and ensure that the reactions proceed in a positive direction.

(2) Gradual Expansion from Small to Large

Catalytic effects are driven by localized updates, activating the surrounding environment. It's a process that starts from small-scale updates and gradually influences broader areas. This approach helps prevent the destruction of the overall urban character that can result from large-scale demolition and construction.

(3) Diversity in Levels

Different catalytic points have varying effects and impacts on the surrounding area and come with inherent hierarchical attributes. As the distance from the catalytic point increases, the catalytic effect weakens, following a diminishing trend. Additionally, the emergence of new catalytic points introduces diversity in development as the catalytic areas overlap, resulting in a richer and more diverse range of catalytic effects.

(4) Respect for History

Catalytic reactions emphasize the preservation of the existing history. They should be guided by a positive approach based on understanding and researching the history.

(5) Sustained Progression

Regardless of the form of catalytic points, the catalytic effects they generate are neither short-lived nor immediate. Instead, they continually and gradually impact and transform the development of regions and even entire cities, embodying a progressive and incremental mode of action.

2.2.3 Types of Urban Catalysis

(1) Classification by Material Form Attributes

Urban catalysis can be classified based on material attributes into two main categories: material catalysis and non-material catalysis. Material catalysis can be represented by elements such as a specific building, a street, or a plaza within urban design. These types of catalysts often emerge in projects related to old city renewal, historic districts, pedestrian streets, commercial complexes, waterfront promenades, etc. Their impact typically covers a defined area and is aimed at creating regional distinctiveness to attract people. Non-material catalysis includes features like historical and cultural events, specific policies, or major urban thematic activities. These catalysts are often government-led and have a wide-ranging impact, representing a top-down approach to urban renewal.

(2) Classification by External Expression Form

Urban catalysis can be classified based on external forms into three main categories: point catalysis, line catalysis, and surface catalysis. Point catalysis refers to spatial configurations with point-like forms, characterized by relative distinctiveness. These can be individual buildings, specific landscape nodes,ect. Line catalysis refers to spatial configurations with linear forms, which can also be composed of multiple point catalysis elements connected together. Common examples include street spaces and waterfront areas. Surface catalysis refers to spatial configurations with extensive, continuous forms, which can be areas composed of point or line catalysis elements. Typical examples include public parks, urban squares, entire historic districts, etc. These three categories have a progressive scale and hierarchical

relationship, transitioning from points to lines and from lines to surfaces, resulting in broader catalytic impact areas.

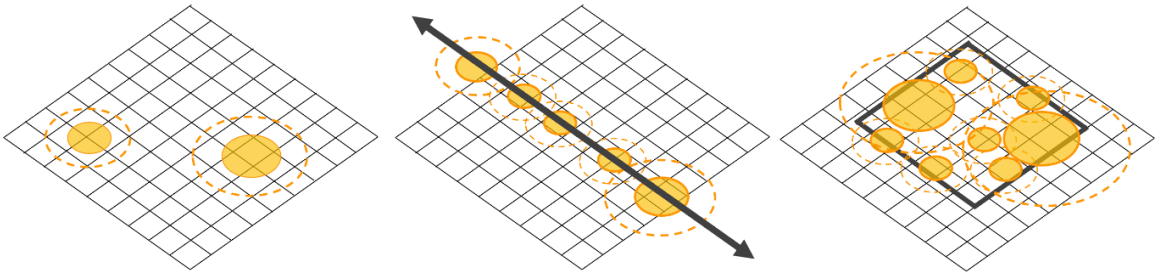


Figure 2-2 The relationship between the three types of catalysts in point, line and surface
(Source: Self-Drawn by the Author)

While these three forms of catalysis may have varying degrees of influence, they are interrelated and can, to some extent, transform into one another. For example, a point catalysis can serve as a node within a line catalysis, and multiple point catalysis elements can also compose a line or surface catalysis. Line catalysis may include point-like nodes or be formed by numerous point catalysis elements. Surface catalysis, on the other hand, can be jointly created by multiple point and line catalysis elements, resulting in a regional effect (Figure 2-2).

2.3 Case Study

2.3.1 Ghirardelli Square in San Francisco

Ghirardelli Square is located on the San Francisco Bay at 900 North Point Street. It is on the west side of Fisherman's Wharf, two blocks east of Van Ness Avenue and one block west of the cable car turnaround at Beach and Hyde streets. There are two primary pedestrian access points into Ghirardelli Square, both with original character-defining features: the corner of Beach and Larkin Streets where an original historic planter has been retained and on Larkin Street where an original 1960's era arched sign marks the entry. There are two secondary entrances, at Beach Street near Polk Street and at North Point Street. The hardscape connecting the buildings is part of the 1960s work. The layout retains many features from the 1960s though there have been several alterations to the site(Figure 2-3).

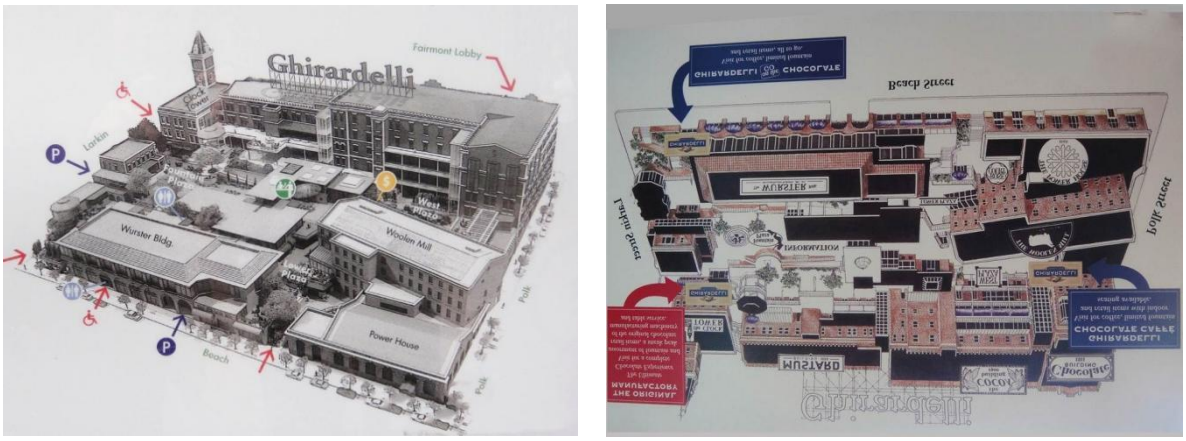


Figure 2-3 Comparison before and after the renovation of Ghirardelli Square in San Francisco (Source: https://image.so.com/)

(1) Catalytic Perspective

Ghirardelli Square was originally built in 1893 as a chocolate factory located along the coastline of San Francisco's Fisherman's Wharf. In 1964, the abandoned chocolate factory and other old structures, including a woolen mill, were transformed into shops and dining facilities. It became the first open-air shopping center in the United States converted from a factory and was renamed "Ghirardelli Square."

(2) Identifying the Catalyst Carrier

The old factory underwent functional replacement and environmental renewal, being transformed into a shopping center specializing in boutiques. Architects made full use of the building's unique industrial aesthetic features by shaping public spaces such as Ghirardelli Square and the atrium. They utilized a system of pedestrian pathways to connect the original industrial structures, creating a vibrant outdoor social space, thereby enhancing the area's popularity (Figure 2-4).

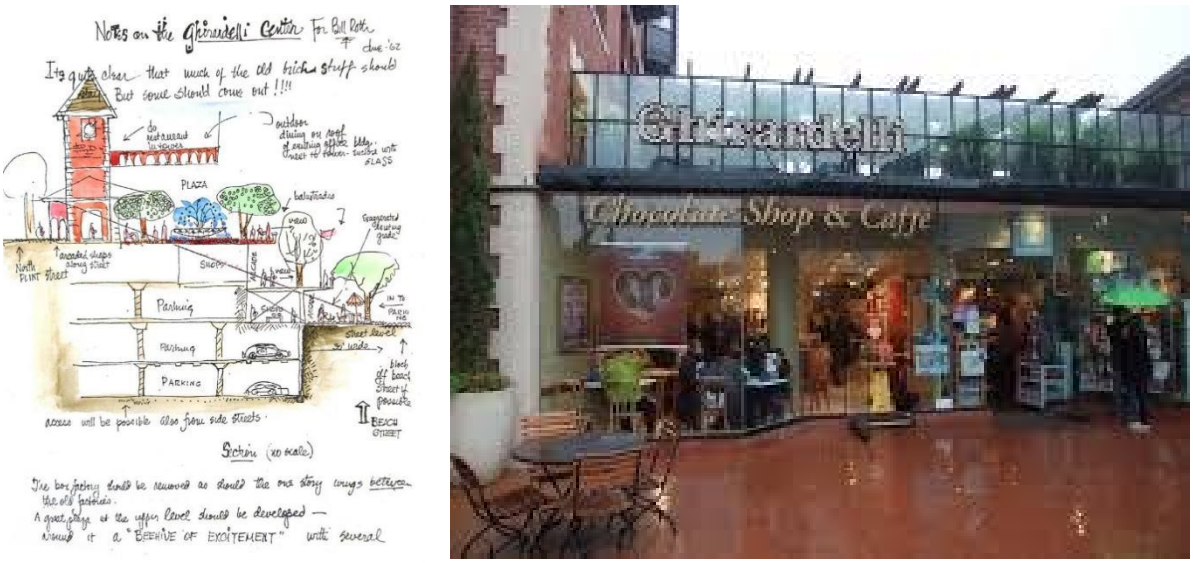


Figure 2-4 Phase 1 - Renovation of old industrial buildings in Ghirardelli (original catalyst point)
(Source: http://mt.sohu.com/20170615/n497180973.shtml)

(3) Occurrence of Catalytic Reaction

The successful intervention of Ghirardelli Square as a catalytic element sparked the development of the surrounding area and set an example for subsequent renewal efforts. Located just a block away, a canning factory was also transformed into retail boutiques using the same renewal model. The catalytic effect was not only evident in economic success but also in the adoption of similar renewal methods in terms of architectural style and form (Figure 2-5).

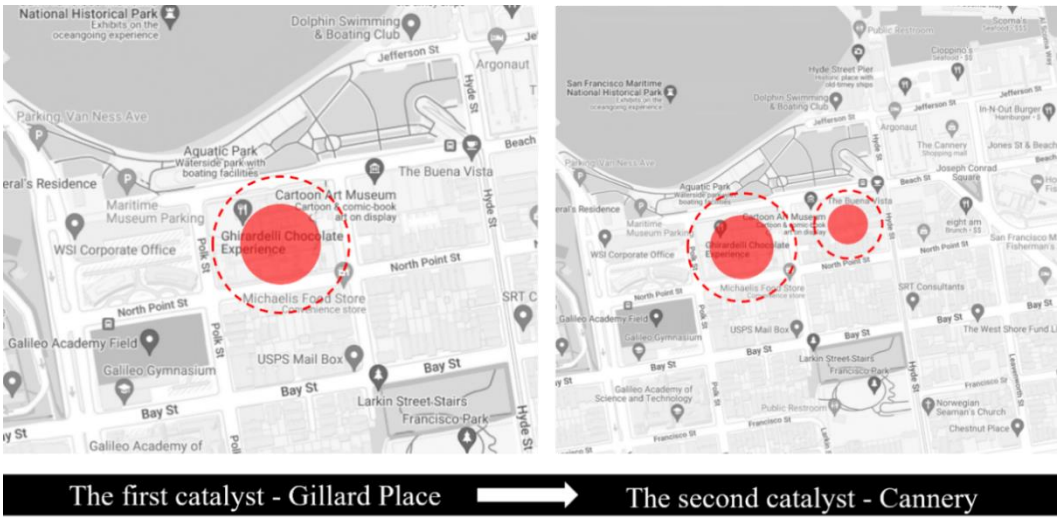


Figure 2-5 Phase 2 - Renovation of surrounding old industrial buildings (catalyst effect)
（Source:https://image.so.com/）

(4) Diffusion of Catalytic Effects

The urban area between the two catalytic elements - Beach Street - also underwent gradual renewal and redevelopment, and influenced by the original catalysts, the new and old buildings maintained consistent architectural forms and even detailed designs. Under the influence of market forces, the catalytic effect expanded to encompass the entire Fisherman's Wharf area, facilitating its revitalization and the establishment of a regionally distinctive urban segment (Figure 2-6).

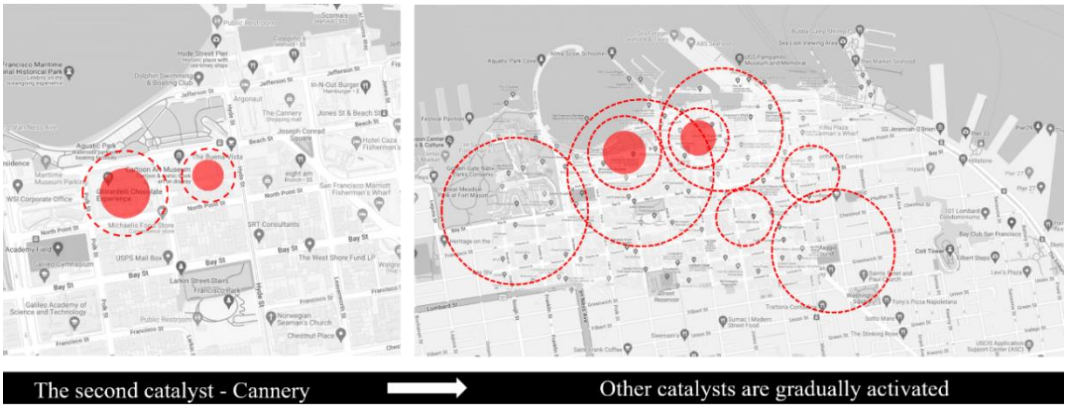


Figure 2-6 The third stage - neighborhood renewal between the two (expanding the catalyst effect)
(Source: https://image.so.com/)

Ghirardelli Square provided significant inspiration for the subsequent renewal of markets like the New York Holiday Market and Quincy Market. It is evident that typified catalytic effects are remarkable.

2.3.2 Beijing Shougang Industrial Zone North District

(1) Geographic Location

The Shougang Industrial Park was founded in 1919, originally known as the Shijingshan Iron and Steel Company, and was one of the largest steel enterprises at that time. The New Shougang High-end Industrial Comprehensive Service Zone is located on the east side of the intersection of Chang'an Street and Yongding River in Shijingshan District, Beijing. To the north, it is adjacent to residential areas such as Bajiao Residential District, Special Steel, Modoukou Historical Preservation District, Shijingshan Thermal Power Plant, and Gucheng Residential District, covering a total area of 8.63 square kilometers. The Shougang Park is situated at the junction of Shijingshan, Mentougou, and Fengtai districts, boasting scenic urban nodes including the Beijing Forest Park, Fahai Temple Forest Park, and Yongding River Leisure Park.

It serves as a frontier for Beijing's future westward development and plays a leading role in the development of the western economy[59]. The overall research scope of the project covers the northern part of the New Shougang High-end Industrial Comprehensive Service Zone, occupying an area of approximately 2.91 square kilometers with a building scale of 1.82 million square meters. It is the birthplace of Shougang's century-old legacy, featuring magnificent industrial heritage, harmoniously blending with the natural landscape of Shijingshan and the Yongding River, and possessing a unique Shougang-style appearance (Figure2-7).

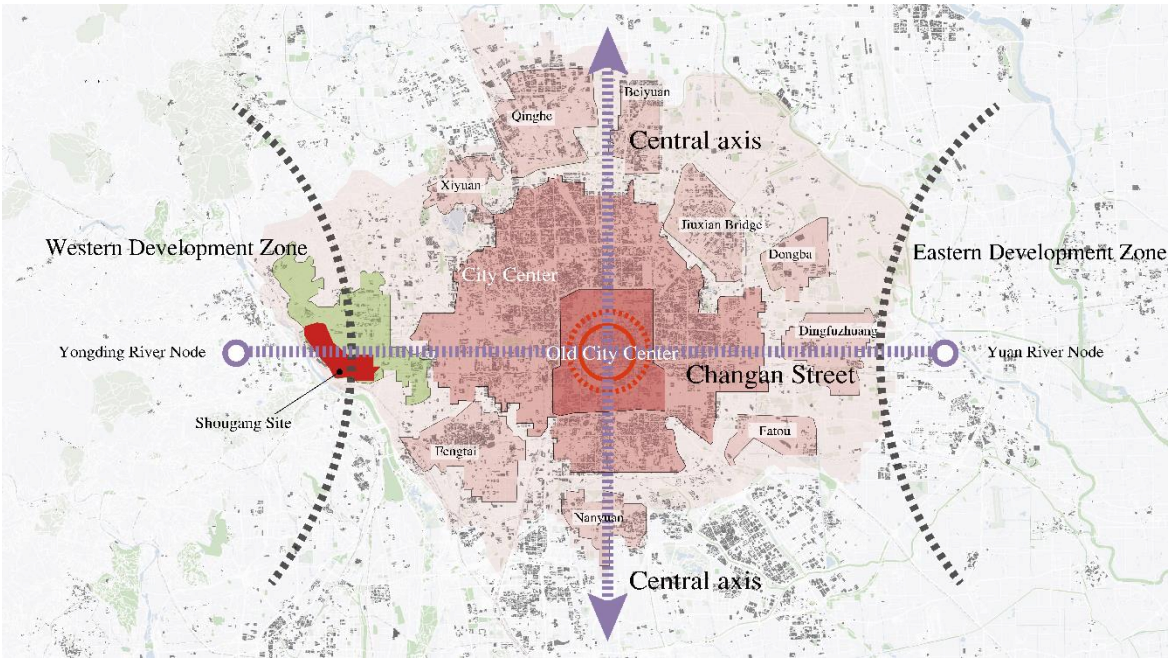


Figure 2-7 Shougang location map (Source:Seft-Drawn by the Author)

(2) Background of the Revitalization

The Shougang Industrial Area has a long and storied history, dating back to its establishment in 1919 as the Longyan Iron Mine Company, a joint venture between the government and private enterprise. In March of the same year, the Longyan Iron Mine Co., Ltd. was founded, and construction of the No. 1 blast furnace equipment began. In 1928, it was nationalized by the Nationalist government and restructured as the Shijingshan Ironworks. In 1937, during the "July 7 Incident," the Japanese army occupied the Shijingshan Ironworks and renamed it the "Shijingshan Iron Smelting Plant," adding a second blast furnace in the process. Production came to a halt in 1938. After the victory of the Anti-Japanese War in 1945, the Nationalist government took control of the "Shijingshan Iron Smelting Plant" and renamed it the

Shijingshan Iron and Steel Works, resuming production. In 1948, Shijingshan was liberated, marking a period of comprehensive development for the steel mill. In 1958, the Shijingshan Iron and Steel Works expanded and was transformed into the Shijingshan Iron and Steel Company, putting an end to its history of producing iron without steel. In 1962, the first oxygen top-blown converter was completed, ushering in a new era of converter steelmaking in China. In 1996, Shougang Group was established. In 2005, due to conflicting with Beijing's urban strategic development direction, the relocation and adjustment of Shougang officially began, with the No. 5 blast furnace being extinguished on July 5th of the same year. In 2011, Shougang's Shijingshan district ceased production entirely, marking the end of its 91-year history of steel production (Figure2-8). The restoration and utilization of the numerous industrial buildings and structures left behind in the old Shougang industrial area, the preservation of its industrial culture, and the improvement of the ecological environment have become significant challenges in coordinating the economic, cultural, and social development of the western region of Beijing.

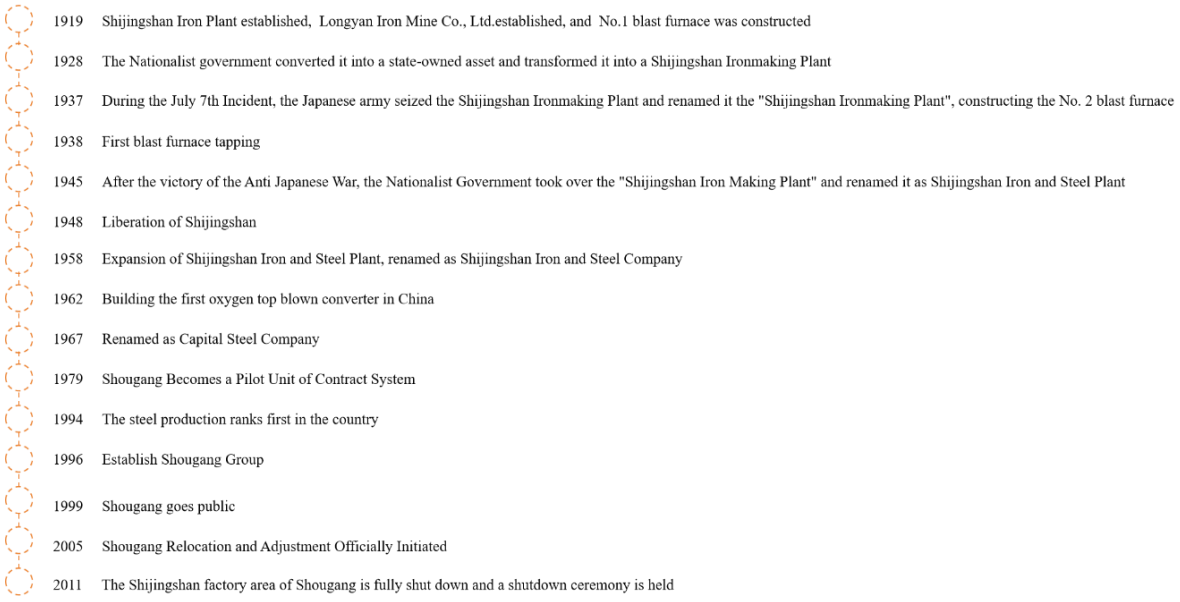


Figure 2-8 Development history of Shougang Park (Source:Seft-Drawn by the Author)

(3) Catalyst Activation Analysis

① Catalyst Perspective

In December 2015, guided by the principles of a "Green Olympics" and a "Frugal Olympics," the Beijing 2022 Winter Olympics Organizing Committee was established at Shougang. The

office was located in the West Ten Silos of the northern part of Shougang Park. While focusing on preservation and utilization, the committee conducted reasonable planning and transformation of the original industrial site. This effort aimed to transform the Shougang Industrial Park into China's first themed cultural park featuring the cultural heritage of the steel industry.

② Catalyst Carrier

a) Point Catalyst Carrier

The old industrial area of Shougang covers an area of approximately 2 million square meters. The northern section of the park retains a large number of industrial relics, including the production systems of various factories such as iron smelting, oxygen and nitrogen production, water softening, coal storage and pulverization, power generation and substation, cooling, and air blowing. It also includes supporting facilities for living and entertainment, such as offices, logistics, staff dormitories, and cinemas. From the two dimensions of "production" and "residence," it provides a panoramic presentation of the work and life memories of the original factory area, offering the best material carrier (Figure2-9,2-10). The functional zoning of the old Shougang industrial area is complex and diverse, including industrial chains, power facilities, warehousing, production service facilities, and industrial production. Each area has its own unique spatial and architectural characteristics, making them potentially suitable for industrial landscapes. Moreover, these areas bear witness to Shougang's historical development and changes, have historical preservation value, and possess catalyst potential. The main core catalyst points in the Shougang Industrial Park are four: the Winter Olympics Square in the material supply and storage area, the Three High Furnaces Museum in the iron smelting area, the Winter Training Center in the coal storage and pulverization area, and the Ski Jumping Platform in the self-owned power plant area (Figure2-11).

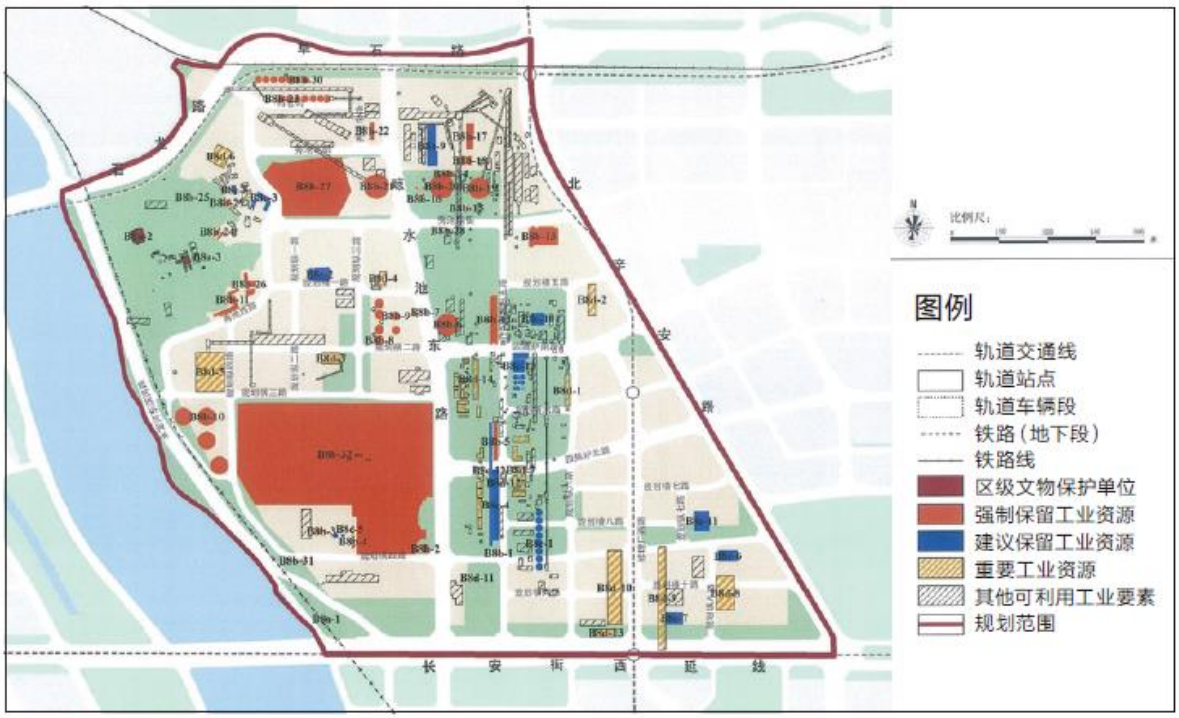


Figure 2-9 Planning map for cultural relic protection and industrial resource retention in Shougang Park (Source: Beijing Municipal Planning Institute)

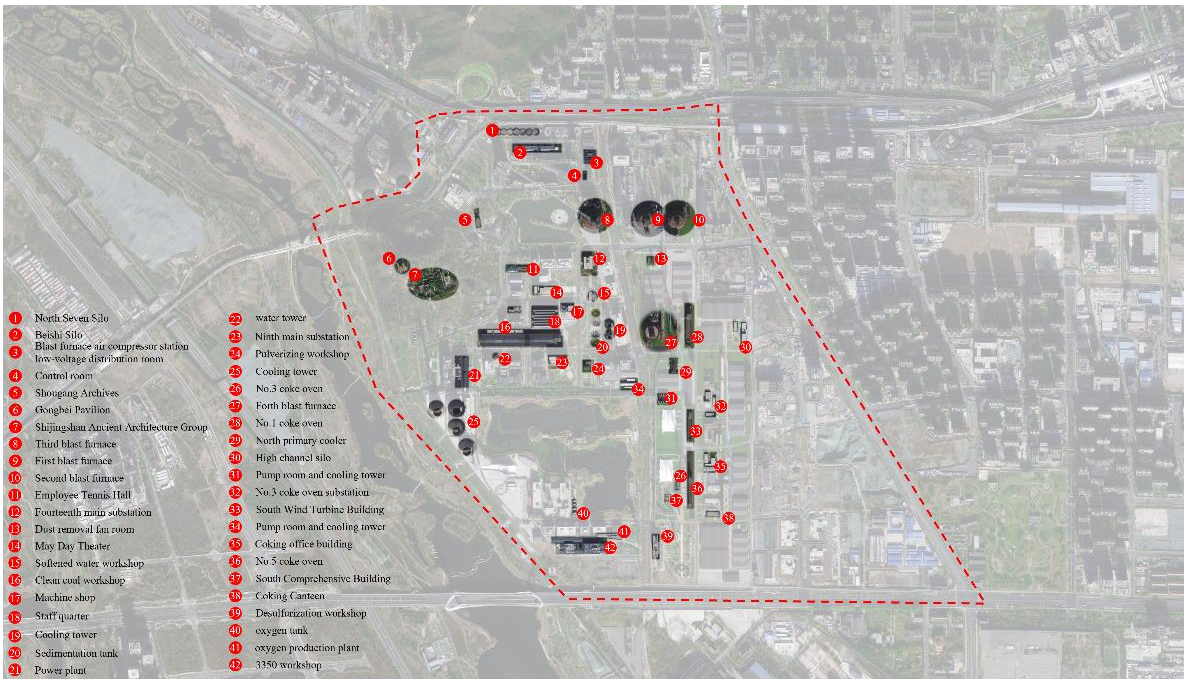


Figure 2-10 Reserved Buildings and Structures in Shougang North District (Source: Self-Drawn by the Author)

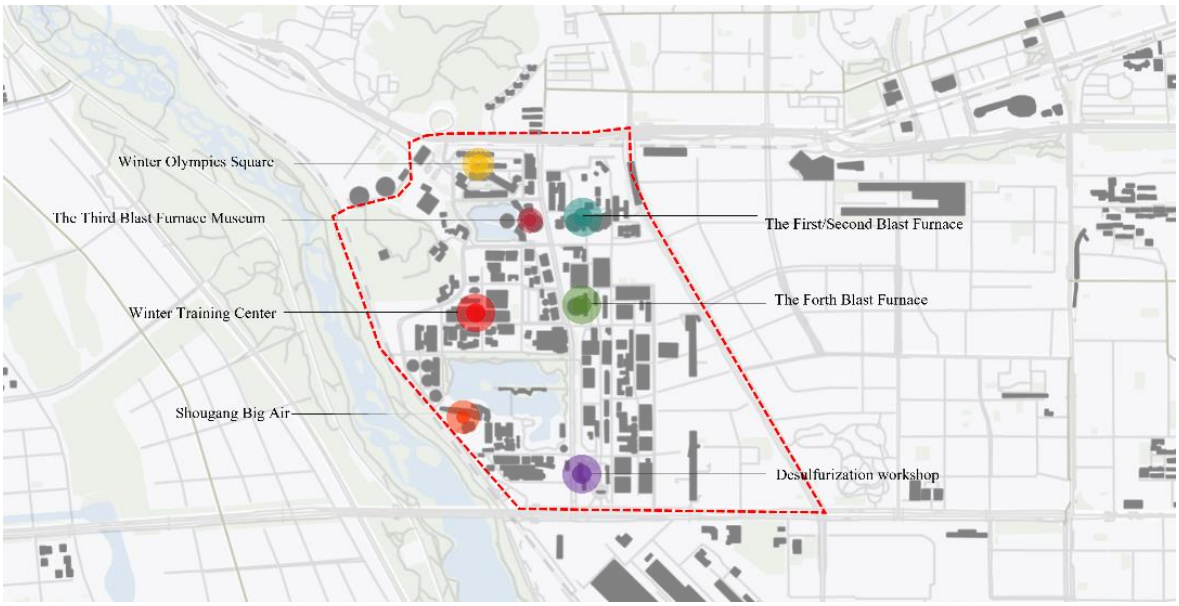


Figure 2-11 Main catalyst building carriers in Shougang North District
(Source:Seft-Drawn by the Author)

b） Line Catalyst Carrier

The line catalyst carrier in the old Shougang industrial area primarily refers to the existing spaces with catalyst potential. This includes the original texture of the factory area, waterfront areas, existing industrial pipelines, and industrial transportation tracks. All of these possess a certain cultural catalyst potential.

Figure 2-12 Railway tracks in Shougang Park
（Source:https://mmbiz.qpic.cn/mmbiz_jpg/）

Figure 2-13 Shougang Park Industrial Pipe Gallery
（Source:https://mmbiz.qpic.cn/mmbiz_jpg/）

c） Surface Catalyst Carrier

From a city-wide perspective, the entire Shougang Park serves as a surface catalyst carrier. Through the rational renovation and planning of the park's overall functionality, it reactivates the vitality of the Shougang industrial area and acts as a catalyst point to drive the development of surrounding areas.

From the park's perspective, the large-scale surface spaces such as squares and green areas left by Shougang Park are the primary surface catalyst carriers. They possess a certain potential for functionality, culture, and landscape. Through thoughtful design, they can be transformed into public and landscape spaces capable of hosting various activities, thereby revitalizing the surrounding areas.

③Catalyst Activation Strategies

a) Implantation of Functional Elements

From the perspective of the entire park, the conceptual master plan for the main factory area adopts a planning structure of "interwoven green axes - multiple cores in four zones." The four main functional zones include the Industrial Theme Cultural and Creative Zone, Comprehensive Office Zone, Riverside Ecological Leisure Zone, and Urban Comprehensive Service Zone(Figure2-14).

Figure 2-14 Five functional zoning maps of the northern area of Shougang Industrial Park
(Source:Seft-Drawn by the Author)

At the architectural level, functional rejuvenation is applied to buildings and structures throughout the entire factory area that hold value for renewal. This includes buildings with significant historical and cultural value, as well as those with good building quality and the potential for renewal in terms of space and structure. Based on the spatial characteristics of

these buildings, a rational design and structural reinforcement of the interior space is conducted, along with the integration of new functions (Table2.1). For example, in the case of the Shougang Winter Olympics Organizing Committee office area, a series of industrial building facilities, such as transfer stations, raw material warehouse control rooms, combined pump stations, dust removal equipment, and others, have been repurposed to serve new functions such as offices, exhibitions, meetings, and parking through restoration, renovation, and expansion.

Table 2-1 Functional Renewal of Buildings and Structures in Shougang North Area
(Source:Seft-Drawn by the Author)

Name	**Original functions**	**Current function**
Xiuchi	Storage of blast furnace cooling water	Landscape pool, underground garage, and exhibition hall
The Third Blast Furnace Museum	iron-smelting	exhibition
The control room next to the tank equipment of the original dry dust collector	Equipment Room	coffee
Clean coal workshop	Storing Coal	Flower Skating Hall, Speed Skating Hall, Curling Hall
Machine shop	mechanical production	commerce
Employee Tennis Hall	Tennis Arena	Tennis Arena
Staff dormitory	dormitory	Ice Hockey Arena
West 10 Silo	Storage and transportation of blast furnace ironmaking raw materials	office
North 7 Silo	Storage of industrial raw materials	Creative Office
Returned coke and ore bin	Recycling and storage	bar
Blast furnace air compressor station, low-voltage distribution room, N3-18 transfer station	Provide compressed air	hotel
Power plant	electric power generation	hotel
May Day Theater	Hold large-scale gatherings	park
Fourteenth main substation	change voltage	office

Table 2-1 Functional Renewal of Buildings and Structures in Shougang North Area-Continued
(Source:Seft-Drawn by the Author)

Name	Original functions	Current function
Accelerated clarifier	Mechanical accelerated clarifier for treating residues such as lime and slag in the blast furnace sewage treatment system to purify blast furnace sewage	Commerce/canteen
Fan room	Provide cold air for the blast furnace	entrance/courtyard
Cooling tower clarification tank	cooling water	park
Boiler room small water tower	storage water	exhibition/park

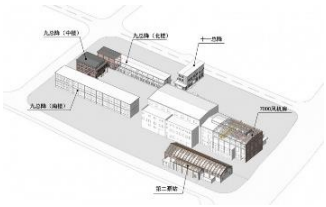
b） Implantation of Cultural Elements

The design of the entire park respects its historical character and places a strong emphasis on preserving and continuing the legacy of old industrial culture. Three flexible approaches are employed: "protective repair," "incremental repair," and "overall style coordination," all aimed at comprehensively enhancing the conversion rate of industrial heritage. Different protective measures are applied to various industrial relics, including existing factory buildings, gantry cranes, chimneys, and railway tracks. Resources with well-preserved industrial aesthetics, strong historical significance, and great commemorative value are retained in their entirety. For resources with lower industrial aesthetic value, a partial preservation approach is used. Additionally, the plan retains 40 kilometers of existing railway lines, which are transformed into rail greenways, and preserves 9 kilometers of existing gas transmission pipeline corridors, which are converted into elevated walkways.

Table 2-2 Appearance update methods of some buildings in Shougang North District
(Source: Self-illustrated by the Author)

Renovation Methods	Building Names	Before Renovation	After Renovation
Conservation Repair	Shijingshan Ancient Architecture Complex		
			
Incremental Repair	North No. 7 Silo Office Area		
	West Ten Silos		
	Three Blast Furnaces		
	WuYI Theater		
	Sedimentation tank		

Table 2-2 Appearance update methods of some buildings in Shougang North District-Continued
(Source: Self-illustrated by the Author)

Renovation Methods	Building Names	Before Renovation	After Renovation
Overall aesthetic harmony	Coal Processing Workshop		
	SixGongHui Shopping Plaza		
	Shangri-La Hotel		
	Desulfurization Workshop		
	16,000-ton Oxygen Production Facility		
	Workshop 3350		

c） Implantation of Ecological Elements

The northern area of Shougang is anchored by natural resources such as Qunming Lake, Xiucheng Lake, and the mountains and rivers of Shijingshan. Leveraging the Yongding River,

the western extension of Chang'an Street, and the ecological restoration areas, it forms an integrated leisure zone along the Yongding River, a public activity and leisure zone along the western extension of Chang'an Street, and a green ecological zone along the planned roads. By combining the existing green spaces and planned roads within the planning area, five ecological corridors are created. This "one core, three zones, five corridors" green ecological spatial structure allows for the integration of ecological and urban spaces, effectively connecting the city with its natural surroundings.

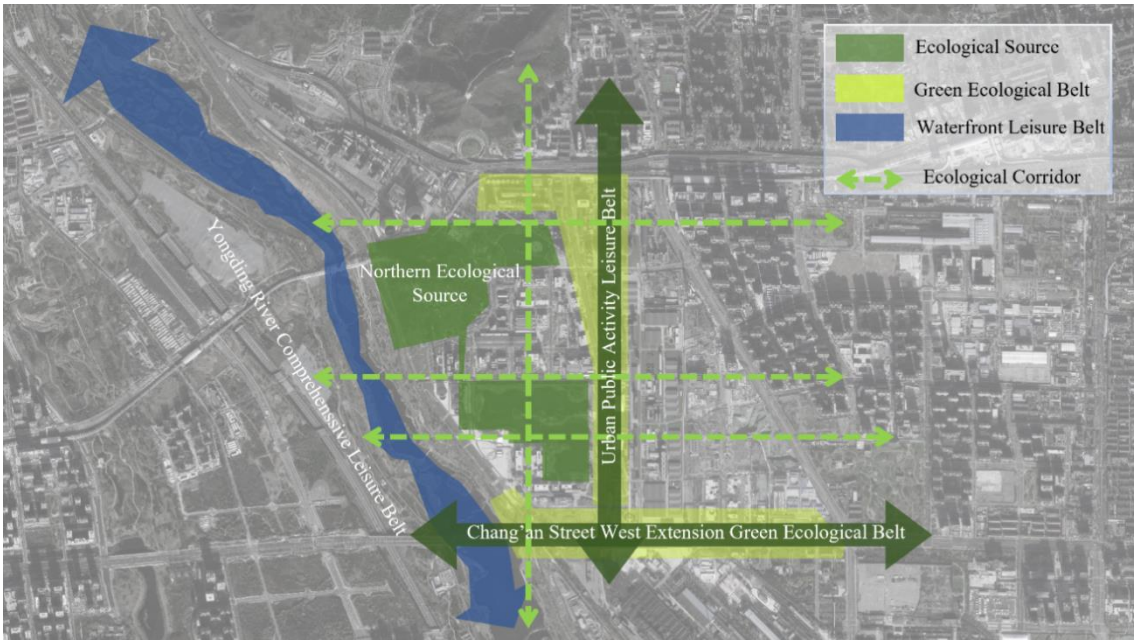


Figure 2-15 Schematic diagram of Shougang's green ecological structure
(Source: Self-Drawn by the Author)

(3) Catalyst Effect Analysis

After protective activation, Shougang Park has been transformed into a comprehensive park that encompasses sports, cultural facilities, education, exhibitions, offices, and more. It has had certain economic, cultural, and social impacts.

Economically, there are commercial hubs including traditional markets and emerging international malls like Xilongdu around the park. While the commercial facilities within Shougang Park primarily serve its own activities and may have limited economic benefits on their own, they attract nearby commercial activities, to some extent, driving economic development in the area.

Culturally, Shougang Park inherits the history and memories of the steel industry. It maintains partnerships and collaborations with nearby institutions such as Tsinghua University and Peking University, shaping new industrial cultural connotations. It has become a cultural and artistic hub, connecting with attractions like Shijingshan Scenic Area and Yongding River Cultural Park, thus establishing itself as a center for cultural and creative activities in western Beijing.

On a social level, the former steel mill in Shougang Park serves as a gathering place for community activities, carrying local memories and social values. Additionally, after activation, the park can attract a certain labor force, revitalizing the vitality of the surrounding areas.

2.4 Summary of this Chapter

This chapter focuses on urban catalysts as the research subject. Beginning with the origins and development of urban catalysts, it elaborates on the process and characteristics of their functioning. The chapter also provides an overview of two classification methods for urban catalysts: one based on material attributes, which divides them into material and non-material catalysts, and another based on their external manifestations, categorizing them as point, line, or area catalysts. By analyzing the functioning of urban catalysts in the context of Ghirardelli Square in San Francisco and the northern section of the Beijing Shougang Industrial Park, this chapter lays a solid theoretical foundation for Chapter Three.

Chapter 3 The Application of Urban Catalyst in Guangzhou's Waterfront Industrial Heritage

3.1 Overview of Guangzhou's Waterfront Industrial Heritage

3.1.1 The Evolution of Renewal and Development of Guangzhou's Waterfront Industrial Heritage

The process of renewal and development of Guangzhou's waterfront industrial heritage can be divided into four phases, with significant policy changes or institution establishments as key milestones.

(1) Early Renewal Practices Before 2008

Before 2008, urban renewal in Guangzhou was primarily driven by real estate development, especially after the market-oriented reforms in the 1990s. This led to extensive redevelopment of old city areas and deteriorating regions. However, in 1999, the government prohibited developers from carrying out transformation projects within the old city limits. Subsequently, Guangzhou's municipal government began experimenting with a gradual and organic renewal approach. As the economy developed, there was a growing awareness of the importance of waterfront industrial heritage. In 2004, the "Development Plan and Urban Design for the Pearl River Back Channel Waterfront Area in Guangzhou" proposed changes to the island's layout to preserve waterfront industrial areas like Taikoo Warehouse and Osaka Warehouse. This plan prompted the government to focus on preserving and reusing industrial heritage, realizing the social and public value of transforming waterfront old industrial areas into public spaces. In 2005, industrial heritage content started appearing in Guangzhou's fourth cultural relic census, and in 2008, modern foreign firm warehouses and former dock sites like Taikoo Warehouse and Osaka Warehouse were included in the seventh batch of municipal-level cultural relics protection units.

Xinyi International Convention Center, converted from the Guangdong Water Conservancy and Hydropower Plant, is a typical example from this period, marking Guangzhou's first influential attempt at renewing waterfront old industrial areas. This project followed a developer-led commercial development model and preserved the historic and cultural value of the industrial area by injecting new functions. The success of Xinyi International Convention Center demonstrated a viable path for the renewal and transformation of waterfront old industrial areas, setting a benchmark for subsequent cultural and creative industry park models.

(2) "Retire Two, Enter Three" Initiative – Rise of Cultural and Creative Parks

In 2008, the global financial crisis prompted the Guangzhou municipal government to launch the "Opinions on Promoting the "Retire Two, Enter Three" Initiative in the Urban Area." This initiative aimed to adjust the city's industrial structure by reducing the proportion of the secondary sector and emphasizing the growth of the tertiary sector. In the planning and construction of waterfront spaces, it involved functional replacement and spatial reorganization for industrial enterprises with severe pollution, high energy consumption, and low returns[60]. Concurrently, the "Measures for the Disposal of Industrial Land of Enterprises Involved in the "Retire Two, Enter Three" Initiative in the Urban Area of Guangzhou" encouraged the long-term use of old factory buildings for creative industries, with the understanding that the land might be reclaimed by the government for urban development in the future. In 2009, the Guangzhou Cultural and Creative Industry Association was established to promote the sustainable development of Guangzhou's cultural and creative industry, introducing the term "Cultural and Creative Industry Park" for creative spaces. During this period, various projects were initiated in Guangzhou's central urban areas, including Taikoo Warehouse Fashion Park, Redtory Art & Design Factory, 1850 Creative Park, and 922 Hongxin Creative Park.

Taikoo Warehouse and its dock, designated as municipal-level cultural relics protection units, were carefully preserved and underwent necessary exterior restoration and structural reinforcement. By revitalizing existing structures and introducing creative tertiary industries,

Taikoo Warehouse was transformed into a comprehensive waterfront leisure and commercial complex, offering wine exhibitions, trade shows, cultural and creative design, dining, leisure, and tourism.

(3) Establishment of the "Three Olds" Transformation Office – Progress and Refinement

In February 2010, the "Three Olds" Transformation Office of Guangzhou was officially established. This marked the formal launch and advancement of the "Three Olds" transformation. In June 2012, the Guangzhou municipal government issued the "Supplementary Opinions on Accelerating the "Three Olds" Transformation," emphasizing principles such as government leadership, planning ahead, comprehensive transformation, priority support for supporting facilities, classification of treatment, and intensive land use under the backdrop of urban industrial structure adjustment. During this phase, comprehensive and systematic transformation of large-scale areas became the primary development model, with a focus on municipal-owned old factories.

Many waterfront old industrial areas continued to adopt the cultural and creative park renewal model during this phase. Among them, the Pearl River Pier Beer Culture and Creative Arts Area was the most prominent project. Complying with the "Retire Two, Enter Three" urban development requirement, the Pearl River Beer needed to move its production lines to Nansha while simultaneously conducting production, relocation, and renovation. The renovation strategy involved expanding and upgrading the original production workshop to create the Pearl River-InBev International Beer Museum. Due to the preservation of the entire production process, visitors could directly witness the authentic beer production process. The waterfront space was used to create a vibrant bar street and a high-end dining and entertainment platform. The old dock was transformed into a waterfront traffic terminal for yachts and sightseeing boats, creating a high-quality waterfront public space with beautiful natural surroundings and a rich variety of activities.

Overall, during this phase, various types of renewal projects began exploring diversification. Projects such as Guangzhou Southern Flour Mill's transformation into the Yueju Red Boat Pier, Changgang Oil Depot's conversion into the Guangzhou Industrial Museum, and Wuxianmen Power Plant's redevelopment into the Guangzhou Overseas Chinese Museum emerged, reflecting the city's emphasis on showcasing industrial culture and local traditions for cultural heritage preservation and exhibition.

(4) Establishment of the Urban Renewal Bureau – Sustainable Development

In February 2015, Guangzhou established the Guangzhou Urban Renewal Bureau as the country's first-level bureau. The responsibilities of the former "Three Olds" Transformation Office were transferred to the Urban Renewal Bureau, which included enhancing urban infrastructure, public building facilities, improving living environments, and enhancing urban functionality. The "Guangzhou Urban Renewal Measures" (Guangzhou Municipal People's Government Decree No. 134, 2015), issued in January 2016, introduced principles such as government leadership, market operation, coordinated planning, efficient use of resources, and transparent and fair interests sharing, which improved the operational mechanisms of "Three Olds" transformation. The accompanying "Guangzhou Old Factory Building Renewal Implementation Measures" proposed two approaches to renewal: comprehensive transformation and micro-transformation, encouraging the use of micro-transformation and prioritizing urban renewal funds for such projects to effectively improve people's livelihoods.

Guangzhou Fisher's Wharf is a successful example of micro-transformation for the renewal of waterfront old industrial areas. Located in the Luoxi Industrial Zone in Panyu District, the area had long been characterized by vacant and dilapidated factories due to a lack of large-scale municipal development and outdated transportation infrastructure. Through land-use conversion and the introduction of social capital using the micro-transformation approach, the area was transformed into Guangzhou Fisher's Wharf. Micro-transformation proceeded in stages, gradually and sustainably converting the industrial zone into a low-density, fully

equipped entrepreneurial incubation and investment service platform, forming a new urban comprehensive area that integrates business, residential, leisure, and entertainment.

In summary, these phases of renewal and development of Guangzhou's waterfront industrial heritage reflect the evolving strategies and policies, ranging from real estate-driven development to a more diversified and sustainable approach, emphasizing the preservation and transformation of industrial heritage into cultural and creative spaces.

3.1.2 The Renewal Models of Guangzhou's Waterfront Industrial Heritage

The utilization and renewal models of Guangzhou's waterfront industrial heritage encompass four main categories: cultural and creative parks with mixed-use development, museum and exhibition hall models, industrial heritage park models, and single-format development models (Table 3-1)：

Table 3-1: Guangzhou Waterfront Industrial Heritage Redevelopment Models
(Source:Seft-Drawn by the Author)

Number	Old Name of Industrial Zone	Renewal Mode	Current Name of Industrial Zone
1	Guangdong Hydraulic and Hydroelectric Plant	Cultural and Creative Park with Commercial Development	Xinyi International Convention Center
2	Guangdong Canning Factory		Red Special Factory Arts and Design Factory
3	Cooperative and Machinery Factory		922 Hongxin Creative Park
4	Jin Zhujiang Double Oxygen Plant		1850 Creative Park
5	Guangzhou Overseas Chinese Sugar Factory		Tangren Cultural Wharf Creative Park
6	Guangzhou Brewery		Original Elements Creative Park Original Elements Creative Park
7	Osaka Warehouse		Osaka Warehouse 1904 Creative Industry Park

Table 3-1: Guangzhou Waterfront Industrial Heritage Redevelopment Models-Continued
(Source:Seft-Drawn by the Author)

Number	Old Name of Industrial Zone	Redevelopment Mode	Current Name of Industrial Zone
8	Chenganwei Shipyard	Cultural and Creative Park with Commercial Development	Guangzhou Qidi Zhonghai Science and Technology Park
9	Taikoo Warehouse		Taikoo Warehouse Fashion Park
10	Zhujiang Brewery		Zhujiang Pati Beer Cultural Creative Art Zone
11	Luoxi Village Industrial Area		Guangzhou Fisher's Wharf
12	Guangdong Shimin Soil Factory	Museum Exhibition Hall	Sun Yat-sen Grand Marshal's Mansion Memorial Hall
13	Guangzhou Lime Factory	Industrial Heritage Park	Zengbu Park
14	Shangjiao Shipyard	Single Business Development	Xilinyuan Cultural Resort Hotel
15	Chengzhitang Warehouse		Taikoo Xinlei Kindergarten

(1) Cultural and Creative Parks with Mixed-Use Development Model

With the flourishing of the cultural industry, the transformation of urban waterfront industrial heritage into cultural and creative industry parks has become a common renewal model. Treating cultural creativity as an industry, it utilizes the physical space of industrial heritage to solve the issues of revitalization and sustainable development by combining cultural and creative industries with the preservation and use of industrial heritage. This model also drives spatial revitalization and economic development in urban areas[60]. Under the activation model of cultural and creative industry parks, strategies include diversifying functional formats and creating an attractive industrial space background for innovation.

The mixed-use development model is based on the preservation of industrial heritage and integrates various resources, such as cultural and creative economy, tourism, shopping, and entertainment, for comprehensive development[61]. This model is often suitable for larger industrial heritage areas with rich and representative heritage elements that have a significant

impact on the urban area. According to case experience, strategies under this model emphasize diversified functional organization and the creation of vibrant waterfront public spaces.

(2) Museum and Exhibition Hall Model

The activation model for museum and exhibition halls emphasizes the representation of the historical, social, and artistic value of industrial heritage. It uses exhibitions to display information about the heritage's historical events, production techniques, industrial processes, and other aspects through physical exhibits or relevant materials, providing an intuitive presentation of the historical context and cultural significance of industrial heritage. Based on relevant cases, under this activation model, existing industrial buildings are transformed into various exhibition spaces, often accompanied by a variety of daily cultural activities.

(3) Industrial Heritage Park Model

The industrial heritage park model is suitable for larger areas with scattered industrial buildings within the factory area. This model focuses on open public spaces as its core, utilizing the environmental elements of the heritage site and meeting the demands of urban functions to create a park that combines cultural display, sightseeing, leisure, and entertainment. This development model emphasizes waterfront natural environment shaping and ecological restoration, multi-level waterfront space design, as well as public participation in the creation. Waterfront spaces of urban waterfront industrial heritage are essential public spaces in the city. In shaping the natural waterfront environment, the ecological value and social value of this type of industrial heritage should be fully utilized. It is based on ecological restoration and envisions building a dynamic waterfront space with interactive relationships between people and water.

(4) Single-Format Development Model

The single-format development model is suitable for smaller areas with few and concentrated industrial buildings within the factory area. This model focuses on the internal functionality of renovating industrial buildings. While preserving the external appearance of industrial buildings and strengthening their structures, it fully utilizes the internal space of industrial

buildings and inserts appropriate functions based on the volume of industrial buildings. This model primarily emphasizes internal space functionality and the rationality of circulation.

3.1.3 The Renewal Trends of Guangzhou's Waterfront Industrial Heritage

(1) Diversified Renewal Objectives and Comprehensive Benefits

The transformation of renewal objectives in Guangzhou's central waterfront industrial areas is embedded within the broader context of urban renewal. It has evolved from a singular, economic-driven focus in the early stages to the pursuit of diverse and comprehensive goals. Initially, urban renewal in Guangzhou was primarily driven by singular economic goals, often prioritizing short-term economic benefits, such as real estate development, revitalizing existing land and deteriorated buildings, or surface-level urban beautification. It heavily emphasized economic benefits while neglecting other aspects of urban renewal. As socio-economic development transitioned into a "new normal" phase, sustainable development concepts gained traction, and the scope of urban renewal expanded to encompass a variety of goals focused on improving living conditions, promoting industrial upgrading, optimizing spatial layouts, enhancing public facilities, restoring ecological environments, and preserving cultural heritage. The shift moved from primarily economic benefits towards a more comprehensive understanding of benefits that encompass social, environmental, and cultural aspects, marking a transition from "urban growth" to "urban development."

(2) Advocating the "Micro-Transformation + Organic Renewal" Approach

In the earlier stage of unregulated market development, renewal projects operated independently, often taking the form of isolated projects without considering the regeneration and coordination of entire urban functional zones. With the national strategy shifting from incremental to stock-oriented development, "Triple Olds" transformation entered a stage of policy refinement. Projects shifted from isolated redevelopment to comprehensive, systematic renewal projects spanning entire areas of the city, such as Guangzhou's New Steel Town and International Finance City. This shift in approach emphasized a more holistic and systematic view, offering strategies that addressed area-level development, overall improvement, and

solutions to various urban renewal challenges. The renewal process moved from large-scale, resource-intensive demolition and construction towards more diversified methods. It simultaneously incorporated comprehensive renovation and gradual, organic renewal. A novel "micro-transformation" approach was actively promoted to encourage market entities and property owners to actively participate, allowing societal resources to facilitate self-renewal. Successful cases like Guangzhou Fisherman's Wharf and Guangzhou CTC Center Tech Park adopted this "micro-transformation" method and achieved significant results in the renewal of waterfront industrial heritage areas.

(3) Diverse and Multi-functional Comprehensive Format Integration

In the earlier stages of urban renewal, there was a focus on "fast, flat, and cheap" projects with significant emphasis on real estate development due to its high profitability. Subsequently, as policies aimed at the development of cultural and creative industries gained momentum, there was a proliferation of cultural and creative parks that often faced issues such as functional duplication, singular types, and excessive homogeneity. As societal demands diversified, the content and forms of renewal in waterfront industrial heritage areas gradually became more varied. Developments such as Guangzhou Steel, Guangzhou Shipyard, and Guangzhou Paper Mill collectively created industrial cultural waterfront parks. Large-scale landmark hotels and boutique hotels with river views were constructed. Novel functions like public kindergartens were introduced, further enriching the types of reuse. The revitalization of individual waterfront industrial areas expanded to include a wider range of functions and formats, moving beyond the confines of single categories. Projects diversified towards comprehensive formats encompassing cultural creativity, artistic trends, dining and entertainment, and specialized office spaces. In the original format of cultural and creative parks and comprehensive commercial development, cases like the second-phase renovation of Pa Ti adopted a more diversified approach, integrating features such as themed boutique hotels, international flagship stores, and art galleries.

(4) Emphasis on Holistic Preservation and Flexible Utilization

In the early stages of "demolition and construction," industrial heritage was often the most severely damaged category of urban heritage. Although there were isolated cases of industrial heritage preservation, it was fragmented in nature. As society progressed, there emerged planning, design, and artistic forces that focused on the value and significance of industrial heritage. They played a pivotal role in advocating for the protection and reuse of industrial heritage, leading to a shift in the government's ideological stance towards industrial heritage. This shift also had a profound impact on urban aesthetics. Preservation of industrial heritage began to shift from fragmented preservation to holistic protection. At the same time, attention was given to preserving intangible cultural heritage aspects such as industrial techniques and processes. For instance, the Pearl River Yingbo International Beer Museum preserved the brewing process as part of beer culture promotion and display. Many abandoned and dilapidated waterfront industrial areas were revitalized and injected with new functions, flexibly utilizing space for various contemporary formats, becoming a scenic and vibrant part of the waterfront.

(5) Opening Up Waterfront Spaces for Interactive Engagement

In the earlier stages of waterfront industrial area renewal, real estate development dominated due to its high profitability and the prominent economic value of waterfront areas. However, as awareness of the public nature of waterfront spaces increased, there was a growing focus on social equity and spatial justice alongside economic gains. Urban waterfront spaces, as significant public areas, began to be reclaimed for public use, promoting inclusivity. In the early planning stages, many waterfront roads separated the waterfront industrial heritage areas from the waterfront, resulting in the compression of waterfront spaces into single-use green belts. These spaces lacked the formation of distinct spatial nodes. In recent years, more and more waterfront industrial areas have actively designed their waterfront docks. For example, Old Port New Use actively attracted more visitors from the water to the renovated riverside hotels. The old shipyard was transformed into a boutique hotel, with the former inner harbor docks turned

into swimming pools, fostering interaction between people and water, gradually transitioning from isolation to engagement.

3.1.4 Renewal Cases of Guangzhou's Waterfront Industrial Heritage

(1) Taikoo Warehouse Fashion and Creative Park

The Taikoo Warehouse Fashion and Creative Park is a renewal project located at No. 124, Innovation Road, Haizhu District, Guangzhou. It was transformed from the former industrial site of the Taikoo Warehouse Pier. The pier consists of three cruciform-shaped concrete piers and seven brick-and-wood warehouses (Warehouses No. 1 to No. 8). The land area covers 54,888 square meters, with a waterfront of 321 meters. The pier is constructed with high-pile beam-and-slab concrete structures. It includes six brick-and-wood warehouses, two mixed-structure warehouses, and two reinforced concrete warehouses. The total stacking area on the concrete ground is 11,362 square meters. There are nine production support buildings, six living support buildings, and five office buildings on the site.

In 2005, the Taikoo Warehouse Pier was included in Guangzhou's cultural heritage protection scope. As an important industrial heritage in Guangzhou, the Taikoo Warehouse Pier witnessed a century of history in the city's modern port transportation and warehousing industry. It also witnessed the development of Guangzhou's modern industry and commerce. In 2008, against the backdrop of Guangzhou's "retreat from the second industry and advance to the third industry" strategy, the Taikoo Warehouse Pier underwent a renewal and transformation project. Following the principle of "preserving the original state", the project involved exterior refurbishment, structural reinforcement, and internal functional replacement, transforming the Taikoo Warehouse into an "urban living room" that integrates functions such as wine product exhibition, trade exhibitions, cultural and creative design, dining, leisure and entertainment, and sightseeing tourism.

Figure 3-1 Godowns,Canton
(Source：Historical photographs of China,Swire,G.Warren,1906-1907)

Figure 3-2 Current status of Taikoo Warehouse
(Source：Baidu.com)

① Functional Layout

Canton Taikoo Warehouse Fashion Creative Park primarily focuses on waterfront commercial development, supplemented by the model of cultural and creative park renewal, with a diverse range of functional formats. Leveraging its unique location and waterfront advantages, Canton Taikoo Warehouse divides its 7 warehouses into five main functional areas, introducing international wine procurement centers, exhibition depots, a business port, a film depot, yacht clubs, distinctive Western and Chinese dining, and leisure bars, making it the "Fisherman's Wharf" of Guangzhou.

Canton Taikoo Warehouse Warehouses 1 and 2, originally used for storing grains, crops, or other miscellaneous items, have been transformed into an international wine procurement center. They are divided into A and B themed areas, focusing on showcasing and trading genuine imported wines, complemented by wine lecture halls, serving as a platform for wine enthusiasts to learn and exchange ideas.

Canton Taikoo Warehouse Warehouse 3, originally used for local specialties and daily goods, has been transformed into a dynamic display area. Linked with the T-shaped pier and Pearl River cruise ships, it offers customers a fresh experience through various dynamic activities and event creation, boosting popularity and providing support for hosting large-scale events for other formats.

Canton Taikoo Warehouse Warehouses 4 and 5, originally used for storing ceramics and other handicrafts, have now introduced companies in animation, clothing, interior design, and boutique design. In addition to on-site creation, the main focus is on showcasing creative works. Visitors and consumers can savor the power of design.

Canton Taikoo Warehouse Warehouses 6 and 7, originally used for storing rice, have been transformed into Canton Taikoo Warehouse Film Depot, the first waterside cinema in China, designed to a star-level cinema standard. What sets it apart from other cinemas is its collection of over 2,000 copies of classic films available for on-demand viewing. It has become the top choice for young consumers to watch movies.

Canton Taikoo Warehouse Warehouse 8, originally used for storing sugar due to its unique moisture-resistant properties, has been transformed into the Canton Taikoo Warehouse Yacht Club. As onshore facilities for yacht berths, it offers services such as a cigar bar, spa, coffee bar, upscale dining, and more to provide corresponding services to VIP customers. The rear of Canton Taikoo Warehouse mainly provides supporting projects such as dining and accommodation, meeting the needs of the project itself and serving the surrounding residents as well.

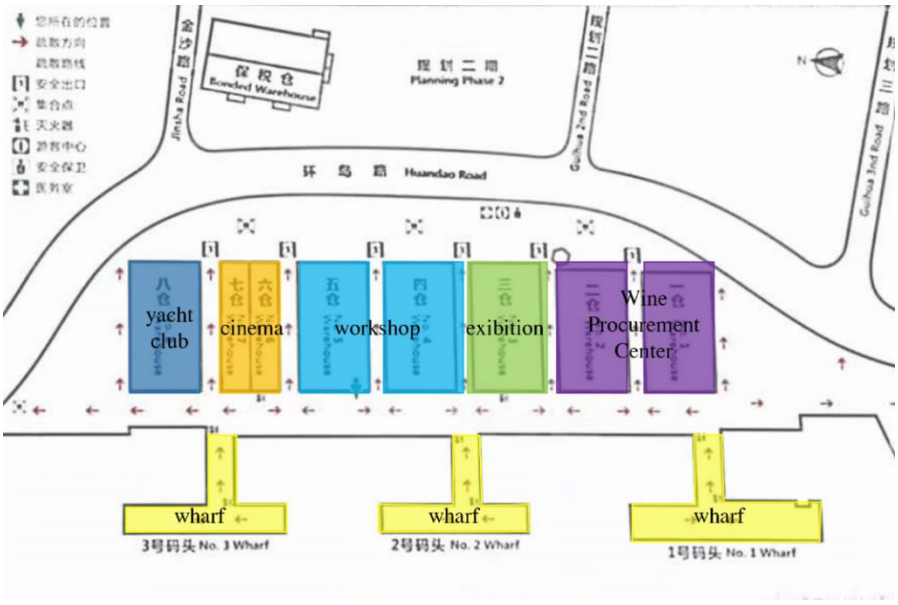


Figure 3-3 Functional zoning diagram of Taikoo Cang (Source:Seft-Drawn by the Author)

In summary, the Canton Taikoo Warehouse Fashion Creative Park presents a comprehensive and well-rounded format plan. It combines the old with the new, the tranquil with the dynamic, offering a complete range of experiences, including sightseeing, dining, accommodation, and entertainment.

② Cultural Continuity

During the renovation and transformation of the Canton Taikoo Warehouse, the principle of "repairing the old to look like the old and building the new to resemble the old" was followed. The original appearance of the industrial buildings was meticulously preserved, showcasing the rich historical charm of the old industrial factory area. The even rows of shutters on the brick-red exterior walls, the circular window openings on the front facade, and the robust metal doors all reflect the authenticity of industrial heritage architecture. The interior spaces of the original warehouses are spacious and open, with partitions and mezzanines added to create a three-dimensional and versatile interior space.

While retaining the original warehouse structure, the interior spaces have been subdivided to accommodate different functional needs. Additionally, some sections of the warehouse's sloping roof have been left as transparent skylights, making full use of natural daylight. Each building is accompanied by a signboard providing a brief introduction to its industrial history. The fire water tower, which once played a dual role in providing firewater and serving as a fire lookout, has been transformed into a coffee shop while preserving its original industrial appearance. This was achieved by expanding the lower space and adding glass elements.

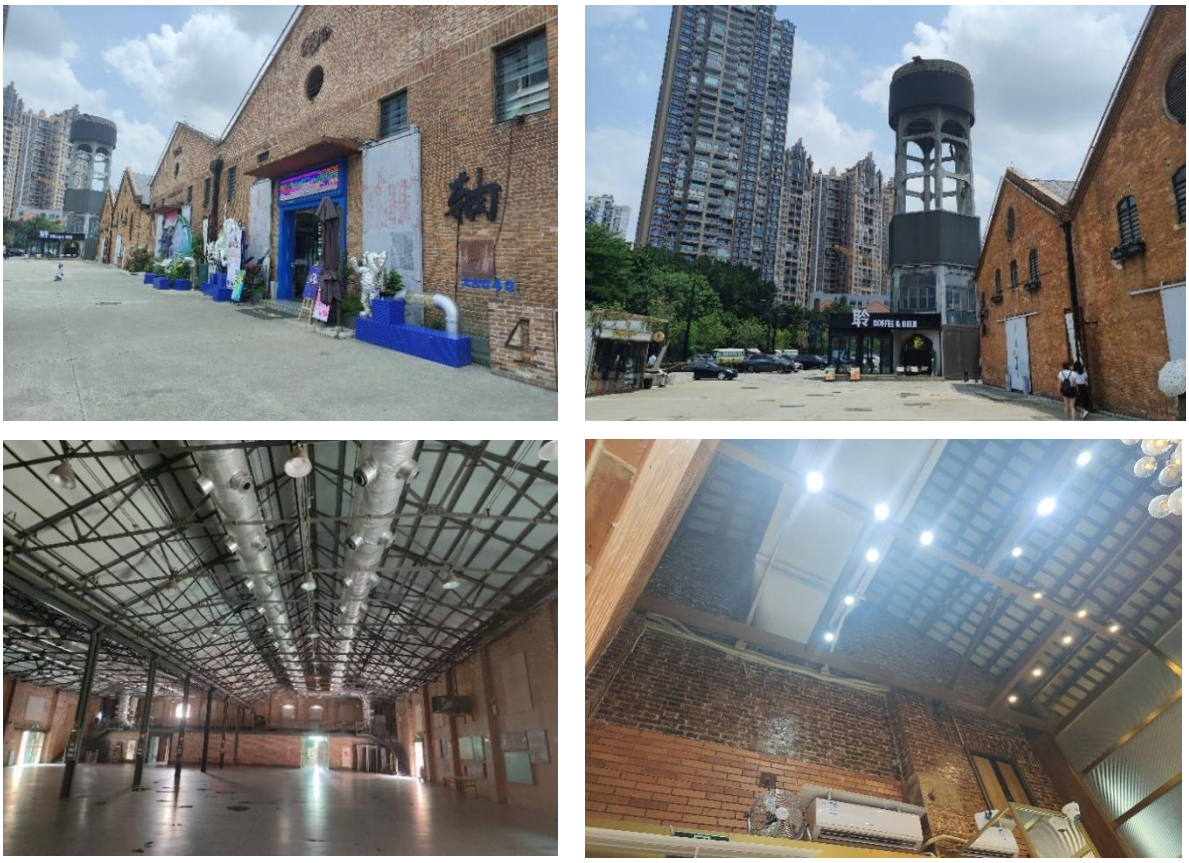


Figure 3-4 Current status of the exterior facade and internal structure of Taikoo Cang
(Source: Self-photographed by the Author)

In addition, the preserved corridor spaces lack overall design and suffer from poor connectivity. The six corridor spaces between the seven warehouses were originally intended to be well-proportioned public spaces, with each corridor approximately 10 meters long and featuring a height-to-width ratio of about 1:1, creating comfortable and pleasant street-like spaces. However, in reality, nearly all of these corridors are obstructed or under maintenance, receiving only basic design treatment, rendering them incapable of providing spaces for stopping and resting.

Figure 3-5 Current status of the Taikoo Cang Corridor
(Source: Self-photographed by the Author)

As a group of industrial heritage buildings primarily used for warehousing, Taikoo Warehouse exhibits a single function and lacks specialized industrial production equipment and distinctive manufacturing processes. On the industrial cultural level, it appears somewhat one-dimensional. The historical and industrial technological aspects of this industrial plant can only be showcased through its architectural and site aesthetics, resulting in relatively weak cultural continuity.

③ Landscape Ecology

a) Waterfront Accessibility

In general, Taikoo Warehouse Fashion Creative Park boasts a favorable waterfront attribute. During the urban development process, the riverside road bypassed the Taikoo Warehouse industrial area, preserving the waterfront character of the site intact. Within the site, the waterfront spaces are primarily composed of riverside walkways adjacent to the warehouses. Visitors stopping here can enjoy panoramic river views. In certain areas of the dock, there are waterfront bars transformed from shipping containers. These dining spaces often incorporate floor-to-ceiling glass windows, presenting lightweight volumes resembling boxes floating on the water, with well-executed waterfront interfaces. The inner harbor space formed by three T-shaped piers and the moored yachts create a small-scale waterscape, making the relationship between people and water more intimate.

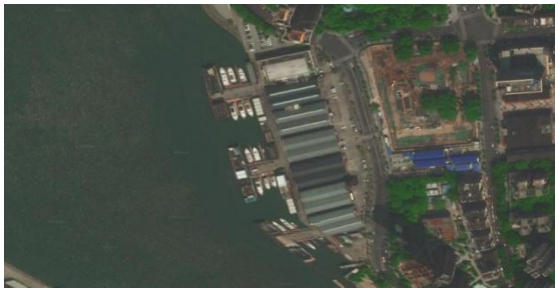


Figure 3-6 Satellite Image of Taikoo Li Fashion Park" (Source: Baidu Maps)

Figure 3-7 Current Waterfront Interface of Taikoo Warehouse
(Source: Self-photographed by the Author)

From a macro perspective, the corridor spaces between the warehouses are oriented perpendicular to the waterfront. In principle, they can serve as urban visual corridors. However, due to some poorly designed public facilities within the site, such as the public restroom between Warehouse 5 and Warehouse 6, the effectiveness of these visual corridors is not ideal. For visitors on the east side of the site, these visual corridors can allow them to directly experience the waterfront atmosphere visually, achieving the effect of attracting foot traffic.

b) Landscape Quality

Due to its specific functional nature, the storage wharf primarily consists of hard-surfaced areas within the factory area. The site is spacious, lacking large expanses of soft soil landscaping and tall trees. Overall, the landscape greening rate of Tai Koo Warehouse is relatively low. Apart from the soft boundary formed by street trees along Ring Road, there are no trees within the site, leaving the entire area exposed to direct sunlight. During the renovation process, due to the limitations of the original hard-surfaced areas, only flower beds were used for planting vegetation, making it impossible to create continuous or patchy green spaces. The variety of flowers, plants, and trees is also quite limited. Except for potted plants at the warehouse entrances, there is a lack of soft green areas and tall trees, and the ecological value of the waterfront space is not adequately emphasized.

Figure 3-8 The current situation of the internal landscape of Taikoo Cang
(Source: Self-photographed by the Author)

(2) Sun Yat-sen Generalissimo Mansion Memorial Hall

The Sun Yat-sen Generalissimo Mansion Memorial Hall is located at 18 Dongsha Street, Fangzhi Road, Haizhu District, Guangzhou, Guangdong Province, China. It is a memorial hall dedicated to the historical site of the Guangzhou Generalissimo Mansion, which was originally the office building of the Guangdong Shimin Cement Factory constructed in the 32nd year of the Guangxu reign of the Qing Dynasty (1906).

The former Guangzhou Generalissimo Mansion consists of three main parts: the entrance gate, the northern building, and the southern building, with a total floor area of 4,238 square meters. The two-story entrance gate is adorned with symmetrical "Five Bat Arch of Longevity" patterns on both sides of the gate's lintel. In between these patterns, there is a granite stone stele inscribed with "In the winter month of the Guangxu Dingwei year (1907), Zhang Renjun of Guangdong Shimin Cement Factory inscribed this." Above the stele, there is a wooden plaque with the characters "Generalissimo Mansion." The entrance gate was originally demolished in the 1980s and converted into dormitories. It was reconstructed to its original specifications and appearance based on historical photographs and completed in 2003.

The northern and southern buildings are both over a hundred years old and are three-story structures made of brick, wood, stone, and reinforced concrete. Each floor is surrounded by a corridor, representing a typical colonial-style architecture with external corridors. Features such as brick arches, decorative lines, terracotta balustrades, and bamboo-shaped drainage pipes

from top to bottom reflect its architectural style that combines Western and Lingnan architectural characteristics.

In November 1996, the former Guangzhou Generalissimo Mansion was designated as a "National Key Cultural Relics Protection Unit" by the State Council of China. The Sun Yat-sen Generalissimo Mansion Memorial Hall serves as a patriotic education base for Guangdong Province, Guangzhou City, and Haizhu District. It is also a base for the United Front Work Department in Guangdong and an early practice in the renewal and utilization of Guangzhou's waterfront industrial heritage.

Figure 3-9 Original Shimen Clay Factory in Guangdong（Source：http://www.360.com）

Figure 3-10 Current Status of the Sun Yat-sen Grand Marshal's Mansion Memorial（Source：http://www.360.com）

① Functional Layout

The former Generalissimo Mansion is divided into two parts: the North Building and the South Building. The North Building hosts long-term thematic exhibitions, while the South Building is preserved to resemble the way it looked when Sun Yat-sen resided there.

In the North Building, there are various exhibitions, including "*A Century of the Generalissimo Mansion*," "*Sun Yat-sen Establishing Regimes in Guangzhou Three Times*," "*Notable Figures of the Mansion*," and "A Glimpse of Guangzhou in the Republic of China Era."

The South Building, on the other hand, is preserved to reflect the layout during Sun Yat-sen's residency. On the first floor, there are rooms like the Deputy Officer's Office, Reception Room, Medical Officer's Office, Staff Department, Treasury, General Affairs Department, Barracks

for the Guards, and Armory. The second floor consists of four rooms designated as the Staff Office (Chiang Kai-shek's office), Secretary's Office (Liao Zhongkai's office), Headquarters Gazette Editorial Office, and General Staff Office (Hu Hanmin's office). The third floor was the primary activity area for Sun Yat-sen and Song Qingling, which includes Sun Yat-sen's office, the Generalissimo Mansion meeting room, Sun and Song's bedroom, dining room, washroom, telegraph room, and the small guest room where Song Meiling once stayed.

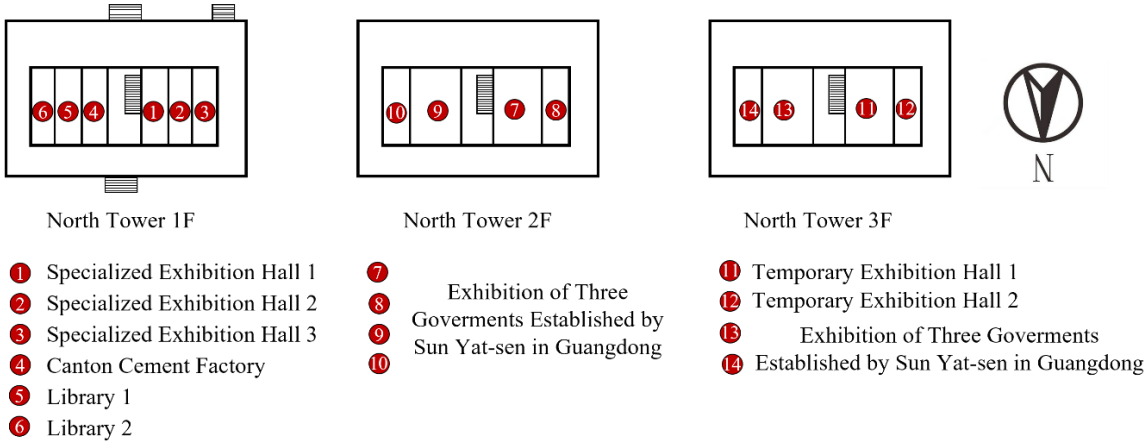


Figure 3-11 Floor Plan of the North Building of the Sun Yat-sen Grand Marshal Mansion Memorial Hall (Source: Self-Drawn by the Author)

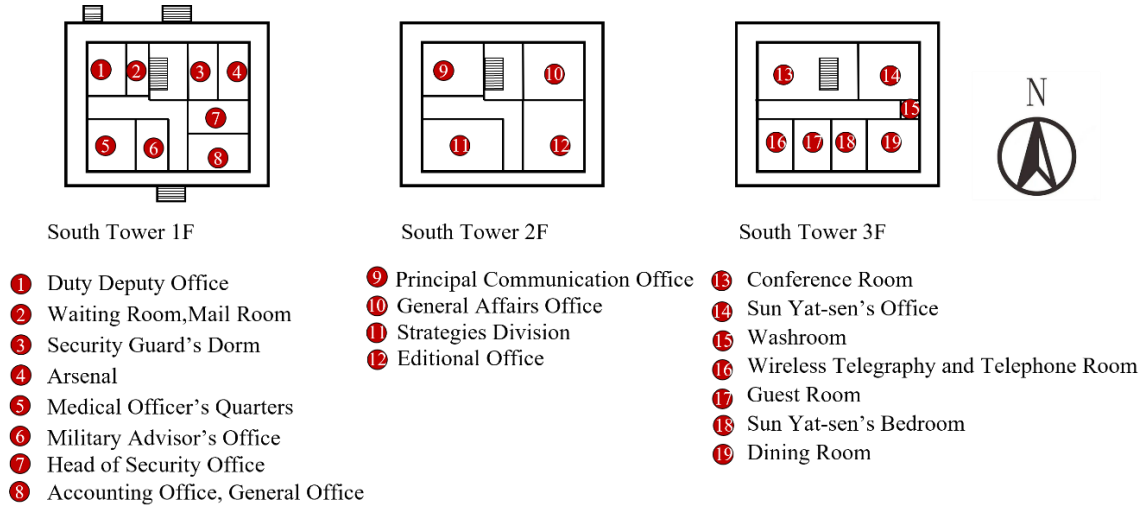


Figure 3-12 Floor Plan of the South Building of the Sun Yat-sen Grand Marshal's Mansion Memorial Hall (Source: Self-Drawn by the Author)

In the case of the redevelopment of waterfront industrial heritage in Guangzhou, there is a general tendency to transform industrial heritage with high historical and cultural value into the form of museum exhibitions, typically organized and developed by government departments. During the transformation process, there is an emphasis on preserving the authenticity and

integrity of the industrial heritage buildings themselves. The Sun Yat-sen Former Generalissimo Mansion Memorial Museum, as a typical example of the redevelopment of an old industrial area in Guangzhou's central waterfront into a museum, has a single functional layout, but it presents the most authentic historical information.

② Cultural Continuity

The Sun Yat-sen Former Generalissimo Mansion Memorial Museum is based on the former site of the Guangdong Shimin Brick and Cement Factory, which was located near the Pearl River and primarily relied on water transportation. Designed by Australian architect Mr. Panet, the building has a total floor area of over 8,000 square meters. The façade of the Generalissimo Mansion gatehouse features a Baroque-style design popular in Europe at the time. Above the gate, there are swirling-shaped decorative elements, with large "寿" (shou, meaning longevity) characters on both sides.

Both the North and South buildings have a century-old history and exhibit a typical colonial-era architecture with three stories of brick, wood, stone, and reinforced concrete construction. Each floor is surrounded by verandas, and the façades feature continuous arcades with decorative details on arches and pillars. The windows follow a double-layered design with interior glass windows (with transom windows above) and exterior louvered windows, reflecting a blend of Western architectural forms and Lingnan (Cantonese) architectural characteristics. The roofs are designed with hipped gables, incorporating features of traditional Guangzhou architecture. The façades also feature bamboo-shaped rainwater pipes for drainage, a typical characteristic of early Western architectural influence in China, often referred to as "Southern Asian Colonial Style." This design showcases the organic integration of Western architectural forms with local Guangzhou styles, boasting high architectural and construction technology values.

As one of China's nationally protected cultural heritage sites, the Sun Yat-sen Former Generalissimo Mansion primarily follows the approach of "restoring the old to its original state" during restoration and preservation to faithfully replicate the former appearance of the mansion. According to Li Xianheng, the former curator of the Guangdong Revolution History Museum, during the restoration, they faithfully reconstructed the gatehouse that had been damaged, following the original foundation, to ensure the authenticity of the heritage. Efforts were made to harmonize and unify the proportions of old and new buildings. Due to the various partitioning forms within the original structures, the interior spaces on different floors were also differently divided, and combined with the verandas, they created diverse exhibition spaces. The interior space design varies according to the exhibition themes, mainly using a black-and-white color scheme and earthy tones to evoke a historical and vintage atmosphere.

The Sun Yat-sen Former Generalissimo Mansion Memorial Museum, originally based on the renovation of the Guangdong Shimin Brick and Cement Factory, does not strictly qualify as an industrial heritage museum. Therefore, it has relatively little continuity with industrial culture and holds lower value as an industrial heritage. The museum provides limited information about the history of the brick and cement factory itself and does not preserve any industrial equipment related to the factory. Instead, it primarily showcases historical figures and events associated with the Generalissimo Mansion identity, effectively creating a sense of historical space and identity.

Figure 3-13 Current State of the Sun Yat-sen Grand Marshal's Mansion Memorial Hall
(Source: Self-Photographed by the Author)


Figure 3-14 Interior of the Sun Yat-sen Grand Marshal's Mansion Memorial Hall
(Source: Self-Photographed by the Author)

③ Landscape Ecology

a) Waterfront Accessibility

The original Guangdong Shimin Brick and Cement Factory was situated along the riverbank, with the gatehouse overlooking the waterfront, providing a direct view of the river. However, the Pearl River shoreline has since receded northward, and due to the division caused by Binjiang Middle Road, there is now a considerable distance between the memorial museum and the waterfront. The massive Jiangwan Bridge on the western side of the site significantly obstructs the view of the museum as a riverside attraction, creating adverse effects and a gray space. Accessibility to the river view from the square has been greatly diminished due to the passage of vehicles along Binjiang Middle Road. The water features of this redevelopment space are not clearly defined, and both the visual accessibility of the waterfront landscape and the usability of the waterfront space have been severely obstructed and restricted due to road and bridge construction.

b) Landscape Qualities

Looking at the overall landscape structure, the memorial museum has intentionally created a north-south axis of landscape composed of the museum, gatehouse, Sun Yat-sen statue, and the Pearl River. In terms of landscape greening, the Sun Yat-sen Former Generalissimo Mansion Memorial Museum has designed small green parks on both the east and west sides of the

memorial square, featuring a rich variety of plant species. Through the thoughtful design of landscape greenery, it has mitigated to some extent the visual impact of the Jiangwan Bridge on the western side. Existing old trees on the museum site have been preserved, and newly added landscape greenery has been meticulously designed. Flower beds along the perimeter of the building and the small park on the western side collectively form a landscape system within the museum site. This clear landscape structure and diverse landscape greenery contribute to a high-quality environmental experience for this memorial site.

Figure 3-15 Sun Yat-sen Grand Marshal Mansion Memorial Garden Axis
(Source: Self-Drawn by the Author)

Figure 3-16 Tree Planter Inside the Sun Yat-sen Grand Marshal's Mansion Memorial Hall
(Source: Self-Photographed by the Author)

(3) The Pearl River PaTi Beer Culture and Art District

The Pearl River PaTi Beer Culture and Creative Art District (Pearl River PaTi) is located on Yuejiang West Road, Pazhou Street, Haizhu District, Guangzhou. It is a redevelopment of the Pearl River Brewery. The Pearl River Brewery was established in 1985 and was a modern large-scale enterprise jointly operated by the Guangzhou Light Industry Bureau and the Guangzhou Farm Management Bureau. It was classified as a key import project at the provincial and municipal levels and became the first modern brewery in China to comprehensively introduce advanced foreign equipment and technological processes after the reform and opening-up.

The Pearl River Brewery, from planning to construction, was completed in only two-thirds of the originally planned time. Just one year after production commenced, it reached 90% of its original design capacity. In just five years, it achieved the second-highest production and sales volume and export value among similar enterprises in the country, earning it the nickname "Pearl River Speed." The Pearl River Brewery bore witness to the reform wave of the 1980s and carried the development process of China's beer industry. Despite having a history of only 30 years, it is still an important "new industrial heritage."

In 2004, Guangzhou Pearl River Brewery Co., Ltd. collaborated with Anheuser-Busch InBev, a Belgian-Brazilian multinational beverage and brewing company, to establish the Pearl River-InBev International Beer Museum on the eastern side of the Pearl River Brewery. The museum is an international beer culture showcase where visitors can learn about beer culture and history, observe the beer production process, and laid a solid foundation for the later industrial transformation of the brewery.

In 2008, the Guangzhou municipal government introduced the urban development strategy of "retreat from the second line, advance to the third line." As a result, the Pearl River Brewery began to relocate from the urban area to the Nansha Economic and Technological Development Zone. By December 2015, the original site of the Pearl River Brewery had ceased all production operations, leaving behind a large number of distinctive industrial buildings and beer

production lines. In 2009, the Pearl River Brewery initiated its renovation and redevelopment efforts. In 2011, leveraging the museum constructed earlier, the Pearl River Brewery gradually transformed into the Pearl River PaTi Beer Culture and Creative Art District, integrating dining, entertainment, creative offices, arts and culture, and leisure tourism.

In 2016, PaTi embarked on an upgrade and transformation project, incorporating additional functions such as office spaces, a beer culture-themed hotel, art galleries, and more. It has since become a popular tourist attraction in Guangzhou.

Figure 3-17: Redline Boundary and Surrounding Area Planning of Zhujiang·Pate Old Industrial Park (Source:Self-Drawn by the Author)

① Functional Layout

The PaTi redevelopment model is characterized by its reliance on the Beer Culture Museum, with a focus on comprehensive waterfront commercial development, supplemented by a cultural and creative park with office functions. It offers diverse and compound functional formats, making it the most comprehensive case in the practice of revitalizing industrial heritage along the Guangzhou waterfront. Currently, PaTi is committed to creating a high-end urban public space in Guangzhou that combines beer culture, dining and entertainment, creative offices, art exhibitions, and leisure tourism. It has shifted from primarily material consumption in dining and entertainment to more experiential consumption, including cultural dissemination activities, public projects, cinemas, fitness clubs, co-working spaces, and incubators. With its

diverse range of functional formats, it can meet the needs of consumers from various backgrounds, expanding its reach to a wider consumer base.

② Cultural Continuity

The Pearl River Brewery was established in 1985, with a history of just over 30 years. During the redevelopment and transformation process, various approaches were adopted for sustainability considerations, depending on the age and value of each industrial building. Buildings and structures with distinctive beer production process characteristics and redevelopment potential were chosen for preservation or appropriate renovation. Those in poor condition and of low value were selected for demolition and reconstruction. This approach balanced economic development value while preserving and reasonably utilizing industrial heritage resources within the factory area.

The Pearl River Brewery preserved 25 of the most representative industrial heritage buildings and structures, including boiler rooms, turbine rooms, coal sheds, packaging workshops, malt silos, coal conveyor galleries, water towers, chimneys, sewage treatment plants, industrial pipelines, and the bases of fermentation tanks. This is a rare case in Guangzhou where a significant number of industrial heritage treasures were preserved, retaining the complete industrial production process, industrial production features, and park layout of the old factory.

The Boiler Culture Square, facing north and open to the Pearl River, is the area within the park where industrial historical buildings are most densely preserved and complete. Originally, it housed the steam turbine boiler room, with core power equipment such as high-pressure steam boilers and steam turbine generators. The transformation retained one boiler, the overhead crane over the Pearl River, the coal conveyor gallery connecting the coal shed and boiler room, and the steam-water wall pipeline. The disassembled boiler was repurposed as an art installation, and the spacious space can accommodate various art creation activities with different themes.

The Turbine Room, built in 1994, was originally the steam turbine building of the Pearl River Brewery's thermal power plant. It was the first large-scale building to be renovated by Pearl River Brewery and was transformed into Pearl River Brewery's headquarters building in May 2021. As a multi-story reinforced concrete structure workshop, the Turbine Room preserved the core production equipment (steam turbine) inside and maintained industrial features such as crane beams, cranes, underground pipelines, and more. During the renovation, only a small portion of the Turbine Room was added as mezzanine levels for office space, preserving the unique industrial spatial characteristics of the workshop. The renovated interior space still centers around the steam turbine and its foundation platform: a seven-story high shared atrium, layered platforms, accessible machinery and equipment pipelines, showcasing the grandeur of the original thermal power production and providing a unique and rich creative office environment. In addition, this office building also preserved other industrial equipment, including malt crushers and milling machines, each equipped with brief introductions for visitors to gain a deeper understanding of Pearl River Brewery's industrial production process. The exterior facade of the headquarters building retained the original reinforced concrete truss structure, most of the architectural window openings, chimneys, pipelines, and other industrial components. It incorporated extensive modern glass doors and windows, as well as light golden metal mesh, creating a strong contrast between old and new.

The Coal Shed, originally used for coal storage, was transformed into an industrial-style multi-functional performing arts center with an 8-meter-high interior space and a 1420-square-meter column-free area in August 2018. Due to leakage, the original roof panels were replaced, but the overhead crane, columns, catwalks, peeling paint layers, and rusty scaffolding were all preserved in their original condition. Various events, including the Qidian Arts Festival, fashion weeks, new product launches, and more, are held here. The old industrial workshop, newly equipped with lighting facilities, creates a stark contrast between modernity and history.

The Malt Silo, located in the center of the park, consists of 15 huge concrete barrels and serves as a landmark for PaTi. Originally used for storing malt, a key ingredient in beer production, the Malt Silo has been fully preserved and transformed into a fashionable concept store.

Table 3-2: Partial Architectural Renovation Techniques and Current Status of Zhujiang Brewery (Source:Self-Drawn by the Author)

Name of building	Heritage Conservation Area	Current architectural photos
Turbo-Generator Room	The core production equipment indoors (turbine), as well as industrial architectural features like crane beams, cranes, underground pipelines, and so on.	
Wastewater Treatment Plant	IC-AS treatment tower and pipelines, sedimentation tank, aeration tank.	
Fermentation plant for saccharification	1. Fermentation tank base. 2. Transportation pipelines and gantries.	

Table 3-2: Partial Architectural Renovation Techniques and Current Status of Zhujiang Brewery -Continued (Source:Self-Drawn by the Author)

Name of building	Heritage Conservation Area	Current architectural photos
Coal-fired power plant	1. East and West Coal Sheds. 2. Water pumps and operating platforms. 3.Chimneys and coal conveyor galleries.	  
Malt silo	Retain the main structure.	
Water Tower	preserve the main structure	

③ Landscape Ecology

a) Waterfront Acessibility

The original Zhujiang Beer Factory was built along the banks of the Pearl River. In the process of urban development, the planning for the site included a tunnel (Modiesha Tunnel) beneath Yuejiang West Road to bypass the beer factory area, preserving the riverside space along the Pearl River. This riverside public space is accessible to the public and has become a part of the

city's landscape, featuring a riverside bar street and public activity spaces, with excellent views of the river.

After 2015, a planned tram route passed through the site, occupying the original ground-level riverside space. Only a footpath remains along the riverside, while the original riverside bar street was elevated to the second floor. Although the tram tracks severed the connection between the site and the riverside footpath, due to the long intervals between tram services, people can generally cross the tracks to reach the riverside path. However, there is only one accessible crossing, which may be somewhat inconvenient, and there are no steps connecting the second-floor platform above the tracks to the riverside path. On the other hand, the space on both sides of the tracks is separated by transparent glass walls, which have a relatively minor impact on the ground-level river view. The second-floor outdoor platform still offers excellent views of the river.

However, due to the constraints of the tram tracks, the riverside footpath is only about 3.5 meters wide and is paved with concrete, lacking the development of a rich river habitat. The approximately 500-meter shoreline follows a straight line, lacking diverse waterside spaces, making it difficult to create interaction between people and the water.

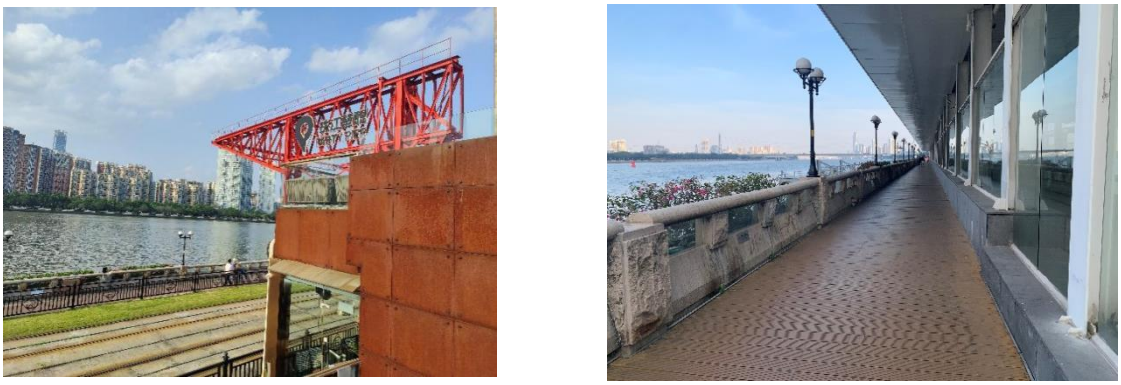


Figure 3-18 Current State of Riverside Walkway in the Park
(Source: Self-Photographed by the Author)

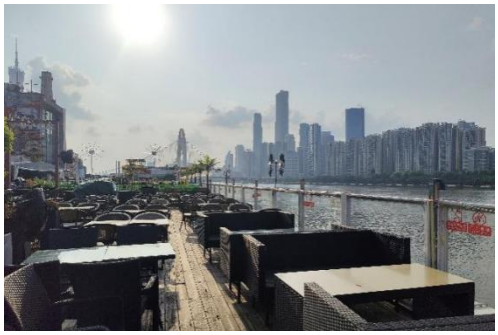



Figure 3-19 Open-air Platform Within the Park Area
(Source: Self-Photographed by the Author)

b) Landscape Quality

As the park's previous incarnation was an industrial production area, the landscape was primarily focused on simplicity and practicality. Additionally, because the riverside space to the north was separated from the park, there are only a limited number of landscaping plants within the site. These are mainly decorative landscape areas designed by businesses within the park. The park primarily consists of hard landscaping with a lack of accompanying public recreational facilities. The ecological environment has not been well restored, and there is an overall absence of concentrated green landscapes.


Figure 3-20 Current Landscape in the Park (Source: Self-Photographed by the Author)

(4) Xilinyuan Cultural Hotel

Xilinyuan Cultural Hotel is located at No. 4 Longzhou West Street, Luopu Shangxia Village, Panyu District, Guangzhou City. It was transformed from an old shipyard in Shangjiao with a history of more than 30 years. Shangjiao Shipyard was established in the 1950s and was one of the earliest collectively owned dragon boat manufacturing factories in Panyu. In 1962, He

Weihong, a 16-year-old apprentice, joined Shangjiao Shipyard to learn the craft of making dragon boats. In 1982, at the age of 36, He Weihong, a worker at the dragon boat factory, took over Shangjiao Shipyard under the influence of the reform and opening up, making it one of the early privately-owned shipyards in Panyu. It was also one of the first manufacturing industries built with private capital in Guangzhou, continuing to produce and make dragon boats. In the late 1980s and early 1990s, the scale of dragon boat activities decreased, and the demand for dragon boats declined, greatly affecting the business of the dragon boat factory. He Weihong, who was facing an operational crisis at the dragon boat factory, saw a new opportunity. He persevered through the pressure and initiated reforms. He first renovated the dock and workshops, and due to the advantageous geographic location of Shangjiao with a natural harbor, he shifted the main business of Shangjiao Shipyard from traditional dragon boat manufacturing to the maintenance and repair of large maritime transport vessels traveling between Hong Kong, Macau, and Guangzhou. After the transformation, Shangjiao Shipyard saw a continuous flow of repair business, repairing various types of vessels over the course of more than 20 years. Shangjiao Shipyard witnessed the vibrant development of the shipping industry brought about by economic exchanges between Guangdong, Hong Kong, and Macau. It also witnessed the changes brought about by reform and opening up and the passage of time.

With urban development, Panyu built a well-connected transportation network, and water transport was no longer dominant. Ferry services gradually ceased operation. In 2012, after 30 years of operation, Shangjiao Shipyard was finally closed down, becoming an industrial relic within the city of Guangzhou. The development history of Shangjiao Shipyard over half a century and the personal struggle of its former factory director are a microcosm of the changing times. They witnessed the rise and fall of the traditional dragon boat manufacturing industry and also witnessed the history of the rise of the individual economy brought about by more than 40 years of reform and opening up, as well as the vibrant development of the shipping industry brought about by economic exchanges between Guangdong, Hong Kong, and Macau.

With economic development, real estate development along the Pearl River continued to advance, and similar factory buildings disappeared in Panyu. The intact and typical layout and structure of the shipyard, including the dry dock, workshops, and wharf, were preserved. In the spring of 2014, the old shipyard officially began its transformation. After three years, Shangjiao Shipyard was transformed into a cultural experience hotel that integrates culture, art, and commerce. The successful revitalization of the old shipyard is in line with the national and Guangdong province's guidance on "developing homestays, promoting rural tourism, and comprehensive tourism" and "beautiful countryside construction." It serves as an example of the renovation and revitalization of old factories and buildings in Guangzhou and has received recognition and support from society and various leaders. Through various cultural activities and exhibitions, it has preserved the cultural memories of Shangjiao and Luopu while creating a pleasant landscape space along the Pearl River for the public.

Figure 3-21 Before the Transformation of Shangjiao Shipyard
(Source: https://mmbiz.qpic.cn/mmbiz_jpg/)

Figure 3-22 Shangjiao Shipyard Before Renovation
(Source: https://mmbiz.qpic.cn/mmbiz_jpg/)

① Functional Layout

The transformation of the waterfront old industrial area into a hotel homestay is relatively rare in Guangzhou's renovation practices, and compared to other development models, the functional formats appear to be relatively singular. The original two-story workshops of the shipyard have been transformed into 24 themed guest rooms for homestays, with expansions outward. A courtyard has been added downstairs, and an open-air observation platform has been set up on the rooftop. The large bathhouse where shipyard workers used to bathe collectively has been transformed into a separate guest room, named "Nianyue," with three

sides facing the river. The low, old car shed that was originally used for factory workers' parking has been transformed into a unique relaxation gallery. The tool storage room and office area on the south side of the shipyard dock have been transformed into a cigar bar and hotel office rooms. The original old factory building of the shipyard, as a spacious and open space, has been transformed into a conference room capable of accommodating various gatherings and events. The former dock has been transformed into a swimming pool and a landscape pond, while the riverside wharf has been converted into an observation platform with three docking piers. The overall design of the hotel adheres to a sense of "order within chaos," with natural transitions between different spaces and rich layers, making it a venue for outdoor weddings, bar performances, and artistic events.

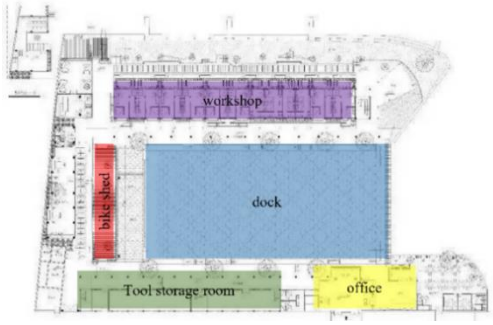


Figure 3-23 Original Shangjiao Shipyard Spatial Layout
(Source:Self-Drawn by the Author)

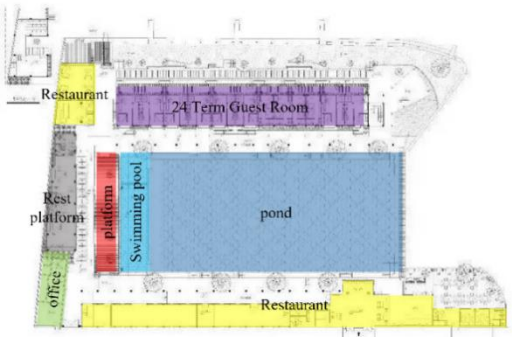


Figure 3-24 Xilinyuan Hotel Spatial Layout
(Source:Self-Drawn by the Author)

② Cultural Continuity

The transformation of the Shangjiao Shipyard is based on the preservation of the original spatial layout and the maritime industrial character. The hotel has retained the shipyard's original architectural contours, industrial traces, and various old objects. It combines steel structures and glass to create a modern aesthetic. The gentle texture of bygone eras is blended with modern design, imparting an artistic influence. The hotel added steel roofs on top of the original workshop walls, building colors, and foundations, forming new guest room structures. Each space in the hotel has its unique style, featuring solid wood, bricks, and tiles, with an emphasis on texture. The extensive use of red tiles, white walls, and wooden red bricks creates a warm and serene atmosphere throughout the entire space.

Before Renovation - Car Shed

After Renovation - Tropical Art Gallery

Before Renovation - South Side of Guest Rooms

After Renovation - South Side of Guest Rooms

Before Renovation - Dock

After Renovation - Swimming Pool

Before Renovation - Workshop

After Renovation - Guest Rooms

Before Renovation - Riverside Rooms

After Renovation - Riverside Rooms

Figure 3-25 Before and After Comparison (Source: https://mmbiz.qpic.cn/mmbiz_jpg/)

③ Landscape Ecology

a) Waterside Affinity

On the riverside of the hotel, the guest rooms have been widened to include a small courtyard with stone terraces, transforming the once overgrown riverbank into a sandy beach for children to enjoy. In front of the cigar bar, there's a waterside terrace where guests can savor the riverfront view. On the east side of the guest rooms, a large banyan tree has been preserved, with an elevated ground floor that serves as a leisurely waterside platform. The second floor features a spacious suite with three sides facing the river, offering expansive views. The infinity pool seamlessly blends with the Pearl River, and a sizable waterside platform is situated by the pool. In summary, wherever the hotel is close to the river, viewing platforms have been designed, creating pleasant waterside spaces that harmonize the building with its surroundings.

Figure 3-26 Overgrown with Weeds on the Riverside Before Renovation
(Source: https://mmbiz.qpic.cn/mmbiz_jpg/)

Figure 3-27 Riverside After Transformation into a Sandy Beach
(Source: https://mmbiz.qpic.cn/mmbiz_jpg/)

b) Landscape Quality

The Xilinyuan Cultural Hotel preserves the trees within the site, incorporating them as part of the entrance courtyard to the guest rooms. The architectural design accommodates the vegetation, providing them with space to thrive. The courtyard is understated and secluded, with a predominant green color palette. It features six sprawling kapok trees and fragrant tropical fruit trees that bloom throughout the seasons, creating a diverse and lush overall landscape.


Figure 3-28 Current Interior Landscape of the Xilinyuan Cultural Hotel
(Source: https://mmbiz.qpic.cn/mmbiz_jpg/)

3.1.5 Problems of Guangzhou's Waterfront Industrial Heritage Regeneration

Based on research into the regeneration cases of four waterfront industrial heritage sites in Guangzhou, the following inadequacies in the regeneration and utilization of Guangzhou's waterfront industrial heritage can be summarized:

(1) Isolated Development with a Lack of Urban Integration

Currently, the development and utilization of Guangzhou's waterfront industrial heritage exhibit fragmented and sporadic development. They have not fully capitalized on the scenic advantages of waterfront locations. The continuity of urban waterfront spaces is conducive to establishing a relationship between the city's hinterland and its waterfront, promoting overall urban development. Most of the regenerated waterfront industrial heritage sites are developed as isolated entities, lacking interconnections between them and failing to synergize with the development of the waterfront area. Leveraging the natural connection provided by the waterfront, a more comprehensive approach can be taken to connect industrial heritage with other urban areas, fostering regional revitalization and vibrancy. Moreover, waterfront industrial heritage, serving as both heritage and urban landscape, should adhere to holistic principles during the regeneration process, considering heritage preservation, spatial revitalization, and other aspects, to ensure the coordination of urban waterfront aesthetics and functionality.

(2) Spatial Isolation from Urban Morphology

During the regeneration process, industrial heritage sites often lack consideration for urban factors, resulting in spaces that are relatively independent from the surrounding urban fabric, leading to a lack of harmony with the city's overall image. The process rarely begins with urban spatial morphology, focusing primarily on the spatial texture and architectural composition of the industrial heritage itself, while neglecting connections with the surrounding urban morphology and transportation.

(3) Inadequate Expression and Interpretation of Industrial Culture

Initially, the regeneration of waterfront industrial heritage was not primarily aimed at revitalizing the urban center but rather at attracting investments and promoting the development of other industries. This approach has led to a focus on environmental improvement and beautification at the material level, with the goal of maximizing economic benefits, while insufficiently considering the preservation and continuation of the cultural characteristics of the waterfront area and its industrial heritage. Current industrial heritage regeneration efforts are beginning to address the issue of cultural significance, particularly in the context of accurately presenting and interpreting industrial culture through museum exhibitions. However, there are still challenges, such as limited interactivity in museums and insufficient exploration of industrial culture in spatial design, which affect the cultural and artistic aesthetic value.

(4) Lack of Vibrancy in Shaping the Waterfront Natural Environment

Under the guidance of urban "dual restoration" efforts, ecological restoration has gradually become a part of urban regeneration, especially in ecologically sensitive waterfront areas, where water quality improvement and environmental enhancement are increasingly emphasized to reflect their ecological value. Additionally, waterfront spaces represent rare opportunities for people in the city to connect with nature, requiring these spaces to be restored to the community, fostering genuine interaction between people and water, and realizing the social public value of waterfront spaces. Overall, the focus of shaping the waterfront natural environment should be on enhancing environmental quality and strengthening human-water interaction.

3.2 Feasibility Analysis of Waterfront Industrial Heritage in Conjunction with Catalysis Theory

3.2.1 The "Catalytic" Characteristics of Guangzhou's Waterfront Industrial Heritage

Due to the differences in the urban context, environment, and development characteristics of waterfront industrial heritage in Guangzhou, there exist variations in their physical forms and cultural features. However, it is precisely these differences that can trigger more possibilities, and these "differences" are essential elements for catalyzing effects. The distinctive features in urban waterfront industrial heritage are mainly reflected in several aspects: urban industrial historical records, regional identity and sense of place, architectural diversity, high usability, and strong adaptability.

(1) Memory Carriers of Urban and Industrial Development

During the continuous process of urban self-renewal, differences in geographical location, natural environment, and cultural environment lead to variations in architecture and spatial texture, leaving behind different urban imprints. Over time, these imprints become precious cultural deposits of the city, showcasing its cultural heritage and urban quality. With the adjustment of the national industrial structure under the "retreat from the second and enter the third," most industrial factory areas and buildings have been abandoned, leaving behind production plants, material storage sites, transportation pipelines, and more, all conveying the charm of industrial culture.

(2) Regional Identity and Sense of Place

During the industrial era, the establishment of industrial and mining enterprises had an impact on the local population size, residential scale, and supporting businesses in specific areas of the city. Prolonged shared living experiences, a common corporate culture and language, and

similar ways of life and production naturally led to a sense of belonging and identification among residents with that region.

(3) Diverse Architectural and Spatial Characteristics

Due to differences in construction periods, types of production, and environmental factors, industrial buildings also exhibit variations in scale and spatial forms. These differences are advantageous for achieving "catalytic" transformations. Variations in architectural spatial forms, dimensions, and materials, as well as the aesthetic tension expressed by industrial buildings and spaces, provide the driving force for catalytic design.

(4) Strong Adaptability and High Usability

Compared to general urban renovation projects, industrial heritage can utilize existing elements and organizational structures on the site to establish a well-structured spatial order during the process of renewal and transformation. Additionally, because industrial buildings have strict construction requirements and craftsmanship, these structures remain relatively intact even after factory operations cease. They can be directly utilized or renovated for use, thereby reducing the problems associated with demolition and reconstruction, including construction waste and technical challenges.

3.2.2 The Compatibility of Catalyst Theory in the Renovation and Utilization of Urban Waterside Industrial Heritage

Urban waterfront industrial areas have made significant contributions to social impact and industrial development. The industrial heritage left by these areas holds exceptional historical and cultural value as well as social significance. The preservation and regeneration of urban waterfront industrial heritage should not involve large-scale demolition and reconstruction but should respect the authenticity of the heritage. Preservation efforts should transform the decaying image of these spaces into active regional assets. Additionally, the preservation should also involve a change in their functional roles, making them new focal points for regional vitality, thereby driving positive development in the surrounding areas. After analyzing the

characteristics of the catalysis theory and its role in industrial heritage preservation, it becomes evident that the catalysis theory aligns well with the diverse needs of urban waterfront industrial heritage preservation and revitalization (Figure 3-29).

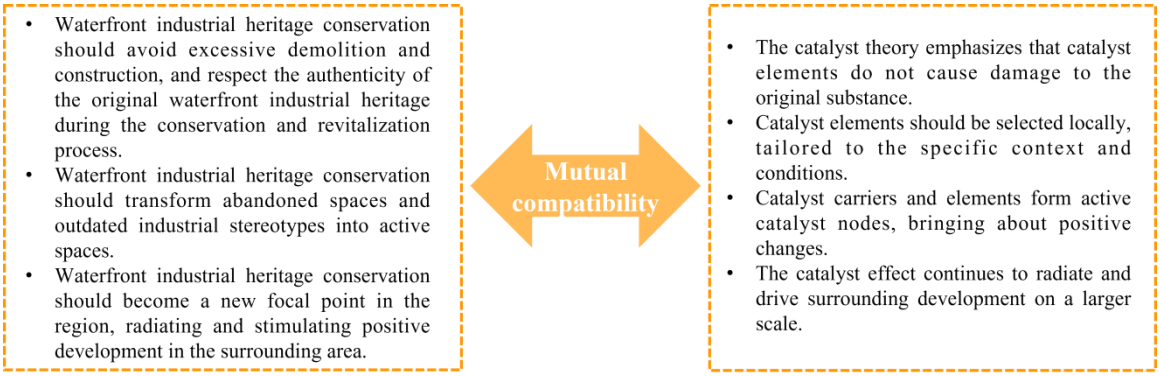


Figure 3-29 The relationship between catalyst theory and industrial heritage protection demand (Source:Self-Drawn by the Author)

The application of catalysis theory in the revitalization and preservation of urban waterfront industrial heritage is about optimizing solutions to specific issues in the heritage preservation and revitalization process. The catalytic preservation and revitalization system emphasize the transformation of local heritage elements to achieve catalytic activation and reshaping. The application of catalysis theory in the revitalization and preservation of urban waterfront industrial heritage generates a synergistic effect that extends to a larger scope, driving development in the surrounding areas.

3.3 The principles of revitalizing waterfront industrial heritage on Urban catalyst

When applying the catalysis theory to the research and practice of industrial heritage renewal and protection, the catalytic mechanism primarily involves analyzing the catalytic activation and protection conditions of the research object. This includes reviewing its historical and cultural elements. Subsequently, based on the goals of industrial heritage preservation and revitalization, appropriate catalytic activation elements and carriers are selected. The combination of these elements and carriers becomes a catalytic focal point, radiating and influencing the surrounding elements to undergo revitalizing changes.

After the catalytic reaction occurs, it will impact the surrounding environment and initiate multiple chain reactions. During this process, new catalytic high-quality elements will be formed, continuing to participate in the catalytic reaction. This transformation will reshape and revitalize the abandoned industrial heritage area into an integrated restructuring of function and space. Simultaneously, control and guidance are applied to the catalytic effect to expand the scope of its influence and stimulate regional development vitality.

The application of catalysis theory in the preservation and revitalization of industrial heritage avoids traditional approaches involving the demolition and reconstruction of heritage sites, which can damage their authenticity and value. Instead, it employs a chain-reaction catalytic renewal process that starts from the local and gradually expands, aligning more closely with the primary goals and objectives of industrial heritage preservation.

The specific process of industrial heritage catalytic activation and protection principles is as follows(Figure 3-30).

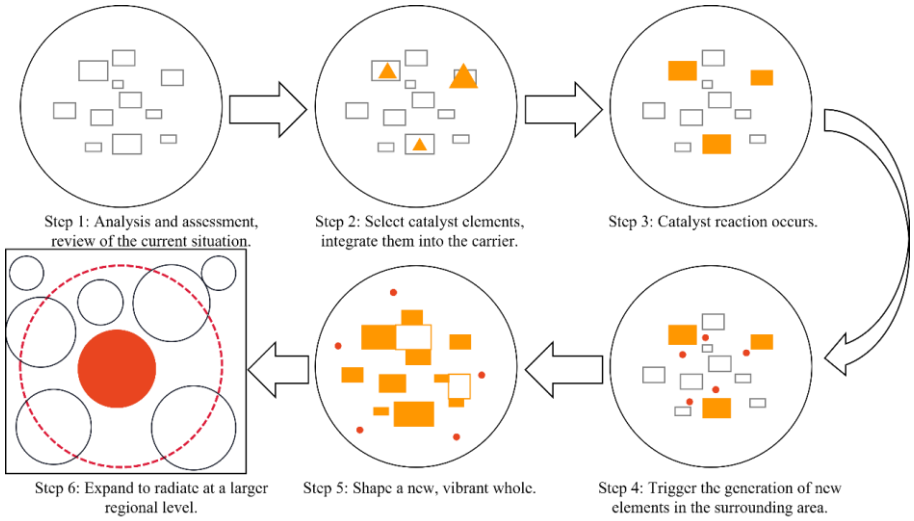


Figure 3-30 The catalyst activation process of industrial heritage
(Source:Self-Drawn by the Author)

Step 1， Analysis of Industrial Heritage Catalytic Activation Conditions.In this step, an analysis of the current status of industrial heritage, along with surrounding development resources and relevant government policies, is conducted to determine the goals of catalytic activation for

industrial heritage. This step involves identifying the direction in which catalysis theory can be applied to industrial heritage preservation.

Step 2，Identification of Catalytic Elements and Carriers.The second step involves a thorough analysis and sorting of material and non-material elements related to industrial heritage, as well as external potential development elements. From these, catalytic elements and the carriers that will bear them are selected.

Step 3，Initiating Catalytic Activation Reactions.Catalytic elements are introduced into the carriers, and methods such as functional substitution are used to guide the carriers into catalytic reactions, leading to beneficial changes.

Step 4，Reshaping the Catalytic Object.Once catalytic reactions have occurred in the material carriers, they become catalytic points influencing other surrounding elements to undergo catalytic reactions. This, in turn, brings about positive changes in the surrounding environment.
Step 5，Control and Guidance of Subsequent Catalytic Effects.To ensure that catalytic reactions align with the goals of catalytic activation, interventions and controls are applied through policies and management guidance. This ensures that the entire old factory area undergoes catalytic revitalization, optimizing the entire system and preparing for radiating and driving surrounding development.

Step 6，Expanding the Impact of Catalytic Effects.The ultimate objective of catalytic protection and activation is to use catalysis theory to guide the preservation and revitalization of industrial heritage. This helps facilitate positive changes in urban functions and social roles at the regional level. The revitalized industrial heritage becomes a vibrant development hub in the region, having a positive impact on socioeconomic development.

3.4 The Application Characteristics of Catalytic Theory in Waterfront Industrial Heritage

The introduction of the Catalytic Theory into the revitalization and protection of waterfront industrial heritage exhibits the following characteristics（Figure 3-31）:

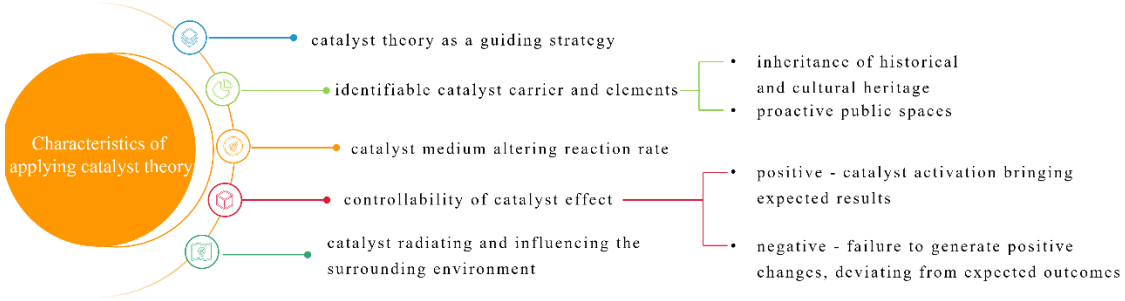


Figure 3-31 Application characteristics of catalyst theory
(Source:Self-Drawn by the Author)

(1) The Catalytic Theory is a guiding strategy and serves as the practical theoretical foundation for catalytic protection and revitalization in waterfront industrial heritage. Its role, mechanisms, and stages in industrial heritage protection are predictable, allowing for the development of plans based on the current conditions and catalytic activation goals of waterfront industrial heritage. Subsequent catalytic reactions can be implemented according to the plan.

(2) In the Catalytic Theory, catalytic carriers and catalytic elements are identifiable. The catalytic protection and revitalization of waterfront industrial heritage can select heritage catalytic carriers and catalytic elements based on requirements such as cultural heritage preservation and the revitalization of public spaces. The initial catalytic carrier is a constituent element of waterfront industrial heritage, with identifiable industrial heritage characteristics, which are preserved even after catalytic activation, meeting the requirements for cultural heritage preservation.

(3) Different catalytic media in the Catalytic Theory can affect the catalytic reaction process of the initial catalytic carrier. In the catalytic protection and revitalization of waterfront industrial heritage, diverse catalytic reactions and effects can occur by implanting different social

functional catalytic elements onto the initial heritage catalytic carrier, depending on the catalytic activation goals.

(4) Catalytic effects are controllable. In the Catalytic Theory, catalytic effects exhibit both positive and negative aspects. Positive catalytic effects achieve the expected results in catalytic activation, while negative catalytic effects do not bring about significant positive changes, deviating from the expected outcomes. In the practice of catalytic activation for waterfront industrial heritage, emphasis should be placed on overall control of catalytic reactions, with a focus on achieving positive catalytic effects.

(5) Catalytic effects can radiate and drive the surrounding environment. The catalytic activation process continues into the mid-to-late stages, generating new elements of vitality internally, which have a positive radiating impact on the surrounding social, economic, and ecological environments. In urban waterfront industrial heritage, catalytic activation is needed to bring about a revival in deteriorating social spaces and functions, creating new focal points for socio-economic development. Therefore, the goal of catalytic effects radiating and driving positive development in the surrounding areas is essential in the revitalization and protection of urban waterfront industrial heritage.

3.5 Summary of this Chapter

This chapter provides a preliminary introduction to the waterfront industrial heritage of Guangzhou from three aspects: its historical development, renewal models, and renewal trends. It also summarizes the shortcomings of the renewal of Guangzhou's waterfront industrial heritage through practical research on four cases: Taikoo Warehouse Fashion and Creative Park, the Pearl River PaTi Beer Culture and Art District, Sun Yat-sen Generalissimo Mansion Memorial Hall, and Xilinyuan Cultural Hotel. By elaborating on the catalytic nature of waterfront industrial heritage and analyzing the feasibility of catalytic theory in the renewal of waterfront industrial heritage, it outlines the principles and characteristics of catalytic theory in

the context of renewing waterfront industrial heritage, providing theoretical support for the formulation of renewal strategies in Chapter Four.

Chapter 4 Renewal Strategies for Guangzhou's Waterfront Industrial Heritage from the Urban Catalyst

4.1 The relationship between the stages of catalytic theory and transformation and renovation planning

As mentioned earlier, the application of catalytic theory in planning can be divided into five steps, including: catalytic condition activation analysis - determining the catalytic angle - selecting catalytic carriers and catalytic elements - shaping and activating the catalyst - guiding the subsequent chain reactions of the catalyst. For waterfront industrial areas with industrial heritage, their transformation and renovation planning can be summarized into three stages: current status - planning - implementation and management.

This study integrates catalytic theory into various stages of the transformation and renovation planning of waterfront industrial areas, and the relationship between the stages of catalytic theory and transformation and renovation planning is shown in Figure 4-1.

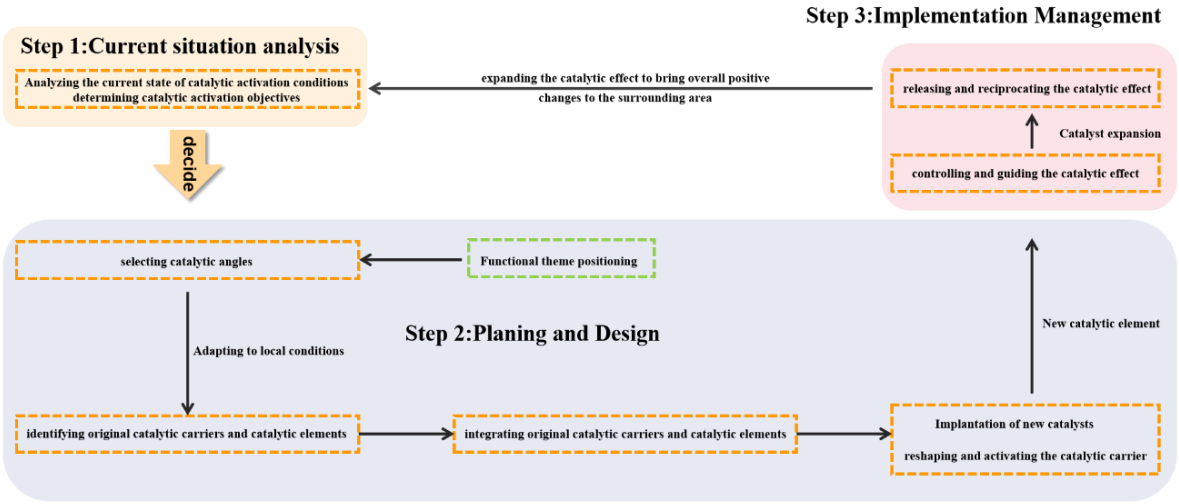


Figure 4-1 Relationship Diagram between Catalysis Theory and Transformation and Renovation Planning Content (Source:Self-Drawn by the Author)

In the current status research phase of waterfront industrial area transformation and renovation, it corresponds to the catalytic theory's phase of analyzing the potential for renewal. During the planning and research phase of transformation and renovation, it is crucial to systematically

assess the existing industrial heritage resources within the planning scope. This assessment helps in defining the planning position and renovation strategies.

During the planning phase of waterfront industrial area renovation and transformation, three processes closely relate to catalytic theory. These processes include selecting the catalytic angle, selecting catalytic elements and carriers, and shaping and activating the catalyst. Among them, the selection of the catalytic angle serves as the foundational research for the effective implementation of the catalytic process. It corresponds to the functional positioning and thematic positioning within the content of renovation and transformation planning. Based on this, different types and expected catalyst points are chosen. The selection of catalytic elements mainly refers to both material and non-material catalytic elements. Shaping and activating the catalyst correspond to the strategic research for the renovation and transformation of waterfront industrial areas.

In the implementation and management phase of waterfront industrial area renovation and transformation, it corresponds to the last phase of catalytic theory, which is guiding the subsequent chain reactions of the catalyst. Essentially, this phase supports and ensures the research, and within the planning content, it can include policy guidance and event guidance, among other aspects.

4.2 Analysis of Catalytic Activation Conditions for Waterfront Industrial Heritage

Different urban waterfront industrial heritage areas possess various values and characteristics. Some have favorable location advantages, while others hold precious historical and cultural assets. Some feature rich physical spaces in their old factory areas with great potential for transformation, and so on. In the protection and revitalization of industrial heritage, it is essential to conduct specific analyses based on the unique characteristics of each site,

considering factors such as its location, environment, and the material, spiritual, and ecological attributes it possesses. This allows us to unearth the maximum potential of industrial heritage. The assessment and analysis of catalytic renewal potential and angles for waterfront industrial areas primarily encompass four aspects: location, culture, internal space, and ecological potential.

(1) Location Potential

Location potential is a critical element in the catalytic effect of urban areas. The geographical location of a redevelopment project determines the city's future development direction, spatial layout, structure, and the functional positioning of its surroundings. Urban waterfront industrial areas played a vital role during the rapid development of modern industry, serving as a source of urban economic vitality and wealth creation. They typically occupy strategically advantageous locations within cities. These areas enjoy efficient accessibility to various functional clusters in the city, attracting a significant population and possessing considerable potential for consumption.

(2) Cultural Potential

Cultural significance provides an enduring driving force for a city's development. For our research subject, industrial heritage resources endow waterfront industrial areas with irreplaceable historical and cultural memories, representing a significant cultural wealth and potential for urban development. These areas have preserved memories spanning hundreds of years since the rise of modern industry. The industrial heritage within them can form cultural landmarks in the city, shaping its unique character and driving its development. Furthermore, utilizing the structures and facilities that carry industrial memories in waterfront industrial areas can serve as demonstration points for educating the public about the city's historical and cultural heritage.

(3) Internal Space Potential

From the perspective of spatial environment, urban old waterfront industrial areas hold significant advantages for redevelopment. Their relatively large industrial building volumes have stable structures, durable materials, and an extended usable life even after transformation. Their spaciousness provides significant flexibility and adaptability in terms of renovation approaches.

To unlock the potential of abandoned industrial building spaces, it is crucial to identify and preserve structures suitable for transformation. These buildings can be repurposed by replacing or introducing new functions while maintaining the industrial memories in their exterior appearance. As for old factory buildings lacking renewal value, consideration should be given to their demolition and the redevelopment of the site, thereby improving land utilization efficiency.

(4) Ecological Potential

Comprehensive redevelopment of waterfront industrial areas mitigates energy and resource waste, construction debris, and environmental damage associated with extensive demolition and construction. It promotes the recycling and reuse of industrial heritage and old factory buildings, aligning with the principles of urban ecological civilization. Such redevelopment holds high ecological potential value.

Compared to other types of industrial heritage, urban waterfront industrial heritage benefits from natural advantages due to their waterfront locations, offering unique catalytic potential in terms of ecological landscapes in the waterfront regions.

4.3 Selection of Catalysts for Urban Waterfront Industrial Heritage

The current catalytic activation conditions of urban waterfront industrial heritage are the foundation that determines whether a catalytic reaction can take place. The catalyst elements and catalyst carriers are the framework for the catalytic reaction and are the decisive factors in

catalytic activation. After analyzing the catalytic activation conditions of Guangzhou's urban waterfront industrial heritage, the selection of catalysts mainly includes three aspects: catalytic perspective, catalyst carrier, and catalyst elements.（Figure 4-2）

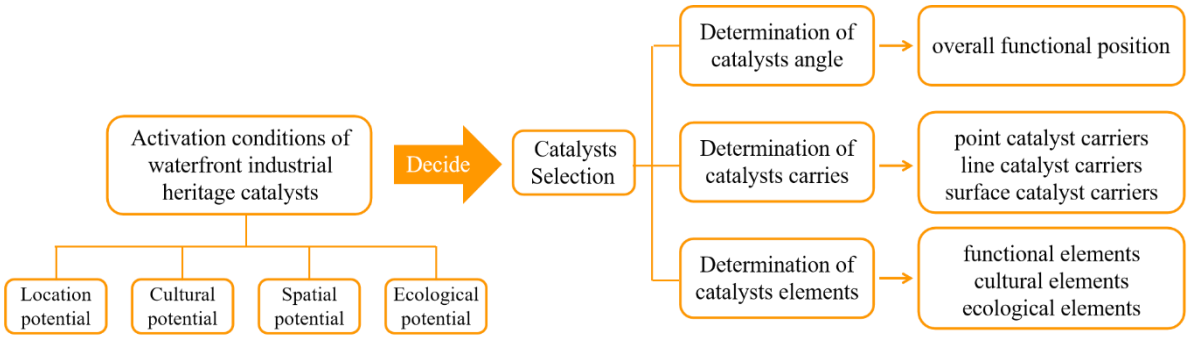


Figure 4-2 Ideas for selecting catalyst elements for waterfront industrial heritage
(Source:Self-Drawn by the Author)

4.3.1 Determining the catalytic perspective of urban waterfront industrial heritage

The catalytic perspective refers to the direction in which catalytic points are utilized and serves as the guiding direction for redevelopment. It primarily encompasses two aspects.Firstly, it's essential to rationally choose and clarify the overall positioning, functional orientation, and thematic orientation for redevelopment. Based on these considerations, catalytic points that can lead in these defined directions are selected. In the case of this research, the most significant feature of the waterfront industrial area under study is the preserved industrial heritage. The main "catalytic points" in this context refer to the preserved old industrial buildings and structures. By renovating and repurposing them, they can have an impact on the surrounding space, radiate outward to drive development, and stimulate more development potential in the vicinity. When selecting catalytic elements and carriers, various catalytic perspectives should be analyzed based on different factors and integrated resources accordingly. This approach guides catalytic reactions, expands catalytic effects, and improves the efficiency, quality, and impact of industrial heritage preservation and activation.

(1) Enhancement of Social Functions in Waterfront Industrial Heritage

Urban waterfront industrial heritage once played a crucial role during its industrial heyday, serving as a significant economic hub in the region. However, as these industrial areas faced challenges such as declining productivity and conflicts between traditional industrial functions and contemporary urban development needs, their roles in the city have shifted. Following business relocations or closures, these sites require a transformation of their social functions and roles. This transformation should align with urban catalyst requirements, allowing them to evolve to meet contemporary functional and thematic needs. Urban waterfront industrial heritage should address urban functional demands, bridge social functional gaps, or enhance and guide social functions in response to these changes.

(2) Revitalization of Waterfront Industrial Heritage Spaces

Different types of waterfront industrial heritage areas exhibit varying degrees of decay. The deterioration of urban waterfront industrial heritage spaces typically manifests in several ways, including inadequate space utilization for social development, abandonment and severe deterioration of industrial heritage buildings and structures, poor ecological and living environments, and environmental pollution. To address these spatial quality issues, urban waterfront industrial heritage spaces should undergo revitalization primarily through spatial optimization and improvement.

(3) Cultural Shaping of Waterfront Industrial Heritage

Urban waterfront industrial heritage serves as the bearer of urban waterfront culture, carrying historical cultural memories that are irreplaceable. It represents a vast cultural wealth and potential for cities. These areas have accumulated memories for centuries, and their industrial heritage can become cultural landmarks, shaping the city's identity through industrial culture. Additionally, heritage structures and facilities can serve as educational and historical sites, promoting urban cultural education.

(4) Value and Benefits of Waterfront Industrial Heritage

One of the objectives of catalytic preservation and activation of waterfront industrial heritage is to drive increased value in the surrounding areas. Assessing the value of these areas should consider various factors, such as regional and urban-level social and economic values, including social, economic, and ecological values. The assessment of value should serve as a measure to guide the ongoing catalytic reactions.

In summary, the choice of catalytic perspective varies according to the current state of different waterfront industrial heritage areas. However, the core objective revolves around the preservation and utilization of industrial heritage. Even with a single positioning, multiple catalytic points with different activation roles and perspectives can be selected, and their combined catalytic actions can be harnessed.

4.3.2 Determining the Catalyst Carriers for Urban Waterfront Industrial Heritage

Determining Catalyst Carriers for Urban Waterfront Industrial Heritage primarily focuses on tangible heritage elements within urban waterfront industrial heritage, which possess physical forms. These tangible heritage elements can be categorized into three types of catalyst carriers: point, linear, and surface. Not all tangible heritage elements require catalytic reactions; therefore, a thorough analysis from multiple perspectives and levels is necessary when selecting catalyst carriers for urban waterfront industrial heritage. The selection of catalyst carriers should align with the goals of catalytic activation and guide the catalytic reactions effectively.

(1) Point Catalyst Carriers

Point catalyst carriers are fundamental components of urban waterfront industrial heritage. In this context, they mainly encompass industrial production buildings, public structures, residential buildings, production equipment and facilities, as well as small-scale landscape elements, gateways, and more. When choosing point catalyst carriers, it's essential to have a deep understanding of their characteristics and historical significance. Buildings play a pivotal role as catalyst carriers, providing spaces for new functions and activities. Heritage buildings

can be categorized into three functional types: production, residential, and public management. Each type exhibits distinct characteristics: production buildings offer spacious interiors, robust structural features, and flat terrains; public management buildings serve as hubs for public activities, showcasing architectural styles reflecting their historical and cultural significance. Iconic structures like tall chimneys, iron towers, or park entrances contribute to the visual and sensory aspects, shaping the industrial cultural identity and serving as local landmarks.

Scholar Ying Zeng proposed an approach to evaluate the catalytic value of industrial heritage buildings based on several criteria:Location-Evaluating the building's location within the factory area and its accessibility.Form-Assessing the overall appearance of the building, its iconic status, and its relationship with surrounding structures.Quality-Considering the building's structural integrity, materials used, and spatial layout.Historical and Cultural Value-Examining the building's construction era, construction techniques, historical events it witnessed, and its role in preserving social emotions and memories.By quantitatively assessing these criteria and applying scores and weights, Zeng created a Building Catalyst Value Quantitative Evaluation Table[54]. Using this approach, well-preserved buildings with good quality, historical significance, and cultural relevance are selected as catalyst carriers. Through appropriate preservation, activation, and the introduction of catalyst elements, these buildings catalyze the revitalization of the entire factory area.

In this study, Zeng's Building Catalyst Value Quantitative Evaluation Table is employed as a reference for the selection of building catalyst carriers. Utilizing existing data, a quantitative assessment of industrial buildings within the waterfront factory area is conducted to determine the final building catalyst carriers.

Table 4-1 Quantitative Evaluation Table of Architectural Catalyst Value
(Source: Zeng Ying, 2015)

Category	Factor	Weight	Score	Characteristics	Catalyst Activation Direction
Location	Accessibility	8%	10	Located adjacent to the main roads and entrances of the factory area, or close to urban roads, transportation facilities, or urban service spaces, with excellent accessibility and locational advantages	Organizing pedestrian and vehicle traffic lines reasonably, utilizing locational advantages to stimulate specific behaviors such as staying, visiting, consuming, and participating in activities, and forming a positive chain reaction with surrounding functions to achieve scale
			5	Near the main roads and entrances of the factory area, or within walking distance of urban roads, transportation facilities, and urban service spaces, with good accessibility and locational advantages	
			1	Distant from the main roads of the factory area, relatively remote and enclosed in location, with low accessibility and less pronounced locational advantages	

Table 4-1 Quantitative Evaluation Table of Architectural Catalyst Value-Continued
(Source: Zeng Ying, 2015)

Category	Factor	Weight	Score	Characteristics	Catalyst Activation Direction
Architectural Form	the overall exterior of the building	10%	10	Well-preserved exterior appearance with distinct industrial architectural features or era-specific characteristics, exquisite craftsmanship, and rich forms	The overall appearance and form play a significant role in showcasing the era-specific characteristics and industrial features within industrial architecture. Exquisite craftsmanship, diverse forms, or era-specific architectural traits are all essential elements in shaping the cultural characteristics during the revitalization of factory areas
			5	Well-preserved exterior appearance with some industrial architectural features	
			1	The exterior appearance is relatively ordinary or severely damaged, with indistinct industrial architectural features	
	Iconic	10%	10	Buildings have a tall and imposing volume, are of a large scale, or are located in iconic positions such as squares or road junctions, providing clear sightlines and possessing strong emblematic features	Create emblematic spaces within the factory area after preservation and revitalization, shaping its image, and establishing visual connections with surrounding functional blocks
			5	Situated in a favorable location, with a certain degree of recognition and emblematic significance	
			1	Less iconic, making it relatively challenging to catch the public's attention	

Table 4-1 Quantitative Evaluation Table of Architectural Catalyst Value-Continued
(Source: Zeng Ying, 2015)

Category	Factor	Weight	Score	Characteristics	Catalyst Activation Direction
Architectural Form	Collective	8%	10	The building holds a unique position within the surrounding groups and spatial compositions, playing a commanding role	Utilizing the collective characteristics of the buildings to shape a positive spatial sequence during preservation and revitalization
			5	The building has a positive role in guiding the construction sequence within the surrounding architectural groups	
			1	The building holds a unique position within the surrounding groups and spatial compositions, playing a commanding role	
Quality	Materials	8%	10	The building materials exhibit era-specific characteristics or have skillfully incorporated locally unique construction materials and techniques, displaying distinctive features	The building materials and their craftsmanship can fully showcase the historical charm and era-specific characteristics of the architecture
			5	They have employed traditional materials distinct from modern construction materials, with significant contrast and specific characteristics	

Table 4-1 Quantitative Evaluation Table of Architectural Catalyst Value-Continued
(Source: Zeng Ying, 2015)

Category	Factor	Weight	Score	Characteristics	Catalyst Activation Direction
Quality	Materials	8%	1	Common or rough building materials have been used, with a high degree of damage, requiring repair or decorative restoration	
	Structure	10%	10	The structure is complete and stable, meeting fire and earthquake safety requirements, or the structural construction techniques have architectural research and historical preservation value	The renovation of industrial buildings tends to be more expensive than new construction, so the condition and stability of the structure determine durability and the economic viability of revitalization, which needs to be taken into account. Additionally, the structural components within industrial factory buildings can showcase the unique charm of industrial aesthetics, serving as intricate expressions of industrial culture
			5	The structure is relatively complete and stable, and with renovations, it can continue to be used	
			1	The structure is unstable and requires renovation before it can be used again	
	Spatial layout	10%	10	The interior and spatial layout of the building are rich, with good spatial quality, and it has high renovation value	The richness of the interior spatial layout of a building is advantageous for diversifying new functions, potentially increasing the possibilities and value of renovation and reuse
			5	The interior spatial layout and structure of the building are clear and have some renovation value	

Table 4-1 Quantitative Evaluation Table of Architectural Catalyst Value-Continued
(Source: Zeng Ying, 2015)

Category	Factor	Weight	Score	Characteristics	Catalyst Activation Direction
Quality	Spatial layout	10%	1	The interior space of the building is single, and there is limited space for renovation	
Historical and Cultural Value	Construction Era	8%	10	Industrial buildings built in the early stages of modern industrialization, with a long historical period and significant industrial commemorative value	The construction era and historical context determine whether industrial buildings possess a rich historical and cultural significance, whether they have commemorative value, and whether they are worthy of preservation and research. Older historical buildings from distant eras are better at evoking people's reflection and resonance with historical culture
			5	Industrial buildings constructed during the mid-phase of modern industrial development, bearing witness to a specific period of industrialization	
			1	Industrial buildings constructed during the mid-phase of modern industrial development, relatively recent in age, and characterized by standardized construction methods, making them relatively common	
	Construction Techniques	10%	10	The construction techniques of the buildings reflect the characteristics of the era and show distinct regional features	

Table 4-1 Quantitative Evaluation Table of Architectural Catalyst Value-Continued
(Source: Zeng Ying, 2015)

Category	Factor	Weight	Score	Characteristics	Catalyst Activation Direction
Historical and Cultural Value	Construction Techniques	10%	5	The construction techniques of the buildings exhibit certain regional and temporal characteristics	Distinctive construction techniques can showcase local indigenous building methods or reflect the architectural technology of the time. This adds historical preservation value and enhances the specificity of catalytic elements
			1	The construction techniques of the buildings are relatively common and lack distinctive features	
	Historical Events	8%	10	The building has witnessed significant events in the factory's production and administration history, carrying historical experiences and having commemorative significance	Buildings that carry historical events have significant preservation and commemorative value. Additionally, major historical events within the factory area are important thematic elements in the catalytic response
			5	The building has hosted events or activities with a certain level of commemorative value	
			1	The building has not experienced particularly significant events or activities with commemorative significance	

In addition to industrial heritage buildings, point catalyst carriers also include equipment, facilities, and structures within the factory area. These may include chimneys, tall towers, water tanks, walls with industrial-era slogans, warning signs, and more. These equipment and structures contribute to place cognition and feature transmission, embodying the cultural and spiritual essence of the factory area. They commemorate production processes, historical glory,

or team spirit. After appropriate revitalization and utilization, they can carry forward the cultural and spiritual essence, creating new place spirit and possessing catalytic activation value. Through artistic and creative processing, we can activate and utilize certain equipment and structures in the factory area with symbolic significance, creating new cultural and artistic symbols and enhancing the overall cultural atmosphere within the factory area.

Some of the landscaped vegetation that has been preserved over the years within the factory area holds certain landscape value and embodies the memories of life within the factory area. In the process of protection and activation, polluted environments should be repaired, and the landscape remnants within the site should be fully explored. They should be appropriately transformed and preserved, with suitable catalyst elements integrated to facilitate change. This makes them one of the catalyst carriers of activation.

(2) Linear Catalyst Carriers

In this study, linear catalyst carriers primarily focus on the spatial elements that facilitate the transmission and diffusion of the value of catalyst points during the renovation of urban waterfront industrial areas. These elements are closely related to the systematic spatial elements in the renovation and planning, including road transportation systems, landscape greenery systems, and the configuration of public facilities and public spaces.

The road transportation system serves as the "skeleton" of urban operation and is a crucial "arterial system" for waterfront industrial areas. During the renovation of urban waterfront industrial areas, different types of traffic routes, including pedestrian and cycling routes, vehicular routes (freight and passenger transportation), and static traffic facilities (parking and smart transportation systems), need to be reasonably planned and distinguished. Vehicular traffic and static traffic facilities are fundamental prerequisites to ensure convenient accessibility for attracting pedestrians. The capacity to accommodate pedestrian flows determines the defined height of catalyst action, with larger pedestrian flows resulting in higher

activity levels. Organizing pedestrian traffic is crucial for linear catalysts and serves as the primary space for public interaction and leisure, allowing for the incorporation of theme-related catalyst points and content, along with landscape greenery, to create centers of vitality in public spaces.

The landscape greenery system is a showcase of urban aesthetics and one of the linear catalyst elements during the renovation of waterfront industrial areas. Water resources along the waterfront are particularly distinctive, setting waterfront industrial areas apart from other industrial zones. Landscape greenery serves as leisure spaces and, on one hand, promotes ecological restoration strategies in renovation and planning through the systematic construction of green points, lines, and areas. On the other hand, it incorporates industrial culture into landscape facilities and landscape aesthetics, ensuring that various spaces in the renovation and planning revolve around the industrial culture theme.

The public facilities and public space system act as points for attracting people, offering convenient public services and innovative entrepreneurial services. These spaces not only provide services but also subtly convey the spirit of the catalyst environment.

(3) Surface Catalyst Carriers

The surface catalyst carriers in waterfront industrial areas encompass two levels: the waterfront industrial area level and the urban level. The goal of renovating waterfront industrial areas with industrial heritage is to transform them from vibrant land parcels into distinctive leaders within the overall urban development.

The activation and promotion of surface catalyst carriers have a "two-way" feedback effect on point and linear catalyst carriers. On one hand, through the combined influence of point and linear catalyst elements, the waterfront industrial area continues to activate its vitality on an area-wide level. At this point, the waterfront industrial area serves as a new catalyst point within

the city's larger environment. It interacts with catalyst line elements such as roads, water systems, landscape belts, and visual corridors, further activating urban sub-areas and even the entire city. On the other hand, when the waterfront industrial area or the overall city is successfully activated, it provides more support and adjustments in return to point and linear catalyst carriers, potentially stimulating the emergence of new catalyst points. As economic vitality increases, it can also benefit the physical environment. The continuous interaction fosters the inflow of capital from various industries, including commerce, culture, entertainment, real estate, and emerging industries. This leads to the coordinated and sustainable development of the waterfront industrial area and the overall city.

4.3.3 Determining the catalyst elements for urban waterfront industrial heritage

After preserving valuable catalyst carriers within the urban waterfront industrial plant area, suitable catalyst elements are introduced to create catalyst points through self-activation reactions or integration with the carriers. The selection of catalyst elements is crucial, as they are the primary factors in igniting new functions and vitality within the plant area. A successful catalyst element can trigger significant catalyst reactions and have a longer-lasting effect, thus inducing a chain reaction of surrounding elements, contributing to the construction of the entire catalyst structural order.

Considering the characteristics of the previous Guangzhou urban waterfront industrial heritage, its related elements can be divided into two categories: "material form" and "non-material form" for exploration.

(1) Catalyst Elements in Material Form

① New Buildings

Comprehensive assessment and analysis are conducted based on the current status of architectural relics in the urban waterfront industrial area. Buildings with poor quality or severe damage, which lack significant historical and cultural value, can be demolished according to

the needs of renovation and revitalization. Urban waterfront industrial areas often have many open spaces, and these idle spaces or areas created after demolition can accommodate new buildings. New buildings are constructed based on the spatial substrate formed by the preserved buildings and site, contributing positively to the catalyst activation process. On one hand, new buildings can create new spatial textures, to some extent, enhancing the spatial system of the plant area, forming a certain catalyst sequence. Meanwhile, new buildings, through their materials, techniques, spaces, and contrasts with the preserved old industrial buildings, highlight the era's characteristics and historical culture, creating a cultural atmosphere of juxtaposition. On the other hand, the spatial layout of the preserved industrial buildings has already been established, and there are certain limitations to their renovation and revitalization. New buildings can complement this aspect, providing more possibilities for the required functions in the catalyst reaction.

The InBev International Beer Museum in the Pearl River Pati Beer Culture and Art Creative Zone, co-established by the Pearl River Brewery Group and Belgium's AB InBev Brewery Group, is an international beer culture exhibition venue that combines appreciation, entertainment, education, art, and openness. The museum's exterior is quite unique, with a beer barrel-shaped structure in the center that complements the museum itself. On both sides are colorful glass buildings that resemble the "guardians" protecting the beer barrels, adding an interesting touch（Figure 4-3）.

Figure 4-3 The Pearl River-AB InBev International Beer Museum (Source: https://img2.baidu.com/)

② Public Space

In addition to new buildings, public spaces such as squares and courtyards are also important elements in restructuring the factory's texture. The implantation of this element can be used to reorganize and plan the external spaces of the park while gathering popularity, creating an

outdoor communication platform for the park, effectively adding vitality to the factory area （Figure 4-4）.

Figure 4-4 The four themed squares of the Pearl River Pati Beer Culture and Art Creative Zone (Source: https://img2.baidu.com/)

③ Art Installations and Landscape Features

Art installations are common elements in artistic culture, encompassing various forms such as sculptures, artistic wall surfaces, and structures. They can be created based on the original cultural character of the factory area, incorporating artistic installations that encapsulate the industrial ambiance and constructing landscape features to enhance the artistic atmosphere within the park. These elements are crucial for adding creativity and vitality to outdoor activity spaces.

(2) Non-Material Catalyst Elements

Based on the characteristics of urban waterfront industrial heritage, three important elements can be summarized and extracted, namely functional elements, cultural elements, and ecological elements. These three elements interact comprehensively in the overall renewal process. However, to explore the specific strategies for catalyst renewal further, we will delve deeper into these three elements, as shown in Table 4-2, to uncover their inherent characteristics and attributes. This will provide a guiding framework for the transformation and renewal design of urban waterfront industrial heritage functions in the following sections.

Table 4-2 Catalyst Elements for the Transformation and Redevelopment Design of Urban Waterfront Industrial Heritage Functions (Source:Self-Drawn by the Author)

Catalyst Elements	Specific Elements	Catalyst Focus
Functional Catalyst Elements	Overall Functional Positioning	Park General Directional Functional Positioning
	Park Function Composition	Park Function Composition and Spatial Layout
	Building Unit Function Placement	Building Unit Function Placement
Cultural Catalyst Elements	Material Level	Industrial Buildings, Structures, Equipment Facilities
	Non-material Level	Industrial Culture, Regional Culture, Social Activities
Ecological Catalyst Elements	Ecological Restoration	Soil Pollution, Water Pollution
	Waterfront Environment	Accessibility, Ecology, Landscapin

① Functional Catalyst Elements

Industrial heritage functions are divided into internal and external functions. Internal functions mainly include production, living, and ancillary functions, while external functions refer to the primary functions that industrial heritage areas undertake within the region, such as industrial production and industrial education and training. After industrial heritage sites are abandoned, their functions deteriorate significantly. Through catalyst protection and revitalization in urban waterfront industrial heritage areas, old buildings are reshaped to accommodate new functions such as commercial buildings and museum exhibition buildings. Therefore, catalyst protection aims to reposition and revitalize the functions of industrial heritage, achieving the goal of catalyst activation.

Functional elements are divided into main functions and subordinate functions. Main functional catalyst elements serve as the source of vitality for the catalyst activation of industrial heritage. If the primary functional elements of heritage are not accurately defined, it may lead to catalyst disorder in the subsequent catalytic reaction, resulting in an inability to achieve catalyst activation effectively. At the same time, it is essential to avoid selecting too many primary functional elements in industrial heritage, as homogeneous development may not highlight the key aspects of catalyst activation. Subordinate functional elements complement and enhance

the primary functional elements, ensuring that the catalyst activation of the entire industrial heritage is systematic and rational.

② Cultural Catalyst Elements

In the composition of cultural elements in urban waterfront industrial heritage, there are material cultural elements and non-material cultural elements. Material cultural elements include the architectural style of industrial heritage, landscape features, materials, and architectural spatial forms, while non-material cultural elements encompass industrial history, significant achievements, scientific and technological aspects, and social customs. To ensure that the redevelopment of industrial heritage meets basic requirements, it is essential to strengthen the analysis and treatment of its cultural concepts, ensuring that spatial design incorporates relevant cultural elements.

Cultural elements have the characteristics of broad application and long-lasting effects as catalysts. Urban waterfront industrial heritage renovation and design should fully consider their historical and cultural value, conduct in-depth exploration of their regional characteristics, architectural styles, and the spirit of the place, promote the highlighting and inheritance of diverse cultures, and revitalize the region through culture and art. Emphasis should be placed on cultural and artistic-led regional revival, focusing on humanistic revival and social benefits, promoting social equity and multi-party participation, and facilitating social and coordinated development.

③ Ecological Catalyst Elements

One of the unique characteristics of urban waterfront industrial heritage, compared to other types of industrial heritage, is its relationship with water. Therefore, as one of the critical elements of urban waterfront industrial heritage, water bodies themselves have significant catalytic potential. When shaping the catalyst medium, the importance of hydroculture must be taken into account.

In general, the most significant difference between industrial areas and waterfront industrial areas lies in the term "water." The water system is one of the critical elements of urban waterfront industrial heritage. The focus of the transformation of urban waterfront industrial heritage is to convert production-oriented shorelines into living-oriented shorelines and reintegrate them into the city. Therefore, the shaping of waterfront spaces becomes a top priority. The water system elements of urban waterfront industrial heritage mainly include ecological restoration, waterfront environment, and landscape corridors.

4.4 Shaping and Revitalization of Urban Waterfront Industrial Heritage Catalyst

4.4.1 Implantation of Functional Elements into Catalyst Carriers

(1) Waterfront Industrial Factory Area (Surface Catalyst)

The fundamental principle of regional revitalization is the integration of new functions, as new functions form the basis for a completely new logic of life.

Currently, the main models of urban waterfront areas' redevelopment include commercial mixed-use development, urban public space development, and the continuation of industrial production. Based on the organic combination of industrial heritage preservation and waterfront development models, the functional revitalization of urban waterfront industrial heritage areas is a convergence and collision of industrial heritage culture and waterfront ecological culture. Considering these two factors and the contemporary development context, this artical proposes three main modes for the functional revitalization of urban waterfront industrial heritage areas:

① Comprehensive Creative Park Model

The richness of functional content is a necessary condition for a district's sustained integration into the city. In order to ensure the vitality of the waterfront area and create the concept of a 24-hour waterfront district, comprehensive development of the waterfront area is a widely adopted development method in recent years. While preserving the characteristics of industrial heritage,

new urban functions are integrated, including commercial, business, office, residential, educational, recreational, and more. Various forms of public spaces are created, taking advantage of the waterfront's ecological advantages to create a waterfront urban landscape that attracts various public activities, thus building a healthy, comprehensive, ecological, and vibrant urban complex.

For example, the Granville Island Naval Yard in Canada, which began construction in 1916, was once a heavy industrial area in Vancouver, housing a large number of manufacturing, machinery, and material industries. After the war, for various reasons, most of the industry on the island declined. After transformation and redevelopment, Granville Island has now become a fully functional urban center, providing diverse social life and comprehensive amenities. The design concept of Granville Island combines traditional industrial production functions with modern commercial and cultural leisure functions. The island has created a series of open attractions, constructing a large "urban complex." Traditional industries have been transformed into modern commercial and cultural functions, including schools, theaters, markets, and handicrafts. Mechanical facilities have been preserved and enhanced with artistic decoration. Water resources and waterfront environments have been cleverly used to connect the entire island's landscape design, creating waterfront residences, water parks, waterfront platforms, yacht marinas, and various water parks（Figure 4-5）.

Figure 4-5 Aerial View of Granville Island Naval Yard, Canada
(Source: http://image109.360doc.com/）

② Urban Public Spaces

The construction of urban public spaces acts as a "catalyst" for urban renewal, and the development of waterfront public spaces can enhance urban functionality, promoting an upgrade in the city's overall quality. Increasing waterfront public spaces can improve urban quality, enhance regional accessibility, improve municipal public service facilities, and attract more urban population.

In the process of transforming waterfront spaces with industrial heritage, it is essential to integrate the atmosphere of surrounding areas, revitalize historical and valuable structures, and create public spaces that are easily identifiable and perceptible. Public spaces should offer comprehensive public facilities that meet modern living needs, creating open, transparent, and continuous waterfront spaces. On an urban scale, it is crucial to consider the overall and continuous nature of waterfront public spaces, forming a complete "point-line-area" structure for waterfront spaces. Additionally, the close connection to inland public spaces should also be taken into account, creating a comprehensive network of urban public spaces.

③ Waterfront Industrial Tourism

Industrial heritage tourism leverages the advantages of regional industrial resources to develop regional industrial tourism brand, enhance urban economic benefits, and cultural characteristics. It often combines various industrial heritage development models, connecting several "spots" of industrial heritage into a cohesive whole, as seen in Germany's Ruhr area where a combination of "attractions + museums + towns" has been adopted.

Waterfront ecological tourism utilizes waterfront natural resources to create a "vibrant" urban landscape and recreational space. The development of waterfront tourism emphasizes the "humanization" of waterfront areas, transforming natural ecological landscapes into urban living landscapes. Waterfront industrial tourism combines industrial heritage tourism with waterfront ecological tourism, creating a city tourism route that balances green ecology and historical human culture. Within the backdrop of a green ecological natural environment, the

historical and cultural significance of industrial history is conveyed through landscapes, scenes, activities, and festivals, shaping the direction of waterfront industrial tourism development.

The above three models primarily explore the functional modes of urban waterfront industrial heritage renewal and transformation. In practice, no waterfront area has a single function; they are all multifunctional complexes to ensure regional vitality. The development of waterfront areas should adhere to the principles of urban master planning and protection, incorporate local conditions, and choose development models accordingly.

(2) Public Spaces (Surface Catalysts)

It is essential to design point-like squares and landscape spaces with small leisure functions within the old urban industrial factory area's public spaces. People are willing to engage in various spontaneous relaxation activities in well-landscaped public spaces, such as resting, reading, napping, playing chess, sunbathing, and chatting. Squares are characterized by their public nature, openness, and permanence. Based on the analysis of the surrounding environment and industrial culture, reasonable zoning and space organization should be carried out to create a combination of dynamic and static, open and closed activity spaces, meeting the needs of various public activities. Larger squares can also serve as gathering places.

In addition, these public spaces need to provide good landscape effects and reasonable relaxation facilities to meet people's needs for these spontaneous activities. This can be achieved through appropriate landscaping, diverse landscape features, and providing ample seating, as well as adequate shading facilities, as exemplified by the design of an open-air cinema and a resting pavilion in the Beijing Zhangjiakou Industrial Culture Park to meet the needs of visitor (Figure 4-6).

Figure 4-6 Resting Pavilion and Landscape Features in the Beijing Zhangjiakou Industrial Culture Park（Source: https://oss.gooood.cn/）

(3) Factory Street Space (Line Catalyst)

The street spaces within urban waterfront old industrial factory areas serve two primary functional forms: transportation functionality and livability functionality. Streets with transportation functionality mainly cater to the movement of vehicles and pedestrians, while streets with livability functionality often feature various public service facilities to accommodate a variety of activities.

For the streets in urban old industrial factory areas, it is crucial to first emphasize the hierarchical classification of their nature, determining which streets emphasize transportation functionality and which belong to the livability functionality category. This enhances the specificity and efficiency of each type. For streets with transportation functionality, their role as transportation links with the outside should be emphasized. This includes the rational allocation of space for both vehicles and pedestrians while accommodating a large influx of people into the area. As for streets with livability functionality, a focus on a variety of people-centered street classifications should be emphasized. These can include pedestrian walkways, commercial streets, and recreational streets, each tailored to its specific function and street ambiance.

Shaping the street spaces within the factory area is also a crucial step in the catalytic reaction. Streets serve as the connecting threads between various spaces and functions. They have a guiding role, and the spaces along the factory's street can be configured with different nodes and functions as needed.

In the preservation and revitalization of old factory areas, we can flexibly use various design techniques for the abundant street spaces to activate the linear spatial carrier within the factory area, achieving the revitalization of the factory space (Figure 4-7).

After reasonable activation design of the street spaces, they can be used to drive the vitality of surrounding functions and introduce diverse activities. The figure below summarizes the functional facilities and activities set up on both sides of the street (Figure 4-8).

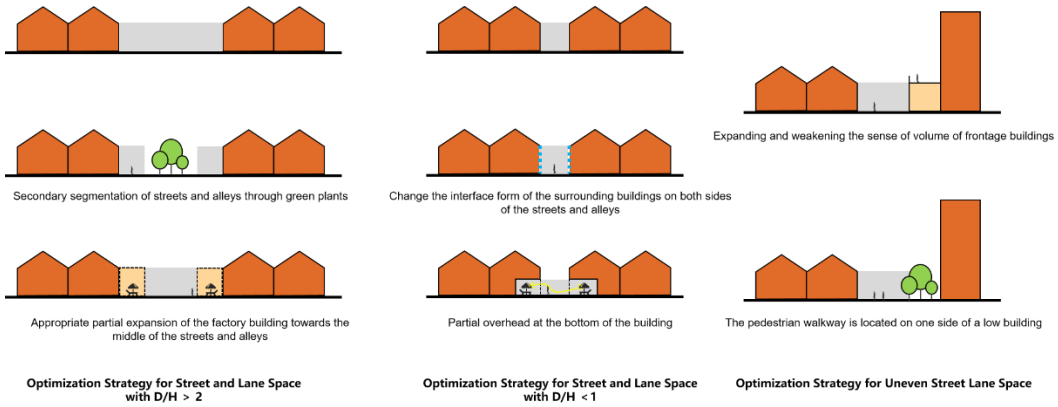


Figure 4-7 Street and Alley Optimization Strategy Diagram
(Source: Seft-drawn by the Author)

Figure 4-8 Examples of Street Activity Forms and Facilities
(Source: Seft-drawn by the Author)

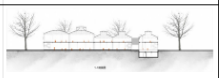
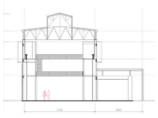
In the preservation and revitalization of factory areas, it is important to use appropriate design techniques to create vibrant street spaces, transforming streets that originally served a single transportation function into multifunctional spaces for both pedestrians and vehicles, for social interaction, leisure, and relaxation. This transformation should guide and drive the activation of functions along the streets.

(4) Industrial Heritage Building (Point Catalyst)

When introducing external functions into urban waterfront industrial heritage, it is essential to consider the differences in functional requirements and the spatial layout of industrial buildings. The architectural spatial style should be matched with the intended functions. In the specific functional design of individual industrial buildings, the methods of functional replacement and functional implantation are commonly used. Different industrial buildings often accommodate various building functions. In the process of architectural catalyst shaping, functional definitions can be based on the distinctive spatial characteristics of industrial buildings (Table 4-3).

Table 4-3 Guidelines for Architectural Function Settings

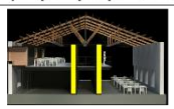
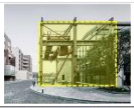
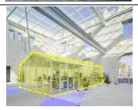
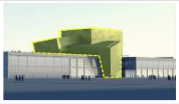
(Source:Self-Drawn by the Author)

Factory building types		characteristics of factory buildings	typical sectional styles	suitable functions after renovation	representative case studies	
Single-story factory buildings	small-span factory buildings	1. Small unit span, low ceiling height; overall length and width are relatively large; 2. Mostly made of reinforced concrete structure; 3. Equipped with daylighting skylights;		1. Commercial shopping 2. Exhibition space 3. Artist studio	Guangming Dongtanyuan (renovation of the former Qianhai weaving factory)	
	single-span large-span factory buildings	1. Large unit span (15-30 meters); overall length is large; 2. Roof mostly composed of truss structures; 3. Equipped with daylighting skylights;		1. Theme restaurants; 2. Sports arenas; 3. Entertainment performance halls; 4. Artist studios; 5. Large-scale supermarkets.	Renovation of the 1897 Science and Technology Innovation City Exhibition Center of Beijing Ungi Factory	
	Large-span multi-span factories	1.Large unit span (15-30 meters); overall length and width are large. 2.The roof is mostly made of truss structures. 3.There are skylights for natural lighting.		1.Exhibition space; 2.Large-scale shopping supermarkets; 3.Information exchange spaces;	Renovation Design of Tianjin Tiantuo J Block Factory Building	
Multi-story factory building	Multi-story factories	1.Units or overall spans are smaller, with lower ceiling height (4.5 meters); 2.Mostly flat roofs, usually without skylights; 3.The structural system mostly uses reinforced concrete frames with dense column grids;		Upper floors: 1.Office spaces for various small and medium-sized independent companies; 2.Hotels or guesthouses; 3.Regular entertainment and leisure spaces; Ground floor: 1.Retail businesses; 2.Small-scale restaurants;	Shajing Village Hall (Hoxiang Lake Cultural and Creative Museum)	
	Top-level large-span factories	1.The top floor consists of large-span factories, similar to single-story large-span factories; 2.The ground floor uses a dense column grid system with lower ceiling height and smaller spans; 3.Most areas lack natural lighting;		Upper floors: 1.Performance venues such as cinemas and concert halls; 2.Exhibition spaces; 3.Regular entertainment and leisure spaces; Ground floor: 1.Retail businesses; 2.Small-scale restaurants;	Beijing Future Design Park – Office Building and Canteen	

After implanting relevant functions for different types of industrial heritage buildings, specific design strategies are needed to modify the spatial aspects of these buildings to meet specific functional requirements. In his book "Protection and Regeneration of Industrial Heritage Buildings in the Post-Industrial Era," Professor Wang Jianguo categorizes the spatial transformation and expansion of industrial building spaces into two major classes. Within this framework, this artical provides a more detailed categorization through practical case studies

and data collection(Table 4-4). Catalyst design can refer to the following methods for spatial form transformation and expansion, aiming to enhance spatial recognizability while respecting the original catalyst space characteristics.

Table 4-4 Design Techniques for the Interior Spatial Transformation of Industrial Heritage Buildings (Source:Self-Drawn by the Author)

Category	Specific transformation techniques	Design enhancement features	Applicable characteristics	Points to consider	Illustration	Representative case	
space reconstruction.	Partitioned	Vertical separation: structural separation, addition of mezzanine floors; increase vertical transportation connections between upper and lower spaces; addition of new materials typically using lightweight materials to differentiate from the existing space materials.	Large-scale factory buildings are commonly used. Large space and floor area ratio requirements.	Pay attention to the relationship between floor load and the original structure. The lower-level space may lack industrial characteristics easily.		Estonia Rotermanni Barn transformation	
		Horizontal partitioning: The existing structural system remains unchanged, and lightweight partition walls, glass, or movable partition panels are used to divide the overall space.	Small space requirements, frequent use of single-story factories.	Pay attention to the safety of partition walls and the compromised integrity of the roof structure.		Lens Beijing Headquarters	
	Sequential	Connecting two or more relatively independent spaces through corridors, roofs, and other means to create a continuous flowing spatial corridor. Typically, materials such as steel and glass are used, and the forms can vary greatly.	Continuity of functional requirements, increasing indoor usable area or providing weather-independent public spaces.	Treatment of materials at the connection point between old and new structures, avoiding a sense of oppression caused by the added large roof.		Osaka Vintage Car Museum in Japan	
	Dismantling	Partial removal of the existing building's enclosure structure components or enclosure interfaces to meet the requirements of new functionalities.	Functional requirements such as daylighting	Avoid damaging the original structure of the building.		Shenyao Art Center	
space expansion/construction	Inclusive	Inclusion: It refers to the integration of new spaces with weak connections to the existing space within. These new spaces have an independent structural system, avoiding secondary damage to the original industrial architecture, and presenting lower difficulty in renovation.	The need for independent small spaces.	Pay attention to the relationship between additional loads and the original structure to avoid damage to the existing building structure.		Casa Meridiziaio Headquarters,	
		Exterior Enclosure: By installing a large roof structure, multiple individual buildings are unified at a spatial level, enhancing the overall integrity of the space.	Independent display of the original building's exterior image.			Nanjing Meiling No. 9 Workshop	
	Additive.	Horizontal expansion: Adding new space only outside the traditional façade to expand indoor usable space and create dynamic, visually engaging spatial boundaries.	The expressive power of spatial form lies in the contrast or harmony between the old and the new.	Pay attention to indoor lighting.		Beijing Minsheng Modern Art Museum	
		Vertical extension: Constructing additional floors on the rooftop or developing new spaces underground to increase the building area and improve the plot ratio.	Emphasize the material contrast between the added volume and the existing building.	Consider the relationship between additional loadings and the original structure.		Thumb Workshop Renovation in Rotermann, Estonia.	

In addition, the rooftop space, as the fifth facade of the building, is also an important space that should not be overlooked. It can be transformed into an open-air activity terrace or a semi-open space with shading structures such as membranes. The rooftop space has distinctive features, providing a different experience from other spaces, with wider vistas and unique landscapes. For example, the Lingotto Factory in Turin, Italy, transformed its rooftop into a racetrack (Figure 4-9), innovating the spatial function of the original format. This aims to provide people with a unique spatial experience, creating distinctive catalyst attraction points. This not only enhances the overall utilization efficiency of the existing building but also promotes the catalyst activation of individual building elements.

Figure 4-9 The Lingotto Factory Rooftop Racetrack in Turin, Italy
（Source:https://pic3.zhimg.com/）

(5) Industrial Heritage Structures (Point Catalyst)

For certain industrial structures, not only do they serve as visual landmarks due to their exterior appearance, but their interior spaces also retain functional value. By introducing innovative functions, unexpected spatial experiences can be generated. For example, the fire water tower in the Guangzhou Taikoo Warehouse Fashion and Creative Park has transformed its bottom space into a café, allowing the fire water tower to not only serve as a visual landmark but also fully utilize its functional value (Figure 4-10). Another example is a massive gas holder in Oberhausen, Germany. Its status as a city landmark is not solely due to its status as the largest in Europe; more importantly, the unique scene formed within its interior space has led to continuous exploration and creation of its functionality. This gas holder was converted into a public astronomy exhibition hall to popularize astronomical knowledge and also served as a stage for installation art performances, providing diverse cultural events. Within just two years of opening the converted gas holder to the public, it attracted over half a million visitors (Figure 4-11).

Figure 4-10 Converted fire water tower into a café in the Taikoo Warehouse Creative Park
(Source: Self-Photographed by the Author)

Figure 4-11 Gas holder in Oberhausen transformed into an astronomy exhibition hall
(Source: http://image.alighting.cn/)

(6) Industrial Plant Gray Space (Point Catalyst)

Gray space refers to a transitional space between indoors and outdoors, such as building entrances with colonnades, eaves, overhead spaces, canopies, and more. Thoughtful design of gray spaces in industrial plants is crucial for collaborative design between catalysts. It not only establishes connections between spaces but also facilitates human activities and enhances spatial experiences. Gray spaces do not have specific functions; they can be used as resting areas, viewing platforms, and more, offering various possibilities. Additionally, Guangzhou has a subtropical monsoon climate with hot summers and mild winters, and the gray space can effectively provide shade and shelter from rain.

The design of gray spaces mainly includes two methods: renovation and expansion. Renovation involves preserving structural components and partially removing enclosing walls to create gray spaces. Expansion includes the installation of canopies, creating sheltered spaces through outward extensions, constructing elevated platforms, and spanning large roof structures to cover multiple building units(Figure 4-12).

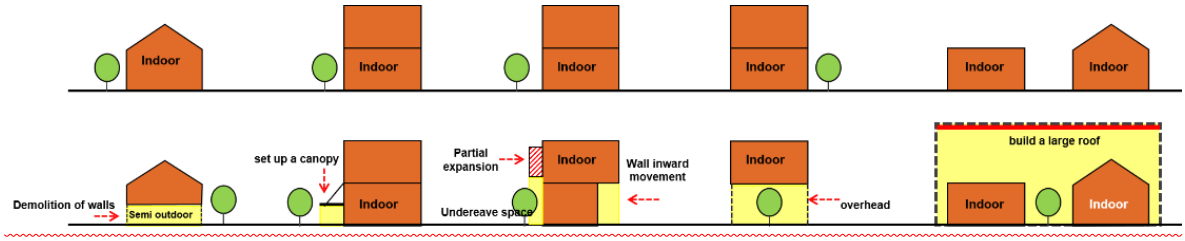


Figure 4-12 Various Methods of Creating Gray Spaces (Source:Self-Drawn by the Author)

4.4.2 Implantation of Cultural Elements into Catalyst Carriers

(1) Industrial Factory Area Working Platform (Surface Catalyst)

For some waterfront industrial factory areas, due to production requirements, there are numerous surface-shaped loading and unloading platforms within the factory premises. These surface-shaped spaces serve as crucial stages in the manufacturing process and hold significant industrial heritage. When renovating and revitalizing such waterfront industrial heritage, these surface-shaped spaces can be utilized as a large catalyst carrier. Through thoughtful design, they

can be transformed into an open plaza, thereby stimulating the revitalization of surrounding buildings.

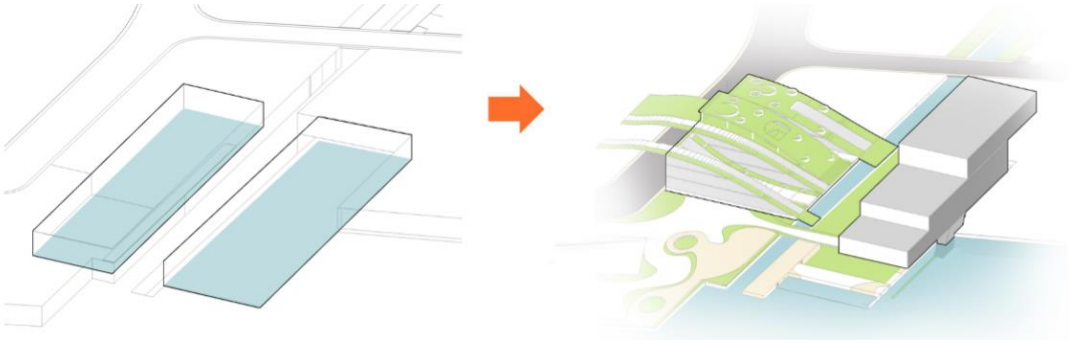


Figure 4-13 Shipyard Dock Renovation Concept (Source:Self-Drawn by the Author)

(2) Industrial Plant Area Linear Spaces (Line Catalyst)

By utilizing the abandoned rail tracks within the factory area as a unique linear landscape resource in the city, the rail tracks along the boundaries are integrated, reshaping the rail track area into an open urban space, altering the original rigid boundaries of the rail tracks, and forming a linear area where people willingly engage in spontaneous activities.

An example of this approach is the High Line Park in New York, USA (Figure 4-14). The park was created by repurposing a derelict elevated freight rail line in the West Chelsea neighborhood of New York. With the theme of "Rediscovering the Beauty of Railroads," the designers preserved the rugged, wild essence of the elevated rail tracks while skillfully integrating vegetation with building materials. They combined lawns, shrubbery, vines, moss, flowers, etc., with concrete, sandbags, steel, and linear wooden flooring. In the midst of the city's concrete jungle, they created a rare pastoral landscape. Through the design of various plant types, linear patterns, and the interweaving of nodes, they crafted diverse mixed spaces, both private and public. This transformation successfully turned a single linear transportation space into a catalyst for stimulating social interaction. Today, the High Line Park not only provides valuable open space for New York City but has also become an economic engine for nearby areas, attracting ongoing development and investment in emerging cultural industries, businesses, and residential projects.

Figure 4-14 High Line Park in New York City （Source：http://www.sohu.com/）

(3) Industrial Texture Renewal (Line Catalyst)

Mr. Qi Kang has defined urban texture as follows: a city is composed of regular or irregular geometric forms such as streets, buildings, plots, and public green spaces.

For existing industrial parks, it is advisable to use graph theory to analyze the spatial structure of the park, extract the existing spatial texture, refine unreasonable factory scales, reconstruct spatial texture, integrate it into the urban texture, create more open and inclusive spatial structures, establish invisible yet essential catalyst connections, and gradually renew and revitalize while respecting the urban texture. In addition, the renewal of industrial areas should be considered from the perspective of urban design, breaking away from the closed industrial production that is incompatible with the urban texture, and integrating new functions, forms, pathways, etc., into the surrounding area, achieving urban space repair and forming a deeply connected catalyst medium.

During the renewal process of urban waterfront industrial areas, it is possible to strengthen the existing road framework while preserving it, making its industrial characteristics more distinct. It is also possible to introduce block-shaped green spaces and squares, along with various preserved industrial buildings and structures, creating a texture quality similar to the "Mondrian classic style" under the comprehensive expression of various "point-line-surface" catalyst carriers, reflecting unique industrial aesthetics.

This spatial composition effect was demonstrated in the transformation of Beijing's 798 Art District. By inserting landscape features into the open spaces between the original factory buildings, small-scale landscape squares were formed. Through the preservation of a clear road network structure, various point-like buildings and structures were connected, creating a distinct point-line-surface constructivist painting, showcasing a profound historical context (Figure 4-15).

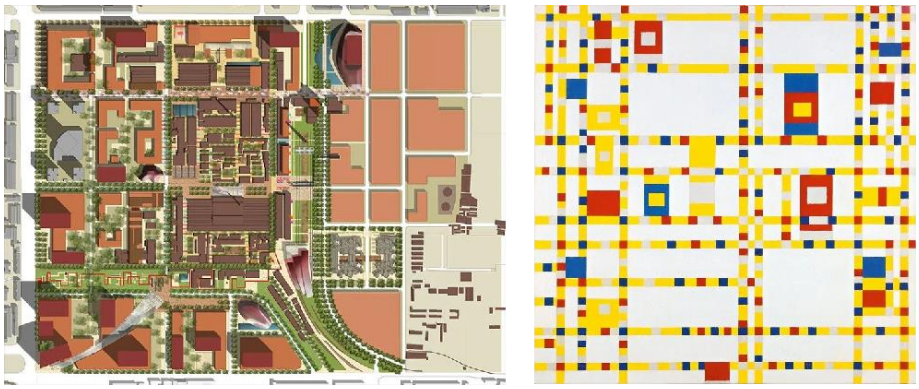


Figure 4-15 Comparison of the Texture of Beijing's 798 Art District After Renovation and Mondrian's Painting

(Source：the left picture：https://mmbiz.qpic.cn/mmbiz_jpg/，
the right picture：http://5b0988e595225.cdn.sohucs.com/images/)

(4) Waterfront Industrial Heritage Corridor (Line Catalyst)

The typical distribution of industrial heritage along the waterfront forms a belt-like pattern. In areas where heritage is concentrated, the design aims to create a linear corridor landscape that connects individual industrial heritage sites with distinctive industrial cultural value. The goal is to achieve the dual development of industrial heritage preservation and leisure tourism.

The establishment of corridors prioritizes the showcase of industrial culture while emphasizing ecological, landscape, and economic considerations. The length of the corridor depends on factors such as the actual distribution of heritage or the shoreline and rivers, often of moderate scale, with a strong emphasis on overall and regional transformation and renewal. The cross-sectional space of the corridor includes five main elements: environmental factors such as water bodies and shorelines, green corridors, pedestrian pathways, industrial heritage, and navigation systems. Sometimes, shorelines and green corridors combine to form a complete waterfront green landscape system, providing a backdrop and embellishment for cultural heritage.

Pedestrian pathways offer walking and non-motorized transportation routes and short-term resting places for tourists, residents, and workers. Industrial heritage forms the core of the corridor, referring to industrial buildings, facilities, and equipment within the corridor. When transforming and renovating industrial heritage within the corridor, its landscape requirements, differentiated functional layout, and comprehensive coordination with the surrounding environment should be considered. The navigation system serves as a guide to help visitors understand the cultural significance of industrial culture within the corridor. Using various forms such as audio, text, and images, it educates people about the cultural content of heritage resources and showcases the cultural value of the corridor. The entire corridor should emphasize connectivity between regions, delve into the historical context of industrial development, strengthen the connection of industrial elements in terms of space and time, vigorously promote the application of common industrial characteristics in the urban environment, and ensure the overall development of the region.

Based on the historical value assessment of industrial heritage, the waterfront industrial corridor can be divided into three segments:

① Historical Preservation Segment, preserving concentrated historical industrial relics or areas that can fully represent the production and living style of a particular historical period.

② Historical and Modern Intersection Segment, featuring preserved or partially preserved historical industrial heritage along the shore, as well as a large number of modern industrial buildings.

③ Modern Landscape Segment, characterized by a scarcity of historical industrial resources and relatively limited industrial heritage value.

Furthermore, detailed classification can be carried out for the complete industrial heritage corridor based on factors such as site texture, natural environmental characteristics, and surrounding urban environmental features, and varied renewal methods can be applied based on different classifications.

(5) Industrial Heritage Buildings (Point Catalyst)

When updating and revitalizing existing industrial buildings, you can start by assessing individual industrial heritage buildings based on the six-value system of industrial heritage: historical value, social value, scientific and technological value, artistic value, economic value, and ecological value (Table 4-5). Based on the scores, industrial heritage buildings can be categorized into three levels, implementing hierarchical protection[62]. First-level industrial heritage refers to those with extremely high industrial heritage value, usually considered as cultural relics protected at the national level or listed in the World Heritage Archives as the highest-level industrial heritage. Second-level industrial heritage refers to those with relatively high industrial heritage value, which require focused protection and reuse. The third category refers to industrial heritage with certain heritage value, even though not fully preserved, it has high potential for reuse, making it the most common type in current urban renovation and redevelopment (Table 4-6).

Table 4-5 Existing Industrial Building Value Assessment Form
(Source:Self-Drawn by the Author)

Industrial heritage value	Specific evaluation items	Industrial heritage building
Historical value	Long history With significant historical significance	
Scientific and technological value	Industry pioneering Technological uniqueness	
Social value	Social identity Corporate culture	
Artistic value	Aesthetic of architectural engineering Industrial style and ambiance Quality of architectural exterior appearance	
Economic value	Structural safety Interior space utilization Locational economic value	
Ecological value	Degree of water environmental pollution Richness of vegetation in the factory area	
Other remarks: The scoring criteria range from 1 to 5, with 5 being the best and 1 being the worst. Each heritage element will be scored based on its current condition.		

Table 4-6 Utilization Approaches for Industrial Heritage at Different Levels
(Source:Self-Drawn by the Author)

	Value	Approach of renovation	Surrounding environment
First-class industrial heritage	High Value	Preserving the basic original form is ensured under the premise of safety	Restrictions are imposed on the surrounding buildings and landscapes within a certain distance
Second-class industrial heritage	Moderate Value	Partial preservation	
Third-class industrial heritage	Lower Value	Select iconic portions for partial preservation	

Different levels of industrial heritage call for distinct preservation and reuse approaches. For the first category of industrial heritage, a preservation-focused model should be employed. It involves safeguarding the heritage structure to its maximum extent while ensuring safety. Simultaneously, restrictions should be imposed on any alterations within a certain distance from the heritage site in its external surroundings.

For the second category of industrial heritage, a model that emphasizes both preservation and reuse is appropriate. Some parts of the heritage structure are preserved, and any missing or damaged components are restored. The restoration approach may follow different philosophies, such as "like-for-like restoration" or "contrasting old with new," emphasizing the regeneration and extension of functionality.

For the third category of industrial heritage, the preservation and utilization process does not need to strictly adhere to the original appearance of the buildings. While respecting the historical spirit, only iconic industrial elements may be retained, or the heritage structure may undergo a more liberal transformation and renovation (Table 4-7).

Table 4-7 Treatment Approaches for Industrial Heritage Buildings in Renovation
(Source:Self-Drawn by the Author)

Intervention methods	Specific means	Explanation
protection and utilization	save	Keep the object in its original state and cannot add or remove anything.
	repair	Restore the object to a State of matter at an early stage of its morphological development process.
	renovate	Implement improvements to the actual state of the building to ensure the normal use of its structure and space.
	reinforce	Strengthen the load-bearing components to enhance structural stability.
Transformation and utilization	recombination	Reassemble a building with its original structure at the original or new site.
	reestablish	Rebuild buildings that have disappeared on their original site.
	rebuild	Reuse the building for applicability and endow it with new functions.
	Additional construction	On the basis of the original building, add new buildings or components to form a new architectural form.
	split	Extract or demolish a certain part of the building, retain usable parts, and assign new functions.
Demolition and reconstruction		Demolition of building entities.
		Empowering the site with new connotations and functions through the construction of new buildings.

(6) Industrial Heritage Structures and Equipment Facilities (Point Catalyst)

Urban waterfront old industrial districts have diverse industries. Due to the uniqueness of each industry, each factory district has its distinctive industrial processes, factory layouts, and various industrial structures such as chimneys and cooling towers. Typically, these structures possess spatial forms and grand volumes that provide a strong spatial impact and a sense of recognition for the factory district. Rational utilization of the spatial tension created by such industrial structures, using them as visual symbols for the factory district, can generate a powerful visual impact. For example, in the Beijing Zhangjiakou Industrial Culture Theme Park, a upstream-type steam locomotive dating from 1983 is placed in the center of the dry fountain square, with lamp posts on both sides transformed from old crane arms. These elements complement each other and create a distinctive industrial-themed space (Figure 4-16). Furthermore, abandoned materials and equipment facilities within industrial factory districts can be designed as landscape features, creating spaces with the charm of industrial history.

Figure 4-16 Beijing Zhangjiakou Industrial Culture Theme Park
(Source: https://www.gooood.cn/)

4.4.3 Implantation of Ecological Elements into Catalyst Carriers

(1) Ecological Park (Surface Catalyst)

Ensuring the rainwater safety of waterfront areas by establishing ecological rain gardens. Rain gardens are shallow depressions, either naturally formed or artificially excavated green spaces, designed to collect and absorb rainwater from roofs or the ground. Through the combined action of plants and sandy soil, rainwater is purified and gradually infiltrates into the soil, replenishing groundwater. Rain gardens are currently one of the most common techniques in sponge city design and have taken on various forms. What we commonly refer to as sunken green spaces is one type of rain garden, and it is now mandatory in the planning and construction of new areas in China. When renovating waterfront industrial heritage, rain gardens can be created by making efficient use of large, flat spaces near the waterfront.

(2) Waterfront Landscape Corridors (Line Catalyst)

Integrated with urban greenways, create a fully functional, well-equipped, aesthetically pleasing, and culturally rich waterfront landscape corridor, providing citizens with a dynamic linear waterfront space for observation, enjoyment, recreation, and activities. Combining waterfront landscape corridors with industrial heritage corridors strengthens the connection between sites and water bodies, while organically blending natural ecological landscapes and

industrial heritage landscapes, facing urban development, connecting surrounding areas, and forming a linear public space that is ecological, cultural, open, and waterfront-oriented.

For example, in New York, the Hudson River Park runs for several kilometers, spanning over a dozen pier-style docks along the Hudson River's edge. The park not only links important industrial heritage landscapes along the riverbank but also features sports fields, fitness facilities, cafes, and various public art spaces. It successfully shortens the distance between citizens and the Hudson River, becoming an important urban waterfront public space (Figure 4-17).

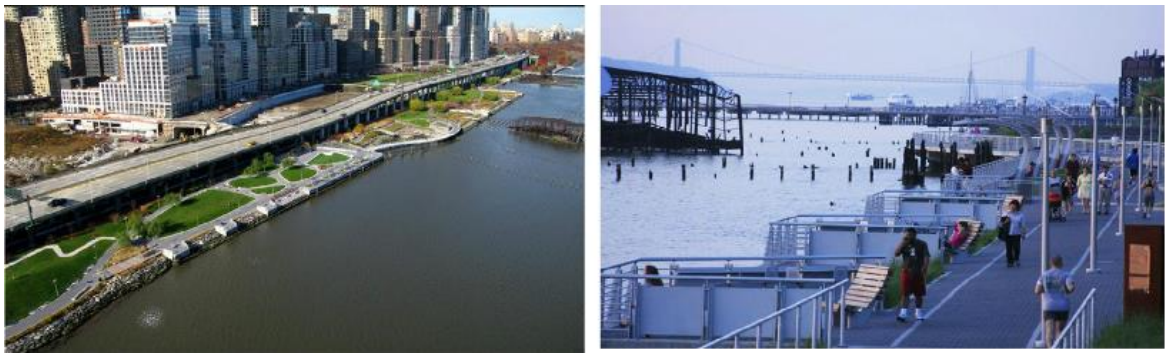


Figure 4-17 Industrial Landscape Design for the South Riverfront in New York
（Source：http://www.landscape.cn/news/39604.html）

Another example is the landscape on the Huishan site in the northern Bund of Shanghai. Originally a warehouse and dockyard, the abandoned factory buildings and obsolete docks severed pedestrian routes along the river. The flood prevention standards enforced on both sides of the Huangpu River also obstructed people's demand for waterfront experiences. The design broke the linear flood control barrier and integrated the upper and lower spaces with the "Axis of the Pujiang River," making buildings and landscapes one entity. It also integrated leisure and commercial spaces within the site, enhancing the continuity of the riverside space (Figure 4-18).

Figure 4-18 Landscape Design for the Huishan Parcel on the North Bund Riverside in Shanghai（Source:https://oss.gooood.cn/）

(3) Industrial Heritage Buildings (Point Catalyst)

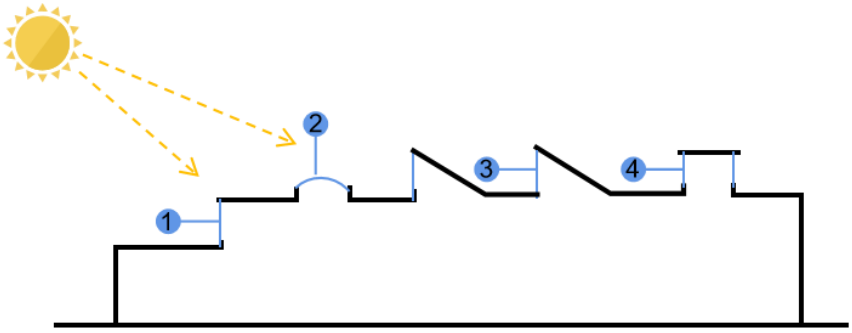
① Rooftop Spaces

During the renovation of industrial heritage buildings, while repairing the aging roofs, it is possible to consider creating natural landscapes on the rooftops, establishing rooftop green spaces, and improving the city's air pollution and lack of natural landscapes. This provides people with a different landscape experience. For example, in the design of the office area on the roof of Zone A in the main exhibition hall of Jiangsu Province Garden Expo Park, metal prefabricated planting troughs were designed for the folded double-slope roof, creating rooftop greenery (Figure 4-19).

Figure 4-19 The rooftop of the office area in Zone A of the main exhibition hall of Jiangsu Province Garden Expo Park.（Sources：https://www.gooood.cn/）

② Sustainable Design for Interior Space Renewal

The comfort of the indoor lighting environment directly affects people's satisfaction and preferences for the space, thereby influencing the vitality of the space. Renovation designs should align with current sustainable development principles, with a focus on passive daylighting supplemented by artificial lighting. Natural daylighting in industrial buildings can be achieved through several methods: setting windows in the exterior walls, known as side lighting, is the most common approach; introducing atrium spaces and courtyard areas to enhance the level of daylighting in adjacent spaces; and installing skylights or roof lighting on the roof surface, offering various forms of skylights (Figure 4-20), which can be creatively designed for the fifth façade of the building as needed.



1-Horizontal skylight； 2- Flat skylight； 3 - Zigzag skylight； 4 - Rectangular skylight

Figure 4-20 Several forms of top lighting
(Source:Self-Drawn by the Author)

When industrial buildings have a significant depth, a large span, or multiple spans in parallel, side lighting may not reach deep into the building. In such cases, top lighting can be employed by installing skylights on the roof to increase the amount of natural light. Alternatively, for buildings with large spans, designing high side windows by raising a portion of the roof to create a higher span. Additionally, sunshade reflectors can be installed below the windows to diffuse direct sunlight into the interior, meeting the normal daylighting needs. When dealing with large-scale industrial buildings, the design of atrium spaces can be considered by strategically placing and sizing atriums and configuring their spatial forms (step-type), thereby enhancing natural lighting (Figure 4-21). The comfort of the spatial environment affects the congregation of people and indirectly influences catalytic reactions.

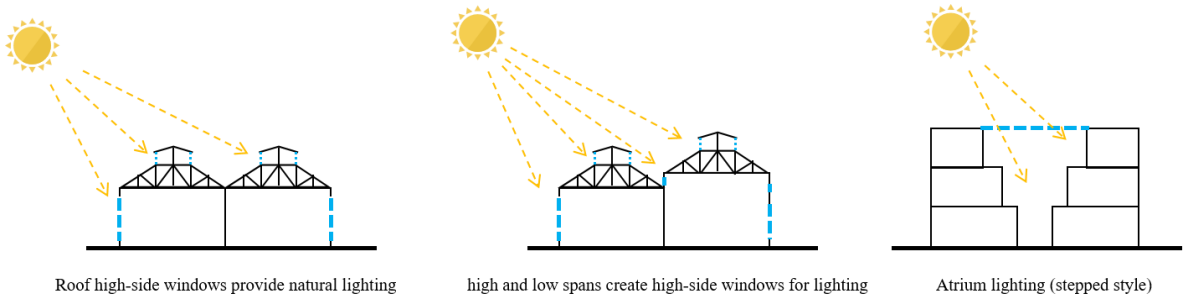


Figure 4-21 Daylighting methods for industrial buildings with large depth, wide span, or multiple interconnected spans (Source:Self-Drawn by the Author)

(1) Shaping Waterside Environments (Point Catalyst)

To create artificial waterside spaces in conjunction with the waterfront landscape, the most commonly used method is to construct raised waterside platforms. The design of these waterside platforms should ensure both water accessibility and safety. In the design of Chicago's Navy Pier, a large wooden waterside platform was built to complement the pier, forming a highly engaging waterfront open space. In the Allegheny Riverfront Park, due to flood walls that divided the park into upper and lower sections, the upper section connects to the city streets via a sloping pathway leading to the lower, true waterside area which is situated 7 meters below street level. In this narrow lower section with only 10 meters of space, a cantilevered concrete pathway was used to extend the waterside road by 4.6 meters towards the water. This expansion created wedge-shaped spaces that were planted with native vegetation capable of withstanding floods. These plants quickly return to lush growth after being submerged, making for a resilient and visually appealing waterside area. The combination of cantilevered pedestrian pathways and wetland vegetation is a design highlight of the Allegheny Riverfront Park (Figure 4-22).

Figure 4-22 The Allegheny Riverfront Park

（Source：http://www.michaelmercil.com/allegheny-riverfront-park）

In conclusion, the revitalization of waterfront areas prioritizes environmental improvement, and therefore, in the early stages of regional urban renewal, the government should allocate significant financial resources to address pollution and shape the waterfront's ecological environment, thereby initially enhancing the environmental landscape of the waterfront area. Building upon this foundation, efforts should be made to satisfy people's desire to be close to water bodies, providing continuous, comfortable, and aesthetically pleasing waterfronts to create distinctive waterfront spaces.

4.4.4 Reshaping Public Space

（1）Plazas

Plaza spaces are vital nodes in the external spaces of industrial heritage, and their spatial design strategies can be considered from three major aspects: spatial features, spatial scale, and spatial retention.

① Plaza Space Features

Utilize areas with high visibility within the space, improve less integrated plaza spaces, and conduct spatial reconstruction by utilizing existing structures within the park or introducing new elements that align with the park's thematic function. This creates a unique sense of place, promoting diverse activities for different demographics. Additionally, upgrading static, observational structures to interactive, experiential objects enhances the appeal of the space and reinforces its thematic features.

② Plaza Space Scale

The comfort of the space scale directly affects people's usability. Research shows that a comfortable aspect ratio (length to width) ranges from 1/2 to 2/3, while a comfortable width-to-height ratio ranges from 2 to 5. Perceptions of plaza scale are also influenced by factors such as green landscapes and structures that divide or obscure the space. Therefore, adjusting the scale of the plaza can be achieved by redefining its length and width or by altering the height of surrounding structures to change the proportions. Creating visual focal points, such as

sculptures and structures, can define space. Landscaping, seating, and paved areas can also enclose space, breaking up monotonous proportions and ensuring a comfortable human experience.

③ Plaza Boundaries

The functionality of the boundaries around the plaza is crucial to the overall plaza environment. Diverse and lively functions should be reasonably placed in the boundary areas, and gray spaces should be set up to allow for strong permeability and avoid a rigid, enclosed image.

(2) Landscape Green Spaces

New landscape nodes can be strategically introduced into the outdoor spaces of the factory area. When creating new landscape spaces, pay attention to hierarchical considerations. Include both large-scale central landscapes and small-scale landscapes. Incorporate vertical landscapes as well as horizontal landscapes to create a visually striking, multi-dimensional environment that combines the industrial character with sensory experiences.

4.4.5 Reshaping the Transportation System

A well-developed road transportation system can enhance the accessibility of a region, injecting urban vitality into former industrial areas along the waterfront. These urban waterfront industrial zones often have characteristics such as large block sizes, sparse road networks, wide road lanes, and poor road conditions due to their past production-oriented needs. Additionally, they are enclosed by high walls or fences for security and privacy reasons, preventing unauthorized access. On the waterfront side, industrial and transportation facilities dominate, isolating these industrial zones from the city as a whole. Therefore, during the process of revitalization and renovation, it is critically important to systematically enhance and integrate the road transportation system to improve its connection with the city.

The primary transportation systems in waterfront areas should include both road transportation and water transportation. Considerations should encompass various dimensions, including

public transportation systems, motor vehicle circulation systems, parking systems, non-motorized vehicle systems, pedestrian systems, and water transportation systems. Within the region, the establishment of an integrated green transportation network, combining public transportation and pedestrian systems, allows people to access the waterfront area from external locations and adopt a primarily pedestrian-based touring approach once within the waterfront area. The design of road systems should consider speed limits for motor vehicles, establish clear and continuous non-motorized vehicle lanes, implement separation of pedestrian and vehicular traffic in key areas, position vehicular lanes closer to the city side, and employ a circular design, placing public parking facilities at the corners near the city side. The creation of a comprehensive pedestrian system along the entire waterfront, focusing on enhancing the connection between pedestrian systems and the water, is essential. This system should ensure connectivity with all recreational spaces, public spaces, and commercial spaces within the waterfront area, creating a network of interconnected and easily accessible pedestrian pathways.

The water transportation system is a significant distinguishing feature of waterfront areas, setting them apart from other regions. After losing their industrial transportation function, waterfront areas often transition to serving recreational purposes in large cities or continue to function as passenger transport hubs in smaller cities. When planning for recreational water transportation, considerations should include the establishment of cruise ship docks and temporary berthing points. Furthermore, these plans should integrate with the overall landscape system while considering the waterfront landscape alignment.For water transportation that still serves passenger functions, it's essential to consider its integration with other public transportation systems, creating a city-wide "Water Public Transportation Network" that works in conjunction with the "Land-Based Public Transportation System," jointly fulfilling the responsibilities of the urban public transportation system.

By thoughtfully planning bicycle systems, pedestrian systems, and other slow transportation systems, connections can be established between formerly isolated industrial factory areas. This

also allows for close integration between industrial heritage sites and other public spaces within the city, facilitating the creation of an interconnected pedestrian network across the entire open space. This network, in turn, constructs distinctive industrial travel routes.Furthermore, slow transportation routes act as important connectors and catalysts for activating the entire region during its revitalization. There are two forms of slow transportation systems: "strip extension" and "point radiation." "Strip extension" refers to multi-level slow walkways along the waterfront, using elements such as boardwalks, flood barriers, and embankments to create various slow travel experiences. "Point radiation" involves enhancing the public spaces on the urban side in the vertical water body to establish connections between the waterfront's slow transportation system and the city's transportation system. Extending the road network from the surrounding areas and setting up wedge-shaped green spaces and node squares can help create a seamless and tightly connected transition between the city and the waterfront(Figure 4-23) .

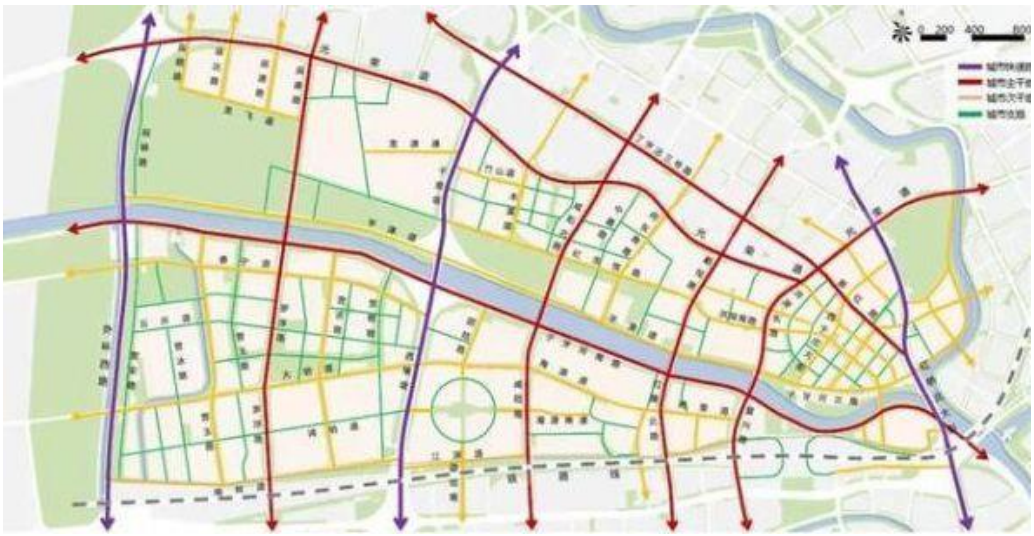


Figure 4-23 Urban Road Transportation System Planning for Both Sides of Ziya River in Tianjin City Center（Source：http://www.sohu.com/a/275866780_750860）

In addition, the exploration of multi-level transportation is possible. An elevated pedestrian system can enhance the connectivity between various catalyst points, enrich the pedestrian experience within the park, increase the uniqueness and recognizability of the park's spaces, and attract more visitors. It plays a proactive role in generating an overall catalytic synergistic effect. For instance, in Beijing's Tongzhou New Luyuan Canal Creative District, a city bridge that traverses the entire park was designed to directly connect the park's entrance near

residential areas with the entrance on the canal bank. This bridge is not only a focal point of interest for both inside and outside the park but is also recognized as part of the city's public infrastructure. As a result, the entire park becomes the backdrop for the bridge, serving as a transitional space between nature and urbanity within the city, seamlessly integrating into the urban landscape and eliminating the park's original sense of enclosure (Figure 4-24).

Figure 4-24 The Urban Bridge of Tongzhou New Luyuan Canal Creative District, Beijing
（Source：https://oss.gooood.cn/）

4.4.6 Constructing new buildings

Based on the specific conditions of the industrial site's architectural structure and site distribution, new buildings can be integrated as catalyst elements in some industrial park protection and activation processes. The relationship between new buildings and preserved buildings within the industrial park can be broadly categorized into three types based on the direction of industrial park protection and activation, site architectural layout, and new functional planning (Figure 4-25).

① New buildings serve as the dominant and leading elements of the entire factory area. The spatial layout and functions of the new buildings become the main highlights of the activated factory area.

② There is a balanced relationship between new and preserved buildings. This creates a dialogue between the old and new, emphasizing the characteristics and cultural significance of the industrial buildings through the contrast with new construction.

③ A third situation involves new buildings acting as catalysts interspersed within the

preserved building complex, serving as elements that enhance functionality and complement the architectural texture of the revitalized factory area.

In the preservation and revitalization of industrial factory areas, the judicious integration of new construction as a catalyst is an effective means of activation.

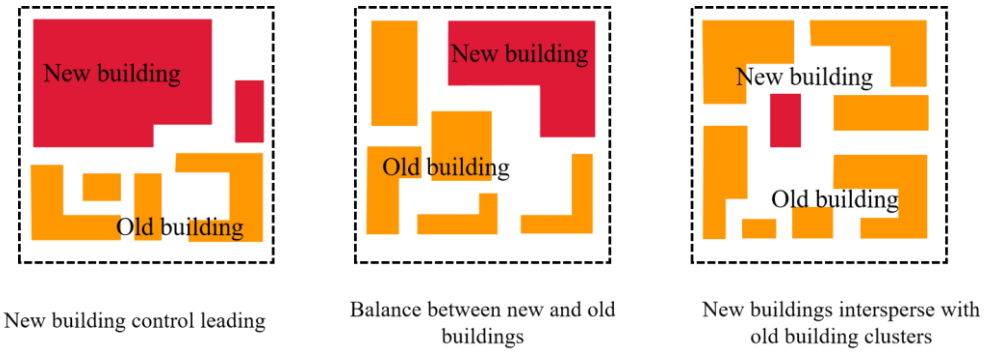


Figure 4-25 Relationship between New Construction and Preserved Building Space Volume (Source:Self-Drawn by the Author)

4.5 Control and Guidance of Urban Waterfront Industrial Heritage Catalyst Effects

4.5.1 Control of Urban Waterfront Industrial Heritage Catalyst Effect

The degree of catalyst reaction in urban waterfront industrial heritage is mainly analyzed through the fusion of catalyst carriers and catalyst elements, and the control of catalyst effects is carried out in stages, promoting them to operate according to the catalyst activation plan.

The first stage involves the combination of catalyst carriers and catalyst elements to initiate the catalyst reaction. The control focuses on activating the catalyst reaction by targeting the characteristics of the catalyst carrier, reshaping the catalyst effect from the catalyst carrier's beginning. During this period, changes are brought about within the urban waterfront industrial heritage due to the implantation of new catalyst elements, resulting in an increased development potential.

The second stage is when the catalyst carrier forms catalyst vitality points, attracting more development opportunities and resolving most of the issues within the industrial heritage area, leading to positive changes. Control in this stage emphasizes the standard selection of catalyst carriers and catalyst elements, avoiding the pursuit of short-term development benefits that could deviate from the plan. It helps facilitate multi-level catalyst activation from point-like and linear to planar within the heritage area, promoting extensive reshaping and activation.

The third stage involves a deepening of the catalyst reaction in the urban waterfront industrial heritage area. The overall improvement of functionality, aesthetics, and cultural characteristics is achieved within the park, transforming it from a socially deteriorating space into a socially vibrant point of activity. In this stage, the key focus is to strengthen the radiating effect of internal catalyst effects on the surrounding development. Some functions may be appropriately dispersed to the surrounding areas, forming points of industrial aggregation and development vitality, thereby increasing the mutual influence between industrial heritage and the surrounding community.

The fourth stage involves the overall reshaping of industrial heritage into a catalyst vitality point within the region. The protection and activation of industrial heritage become catalyst elements for the development of the surrounding area, leading to a new phase of regional synergy and radiating growth. The key focus in this stage is to strengthen policy guidance and industry support, promoting the formation of industrial clusters in the vicinity of industrial heritage and shaping distinctive development characteristics.

4.5.2 Guidance of Urban Waterfront Industrial Heritage Catalyst Effect

Catalytic reactions are a progressively developing process. In the construction of catalytic chain reactions, it is necessary to guide the process progressively to achieve the desired goals. Due to factors such as development progress, changes in the economic environment, evolving audience demands, and policy adjustments, catalytic reactions in the urban development process may face significant uncertainties. Therefore, it is essential to systematically transform, update, plan,

and manage content, using appropriate guidance to ensure a positive and constructive catalytic chain reaction.

Planning, implementation, and management are crucial for ensuring the transmission and implementation of planning content, corresponding to the guidance of subsequent chain reactions in catalysis. This includes two main aspects: government policy guidance and significant event guidance. Government policy guidance mainly involves the issuance of relevant policies or services by the government or industrial heritage developers to guide industrial heritage to become an essential part of social and cultural exchange. Significant events involve activities and exhibitions held within industrial heritage sites to increase public awareness, attract different groups for visits and tours, and enhance the social function and economic benefits of urban waterfront industrial heritage.

(1) Policy Guidance

Whether the transformation and revitalization of waterfront industrial areas are government-driven or the result of spontaneous market forces, relevant guiding measures must be proposed in policies to maintain the catalytic chain reaction. Government departments can provide policies in two main aspects: incentive policies and regulatory policies (Table 4-8).

Table 4-8 Policy Guidance Strategies

(Source:Self-Drawn by the Author)

Policy	Influence	Specific Methods
Encouragement policies	Encourage and promote	Determine relevant incentive policies, provide support for their updating and activation, and provide a certain degree of guidance for subsequent development, such as promoting policies to support the development of creative and cultural industries, promoting the development of tourism industry, attracting foreign investment and attracting funds, and so on.
Normative policies	Standardization and control	Promote relevant policies and specifications, implement corresponding control indicators such as Floor area ratio, building density, etc., limit their development intensity, and ensure that the protection of industrial heritage space will not be affected by activation and renewal activities.

(2) Event Guidance

In today's era of the internet, effective management not only requires policy support under government auspices but also the creation of an environmental atmosphere under market mechanisms. This includes theme events, brand effects, and self-media teams. Through event

guidance, the exposure and activity duration of catalytic points can be increased. Market-oriented activities are used for promotion and publicity, creating "internet-famous" products (Table 4-9).

Table 4-9 Event Guidance Strategies

（Source:Seft-drawn by the Author）

Event	Influence	Specific Methods
Organize special events	Enhance image; Attract crowds;	Determine relevant incentive policies, provide support for their updating and activation, and provide a certain degree of guidance for subsequent development, such as promoting policies to support the development of creative and cultural industries, promoting the development of tourism industry, attracting foreign investment and attracting funds, and so on.
Combining media promotion	Improve exposure and visibility	Through the promotion of relevant media, we can enter people's lives more deeply and widely, enhance the visibility of the updated and activated park, increase people's sense of identity, and enhance social impression by protecting relevant reports and tracking the activation process, making the influence of catalysts more lasting.

4.5.3 The catalytic effect of urban waterfront industrial heritage drives development in the surrounding areas

The main purpose of catalyzing and protecting urban waterfront industrial heritage is to drive the development of the surrounding areas through catalytic activation. Catalytic activation of urban waterfront industrial heritage requires comprehensive planning to ensure that these areas can be revitalized.

In general, catalytic activation of urban waterfront industrial heritage should break with conventions, promote regional cooperation, and innovate systems.

① Regional Cooperation: It is essential to establish regional cooperation and development in relation to the resources of urban waterfront industrial heritage. Governments should collaborate on planning and coordination, taking into account regional space, transportation elements, and tourism development resources. This maximizes resource integration to form regional linkages, guiding the protection and activation of specific urban waterfront industrial heritage resources.

② Breaking with Conventions: To invigorate the utilization of industrial heritage, it's necessary to break with traditional approaches and harness the vitality of industrial heritage activation. Technological advancements in society have driven changes in public aesthetics.

This has given rise to new protection models for urban waterfront industrial heritage, evolving from traditional museum exhibitions to various modes of protection like industrial heritage tourism, cultural creativity, and the integration of emerging technologies such as digital technology, the internet, and short videos. Therefore, it is essential to emphasize the historical and cultural characteristics of urban waterfront industrial heritage in protection and activation. "Cultural consumption" and "experiential tourism" can be used as catalytic effect points to explore new development models, stimulating the development of the surrounding community.

③ Sustainable Development: To ensure the sustainable development of urban waterfront industrial heritage protection and activation, it is essential to establish local policy systems that encourage the participation of the entire community in the coordinated governance of industrial heritage protection. The catalytic activation of industrial heritage mainly includes three parts: project initiation, project construction, and post-construction operation and management. From project initiation to completion and operation, various issues related to land management, engineering construction, and ecological protection need to be addressed. Therefore, it is crucial to establish relevant policy systems for the protection and activation of urban waterfront industrial heritage to make these projects a reality. Furthermore, as urban waterfront industrial heritage is a social resource, its protection and activation require public participation and collaborative governance. Establishing a management committee for the protection and activation of urban waterfront industrial heritage, which includes local government, enterprises introduced by the government, and local residents, can provide full-process management of urban waterfront industrial heritage. This ensures that any problems encountered during catalytic protection and development can be promptly addressed, and protection and activation can achieve sustainable development.

The expansion of the catalytic effect of urban waterfront industrial heritage is primarily driven by the development needs of the city. For cultural and tourism-oriented urban industrial heritage, such as museums and cultural creative industry parks, it is necessary to enhance their influence

in industrial heritage tourism. This can be achieved by integrating waterfront features and historical culture into urban-themed tourism promotion, increasing the visibility of urban waterfront industrial heritage tourism, and making it a new cultural landmark. For urban public spaces that require protection and activation, phased reshaping of industrial heritage spaces is needed, with the impact radiating from the community to the city.

4.6 Summary of this Chapter

This chapter is about the principles and application of catalyst design for the transformation and renovation of industrial heritage along the waterfront in Guangzhou. Firstly, it examines the alignment between the role of urban catalysts and the process of project renovation and revitalization planning. Then, it explores the catalyst potential of Guangzhou's waterfront industrial heritage from four aspects: location conditions, spatial utilization, culture, and ecology, providing ample evidence for the implementation of this theory. Subsequently, it integrates a practical framework for urban catalyst renewal in Guangzhou's waterfront industrial heritage. The main steps include selecting the catalyst perspective, determining the original catalyst carrier and catalyst elements, shaping and activating the original catalyst, and introducing new catalyst elements.

Chapter 5 Practical Application of Strategies - A Case Study of the Renewal Design of Wenchong Shipyard

5.1 Project Overview

5.1.1 Planning Scope

The Wenchong Shipyard area is located at the southern end of Huangpu District, Guangzhou, at the eastern end of the Pearl River waterway. It is situated within the Guangzhou Huangpu Economic Zone and the second Central Business District of Guangzhou. The area stretches from Wenchong Creek in the west to Gangqian Road in the north, Guangyu Wharf in the east, and the Pearl River in the south, covering an approximate land area of 70 hectares. Serving as a pivotal point between the inner and outer waterways of the Pearl River and Guangzhou's aquatic gateway, it boasts an advantageous geographical location and immense development potential. The site is 48 kilometers from Baiyun Airport, 20 kilometers from Guangzhou East Railway Station, and 26 kilometers from Guangzhou Railway Station, with multiple transportation hubs within a 25-kilometer radius, providing convenient access to transportation infrastructure (Figure 5-1).

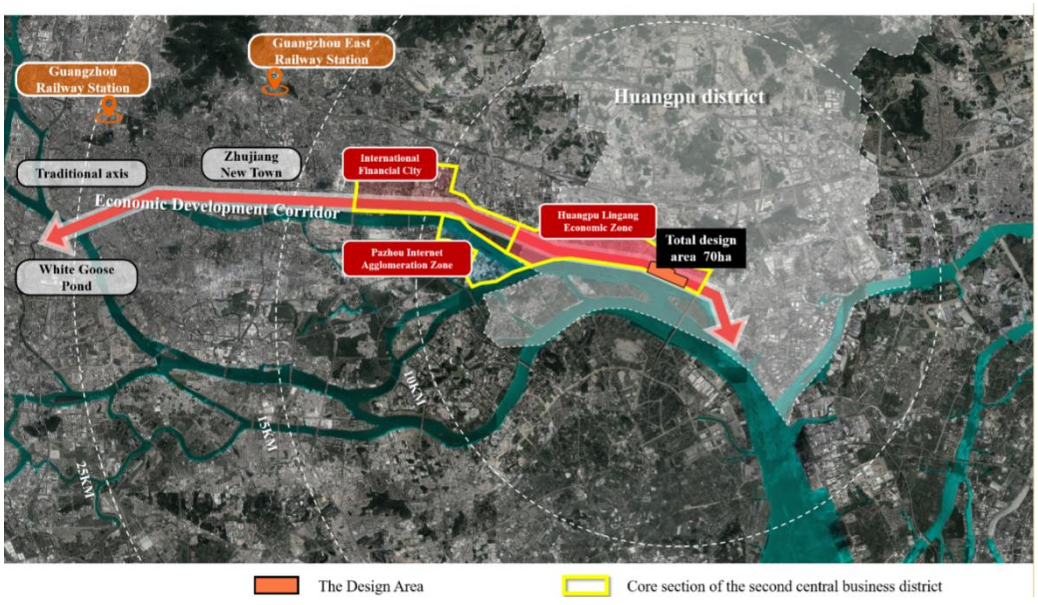


Figure 5-1 Geographical Location of Wenchong Shipyard
(Source:Self-Drawn by the Author)

5.1.2 Overview of Wenchong Shipyard

Guangzhou Wenchong Shipyard, established in 1955, is affiliated with China Shipbuilding Group Co., Ltd. Its predecessor was the Guangzhou Ship Repair Yard, which was a joint venture between the government and private enterprises. Through industry consolidation, mergers, reorganization, and transformation, Guangzhou Wenchong Shipyard was formed by combining 61 private small shipyards, primarily engaged in ship repair. Over the years, it underwent several name changes (Figure 5-2). In 2001, Guangzhou Wenchong Shipyard Co., Ltd. was established, and in 2006, China Shipbuilding Industry Corporation and Hong Kong Yuen Hing Group Co., Ltd. jointly established Guangzhou CSSC Yuen Hing Dockyard Co., Ltd., which continued the ship repair business of the original Guangzhou Wenchong Shipyard Co., Ltd. In 2014, Guangzhou CSSC Huangpu Shipbuilding Co., Ltd. and Guangzhou Wenchong Shipyard Co., Ltd. merged to form CSSC Huangpu Wenchong Shipbuilding Co., Ltd. With over 60 years of development, Guangzhou Wenchong Shipyard has grown into a large modern comprehensive enterprise primarily engaged in shipbuilding, ship repair, and heavy industry manufacturing.

Today, the shipyard has ceased production and undergone a complete relocation. The approximately 70-hectare site will be the subject of urban renewal design, while the remaining assets such as docks, gantry cranes, workshops, and industrial heritage require preservation and utilization.

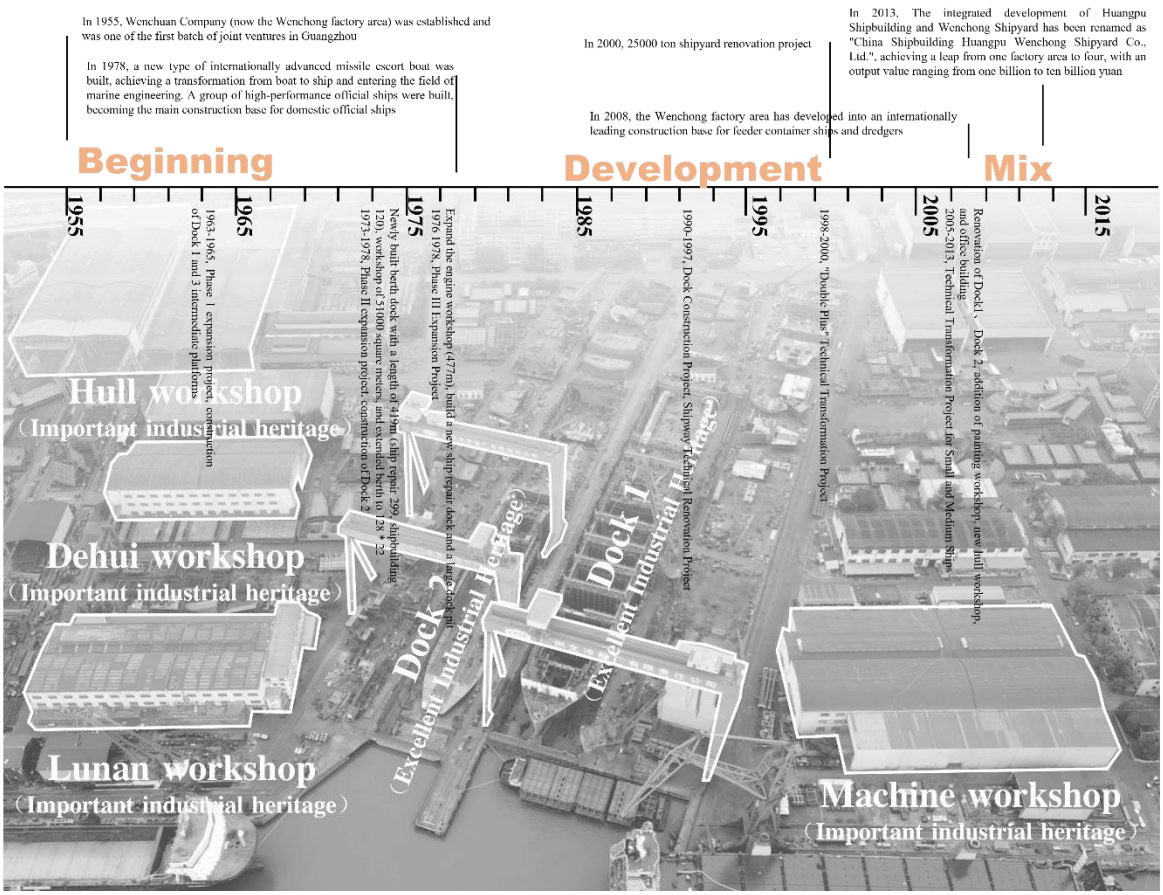


Figure 5-2 Historical development of Wenchong Shipyard
(Source:Self-Drawn by the Author)

Figure 5-3 Site Plan of Guangzhou Wenchong Shipyard in the 2000s
(Source:Self-Drawn by the Author based on 'A Brief History of Guangzhou Wenchong Shipyard 1955-2000')

5.2 Upper-Level Planning

5.2.1 Overall Positioning of Guangzhou City

According to the "Guangzhou City Master Plan (2017-2035)", Guangzhou City's overall positioning is as an international trade center, an external communication center, a comprehensive transportation hub, and a southern international shipping center. It also aims to construct a hub-type networked urban spatial structure, with the Pearl River as the core, optimizing and enhancing the "One River, Two Banks, Three Belts" concept.In accordance with the "Guangzhou City Land Spatial Master Plan (2018-2035)", Guangzhou City's development positioning is to adhere to the development concept of "Innovation and Smart Manufacturing, Leading Globally", continuously enhancing international and domestic influence and radiance. It seeks to optimize the networked urban development structure along the Pearl River system, with the Pearl River as the main axis, ecological corridors as separators, interconnection through expressways and rapid rail transit, supported by major strategic hubs, and forming a spatial development structure of "One Axis, Three Zones, One Core, One Pole, Multiple Supporting Points, and Network Layout".

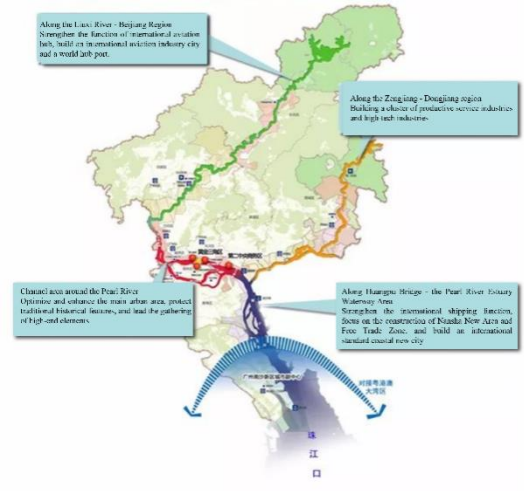


Figure 5-4 Schematic Diagram of Guangzhou's Hub-Type Networked Urban Spatial Structure (Source:Self-Redrawn by the author)

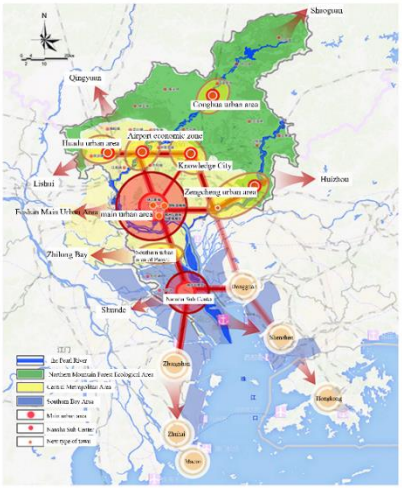


Figure 5-5 Schematic Diagram of Guangzhou's Municipal Spatial Structure (Source:Self-Redrawn by the author)

5.2.2 Huangpu District Planning

In 2021, the Urban Renewal Bureau of Guangzhou Development Zone released the "Huangpu District Guangzhou Development Zone Urban Renewal Special Master Plan (2020-2035)." The plan outlines the overall positioning of Huangpu District, focusing on the development of a Knowledge City, Bay Area Innovation Hub, and an International Talent Harbor. Through urban renewal and transformation, the plan aims to comprehensively enhance the district's urban competitiveness, industrial development potential, and livability. Additionally, the plan introduces a spatial layout structure known as "One Belt, Four Zones, Four Centers," promoting the formation of a new innovative spatial pattern with four distinct and complementary characteristic areas that drive interconnected development.

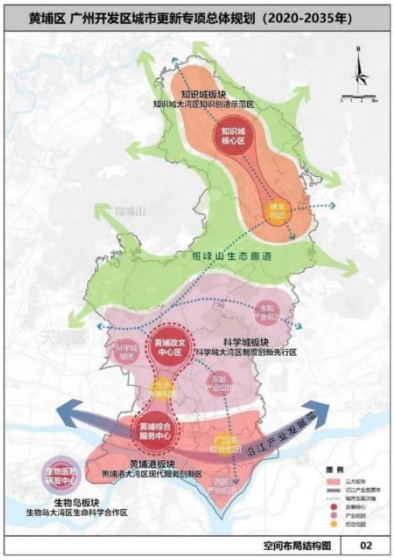


Figure 5-6 Huangpu District Spatial Layout Planning Diagram
(Source:Self-Redrawn by the author)

Figure 5-7 Huangpu District Subdivision Functional Planning Structure Chart
(Source:Self-Redrawn by the author)

In December 2016, during the 11th Guangzhou Party Congress, it was proposed to "construct the second central business district centered around the International Financial City - Huangpu Linye Economic Zone." The second CBD in Guangzhou consists of two core areas: the Guangzhou International Financial City and the Huangpu Linye Economic Zone. It encompasses key development zones such as the Huangpu Linye Economic Zone, International Financial City, Pazhou area, International Innovation City, the western region of the Guangzhou Economic and Technological Development Zone, and Changzhou Island.

The "14th Five-Year Plan" for the development of the Huangpu Linye Economic Zone (2021-2025) outlines the goals for the next five years. The plan aims to establish the zone as a digital economy experimental area, a hub for new trade innovations, an integrated demonstration area for harbor-city development, a waterfront ecological civilization demonstration area, and a demonstration area for digital social governance. In terms of spatial planning, the plan proposes the construction of a "core with three zones and multiple points" within the Huangpu Linye Economic Zone and the Guangzhou Artificial Intelligence and Digital Economy Experimental Zone (Yuzhu area).

Figure 5-8 Spatial Planning Structure of Huangpu District
(Source: "14th Five-Year Plan" for the Development of the Huangpu Linye Economic Zone, 2021-2025)

5.2.3 The Planning of Wenchong Shipyard

On November 24, 2022, the Industrial and Information Technology Bureau of Huangpu District, Guangzhou, published the "Adjustment of Industrial Industrial Blocks in Huangpu District." This adjustment is made based on the actual situation to update the control lines of industrial industrial blocks. The most significant change in this adjustment announcement is the disappearance of the secondary control lines for industrial industrial blocks along the Pearl River. Except for a small portion adjusted to primary control lines, most of them no longer have control lines, meaning they are no longer designated for industrial land use.

Leveraging the Guangzhou Second Central Business District, the area where Wenchong Shipyard is located will be developed into a "Marine High-Tech Agglomeration Center." The project is situated in the "Global Smart Innovation Agglomeration Zone" and is primarily planned for functions such as commercial offices, research and development offices, supporting residences, and cultural parks. It aims to create an integrated smart maritime, artificial

intelligence, and digital economy innovation hub under the concept of a "Smart Port," with enormous development potential.

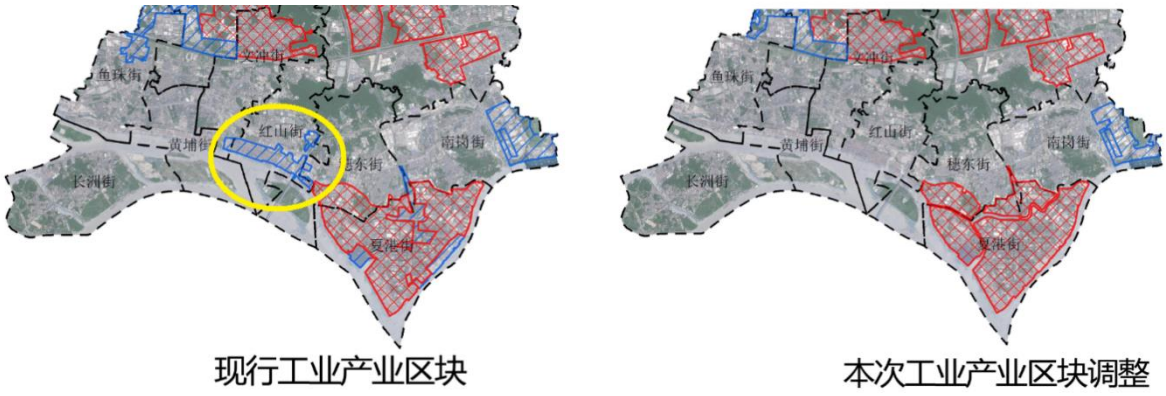


Figure 5-9 Industrial Zone Adjustment (Image Source: Redrawn by the author based on Guangzhou Huangpu District Industrial and Information Technology Bureau)

5.3 Site Analysis of Wenchong Shipyard

5.3.1 Current situation of Wenchong Shipyard

(1) Geographic Location

From the analysis of the surrounding transportation, the current road network of the site shows good regional accessibility, with connections to the outer city through the Ring Expressway and Huangpu East Road. However, the site itself has relatively weak connectivity with regional arterial roads, and the nearby road network lacks systematic planning, resulting in many dead-end roads(Figure 5-10). In addition, the site is within 500 meters of both the Shuanggang Metro Station and BRT (Bus Rapid Transit) stops, providing convenient conditions for public transportation(Figure 5-11). Overall, the site's location is relatively advantageous in terms of transportation, with the potential to activate catalyst elements and quickly bring about positive catalytic effects for the factory area.

In terms of surrounding facilities, there are two cultural stations, Wenchong Street Culture Station and Suidong Street Culture Station, to the northwest and southeast of the factory area, respectively. From a cultural perspective, these stations can form a regional circle of catalytic effects with the cultural catalysts within the factory area, facilitating the release of catalytic

effects and driving regional cultural development (Figure5-12). On the northern side of the factory area, there are multiple educational facilities, including primary schools, middle schools, and high schools (Figure 5-13). Regarding medical facilities, there are four health service centers located to the north, east, and west of the factory area (Figure 5-14).

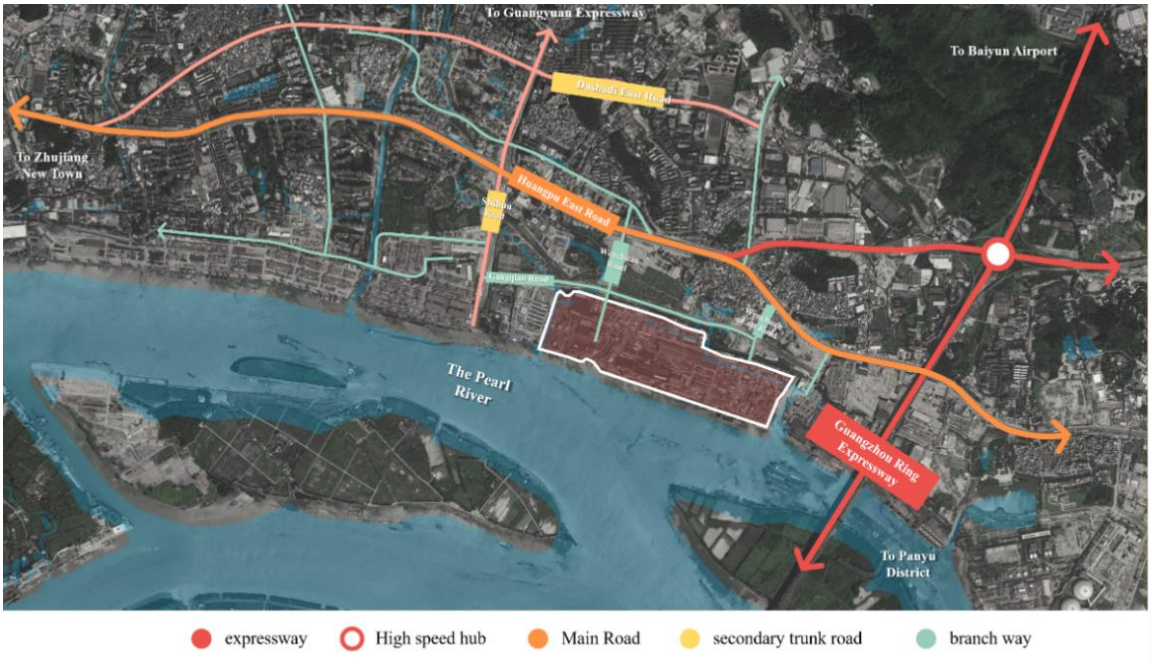


Figure 5-10 Road Traffic Status of Wenchong Shipyard
(Source:Self-Drawn by the Author)

Figure 5-11 Public Transportation Status of Wenchong Shipyard
(Source:Self-Drawn by the Author)

Figure 5-12 Current Status of Cultural Facilities at Wenchong Shipyard
(Source:Self-Drawn by the Author)

Figure 5-13 Current Status of Educational Facilities at Wenchong Shipyard
(Source:Self-Drawn by the Author)

Figure 5-14 Current Status of Medical Facilities at Wenchong Shipyard
(Source:Self-Drawn by the Author)

From the surrounding landscape analysis, the site is bordered to the south by the Pearl River, with the Shuanggang Creek to the east and the Wenchong Creek to the west, providing excellent waterfront views. In addition, the site is surrounded by high-quality scenic resources such as Longtou Mountain Forest Park, Nanhai Temple, Changzhou Island, as well as various-sized open parks scattered around. These resources facilitate the connection with the landscape catalyst elements within the factory area, igniting the landscape vitality within the factory area (Figure 5-15). In summary, the surrounding landscape resources of the factory area are rich, and when reshaping the landscape catalyst elements within the factory area, they can be combined with the surrounding landscape elements to generate a catalytic synergistic effect.

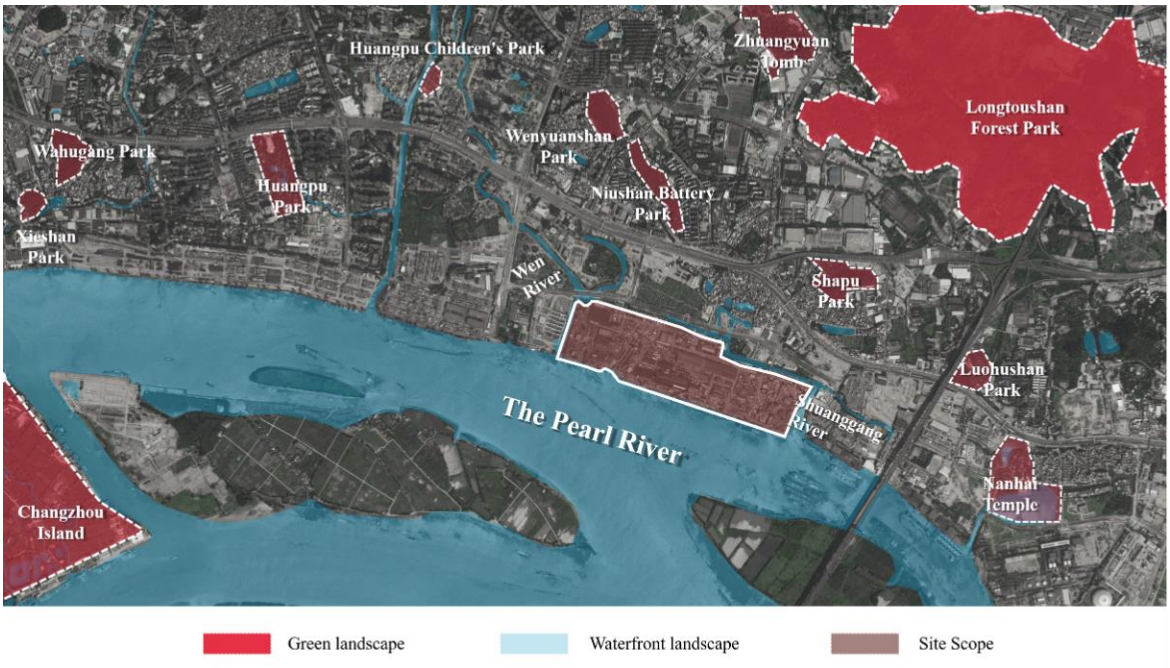


Figure 5-15 The surrounding landscape of Wenchong Shipyard
(Source:Self-Drawn by the Author)

(2) Overview of Current Functional Space Distribution

From the perspective of the factory's layout, Wenchong Shipyard's industrial heritage area follows a compact layout along the waterfront, with the shipbuilding and manufacturing zone at its core (Figure 5-16). Most of the land along the waterfront is used to accommodate production spaces closely related to shipbuilding and manufacturing processes. The shipyard docks and platforms, serving as the core of the shipyard's production processes, are arranged perpendicular to the waterfront. Dock 1 and Dock 2 are concentrated on the west side of the factory, while Dock 3 is situated on the east side of the factory. Pre-assembly areas and auxiliary buildings are located near the docks and platforms, and residential and office buildings are distributed in the northern part of the factory.

Figure 5-16 Functional space distribution at Wenchong Shipyard

(Source:Self-Drawn by the Author)

From the perspective of the factory's layout, Wenchong Shipyard's industrial heritage area follows a compact layout along the waterfront, with the shipbuilding and manufacturing zone at its core (Figure 5-16). Most of the land along the waterfront is used to accommodate production spaces closely related to shipbuilding and manufacturing processes. The shipyard docks and platforms, serving as the core of the shipyard's production processes, are arranged perpendicular to the waterfront. Dock 1 and Dock 2 are concentrated on the west side of the factory, while Dock 3 is situated on the east side of the factory. Pre-assembly areas and auxiliary buildings are located near the docks and platforms, and residential and office buildings are distributed in the northern part of the factory.

(3) Analysis of Industrial Factory Layout

The factory's layout has evolved over time as the factory has developed, reflecting the self-renewal of internal spaces within the factory. The predominant layout within Wenchong Shipyard is a geometric pattern oriented east to west. This pattern maintains a consistent direction and continues to evolve as the site develops (Figure 5-17).

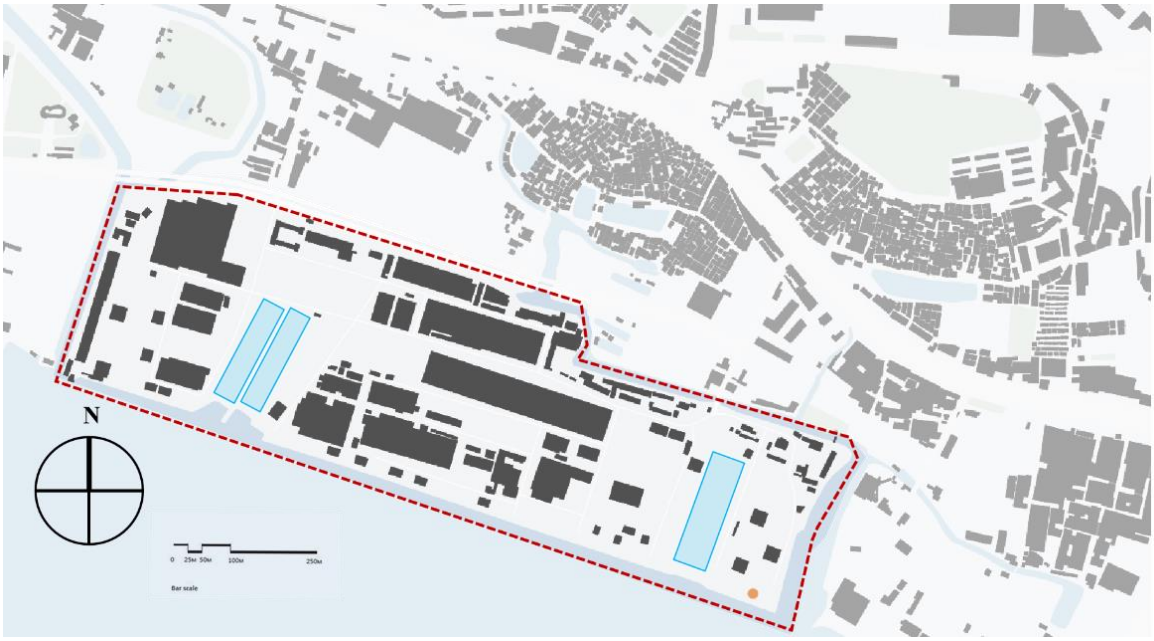


Figure 5-17 The layout of Wenchong Shipyard
(Source:Self-Drawn by the Author)

(4) Industrial Heritage Status

The Wenchong Shipyard complex consists mostly of modern industrial buildings with large spans, high ceilings, and ample open spaces. The internal industrial structures and production equipment within the complex have been well-preserved. Various production facilities, storage spaces, transportation infrastructure, and more have been retained in their original condition. These industrial relics bear witness to the developmental history of Wenchong Shipyard and possess significant historical and cultural value.

In September 2020, the Municipal Famous City Office proposed this project for inclusion as a protected industrial heritage site and identified 12 buildings requiring preservation. It was recommended that each district organize experts to conduct assessments and carry out preliminary protection efforts.

According to the "Planning for the 15-Kilometer Industrial Heritage Park in Huangpu Riverside" (in progress), there are currently six outstanding industrial heritage sites and seven relatively important industrial heritage sites within the Wenchong Shipyard industrial complex (Table 5-1,Figure 5-18).

Table 5-1 Assessment of Industrial Heritage Buildings within the Site
(Source:Self-Drawn by the Author)

Industrial heritage level	The number	The name
Industrial heritage with high value	WCG103	Dock No.1
	WCG102	Dock No.2
	WCG104	Dock No3
	WCG101	Ship building berth
	WCJ204	Old warehouse
	WCJ205	Centralized warehouse
	WCJ106	Ship-hull workshop No.1
	WCJ107	Ship-hull workshop No.2
Industrial heritage with a little value	WCJ110	Dehui Workshop
	WCJ111	Lunan Workshop
	WCJ123	Forging shop
	WCJ112	Mechanical Workshop
	WCJ113	Electric workshop

Figure5-18 Assessment of Industrial Heritage Buildings within the Site
(Source: "Planning for the 15-Kilometer Industrial Heritage Park in Huangpu Riverside")

Due to the requirements of shipbuilding, the building volumes are relatively large, with predominantly elongated spaces featuring high ceilings. The roof forms and window openings are repetitive in style, characterized by a rhythmic pattern created by rectangular windows, which adds significant aesthetic value. The color palette primarily consists of white and blue,

and the structures mainly include frameworks and racks. The office buildings are predominantly white in color, with a height of 5 stories, presenting an overall modern architectural style(Figure5-19).

Figure 5-19 Industrial Heritage Sites in Wenchong shipyard
(Source: Self-Photographed by the Author)

(5) Park Landscape Status

Due to the specific nature of its industry, the Wenchong Shipyard is primarily covered with hard surfaces, and greenery is scarce, with only four notable areas. One area is near the main entrance of the park, where there are a few flower beds, and roadside trees line both sides of the road. The second area of greenery is concentrated near the mechanical processing workshop, engine room, and electrical workshop, with trees distributed around the factory buildings. The other two green areas are mainly concentrated in a strip along the western and northern sides of the factory, adjacent to the waterfront.

The maritime subtropical monsoon climate provides an excellent environment for plant growth, and the existing plant resources in the park, along with its favorable climatic conditions, provide a solid foundation for the creation of plant landscapes (Figure 5-20).

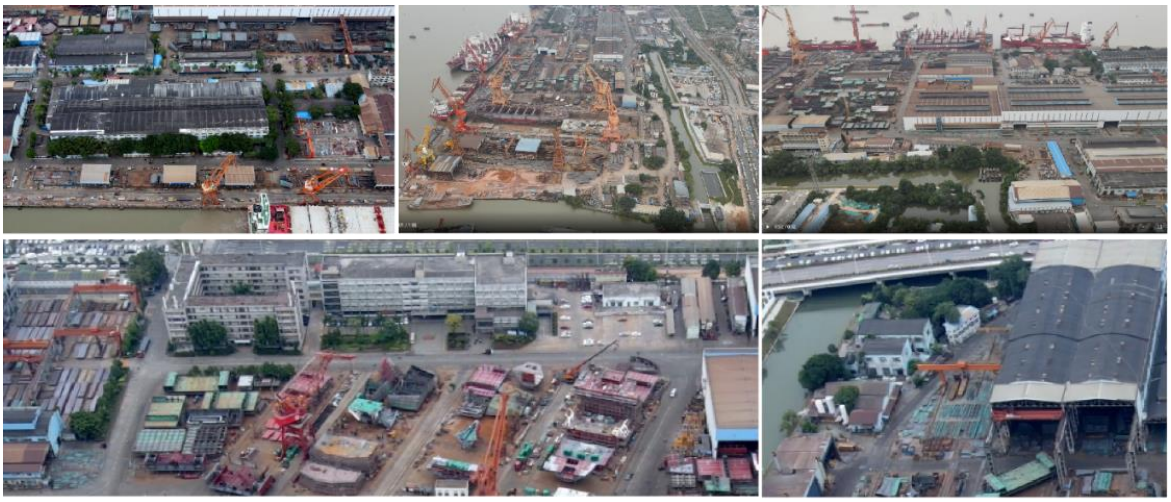


Figure 5-20 Existing Landscape Greenery at Wenchong Shipyard
(Source: Self-Photographed by the Author)

Figure 5-21 Distribution of Current Landscape at Wenchong Shipyard
(Source:Seft-Drawn by the Author)

5.3.2 Current Issues in Wenchong Shipyard

(1) Ecological Pollution and Riverside Decline

The entire industrial park has large and numerous buildings with little and sparse greenery. The industrial factory area prioritizes functionality, leading to a relatively weakened landscape

environment. The production of industrial waste in the area has made the ecological environment more fragile. Despite its southern location along the Pearl River, the shoreline consists mainly of hard revetments without waterfront roads or leisure spaces, lacking vegetation. The waterside is dominated by numerous industrial facilities. Guangzhou falls under a subtropical monsoon climate, characterized by long summer periods and ample sunlight, subjecting the entire industrial factory area to prolonged exposure to the sun without sufficient shading facilities.

(2) Urgent Need for Functional Updates

The factory area has already been planned for relocation, and valuable buildings that remain after the factory's cessation of operations need to be repurposed. Given the existing spatial foundation, the challenge is how to transform the factory area to adapt to the overall regional planning and development with a new appearance.

(3) Preservation of Industrial Culture

Currently, Wenchong Shipyard is in the planning stage of cessation and relocation. Drawing from past experiences with industrial heritage revitalization, there is a risk that valuable industrial buildings and structures may face the threat of demolition, as developers often prioritize maximizing economic benefits.

(4) Closed-Off Factory Area Affecting Overall Regional Development

Due to production requirements, the entire factory area remains closed off, with minimal interaction with the urban space outside the factory. This situation is not conducive to the overall development of the region.

In summary, the site contains numerous industrial relics with a strong historical imprint and industrial spirit. Its southern proximity to the Pearl River offers excellent ecological landscape resources. However, due to the nature of heavy industrial land use, there are current issues such

as limited external transportation connectivity, disorderly vegetation growth, and severe land pollution. During the planning process, constant attention should be paid to water pollution control, the development of waterfront landscapes, and the preservation of historical and cultural heritage.

5.4 Selection of the Catalyst for Wenchong Shipyard

5.4.1 Determining the Catalyst Angle for Wenchong Shipyard

According to relevant upper-level planning, the primary direction for the transformation and upgrading of Wenchong Shipyard's waterfront industrial area is "retiring two and advancing three," establishing a high-quality demonstration zone for marine economic development, and promoting the development of green technology and green industries, among others.

From the catalyst perspective, the transformed and renewed Wenchong Shipyard will become a waterfront cultural, ecological, innovative, and fashionable destination that integrates the "shipyard industrial imprint" and a "completely new lifestyle" for tourism, living, and shared workspaces.Specific goals can be divided into the following four directions:

(1) Material Development Goals: Thoroughly assess existing industrial heritage and, while fully realizing its industrial heritage value, introduce new urban functions. Using industrial heritage as a catalyst, achieve comprehensive area development and efficient integration and reuse of land resources.

(2) Cultural Development Goals: Leveraging the culture of Wenchong Shipyard and incorporating the culture of the Pearl River, inherit diverse cultural derivatives, and elevate regional cultural taste.

(3) Economic Development Goals: Relying on regional revitalization, introduce additional functions, create more employment opportunities, attract increased consumption, and enhance regional economic development.

(4) Environmental Development Goals: Utilize landscape design techniques to create green and innovative post-industrial landscapes, establishing a new type of urban public space with beautiful ecological environments and well-developed infrastructure.

Figure 5-22 Visionary Illustration of Wenchong Shipyard Renovation
(Source:Seft-Drawn by the Author)

5.4.2 Determining the Catalyst Carrier for Wenchong Shipyard

(1) Identification of Catalyst Points Carrier

In project practice, the identification of catalyst points relies primarily on the analysis of industrial heritage value assessment. According to previous research, the evaluation of industrial heritage value in relevant fields is mainly conducted through scoring assessments based on an index system. In the case of Wenchong Shipyard, it is necessary to establish a suitable evaluation index system. In addition to industrial structures that have already obtained national, provincial, municipal, or county-level recognition as industrial heritage or historical cultural resources, this method assists in identifying old industrial buildings that are recommended for preservation, renovation, or demolition.

① Buildings

According to the "Huangpu-Lingang 15-Kilometer Industrial Heritage Park Plan" (in preparation), Wenchong Shipyard's industrial plant area currently includes 6 outstanding industrial heritage sites and 7 relatively important industrial heritage sites. The outstanding industrial heritage buildings include old warehouses and distribution warehouses, while the relatively important industrial heritage includes shipbody workshops, Dehui workshops, Lun'an workshops, forging workshops, machining workshops, and electrical workshops (Figure5-23). In this planning and design, Dehui Workshop, Lun'an Workshop, Mechanical Processing Workshop, the old warehouse, and the distribution warehouse will be retained as catalyst carriers, while other industrial heritage buildings will be relocated or demolished.

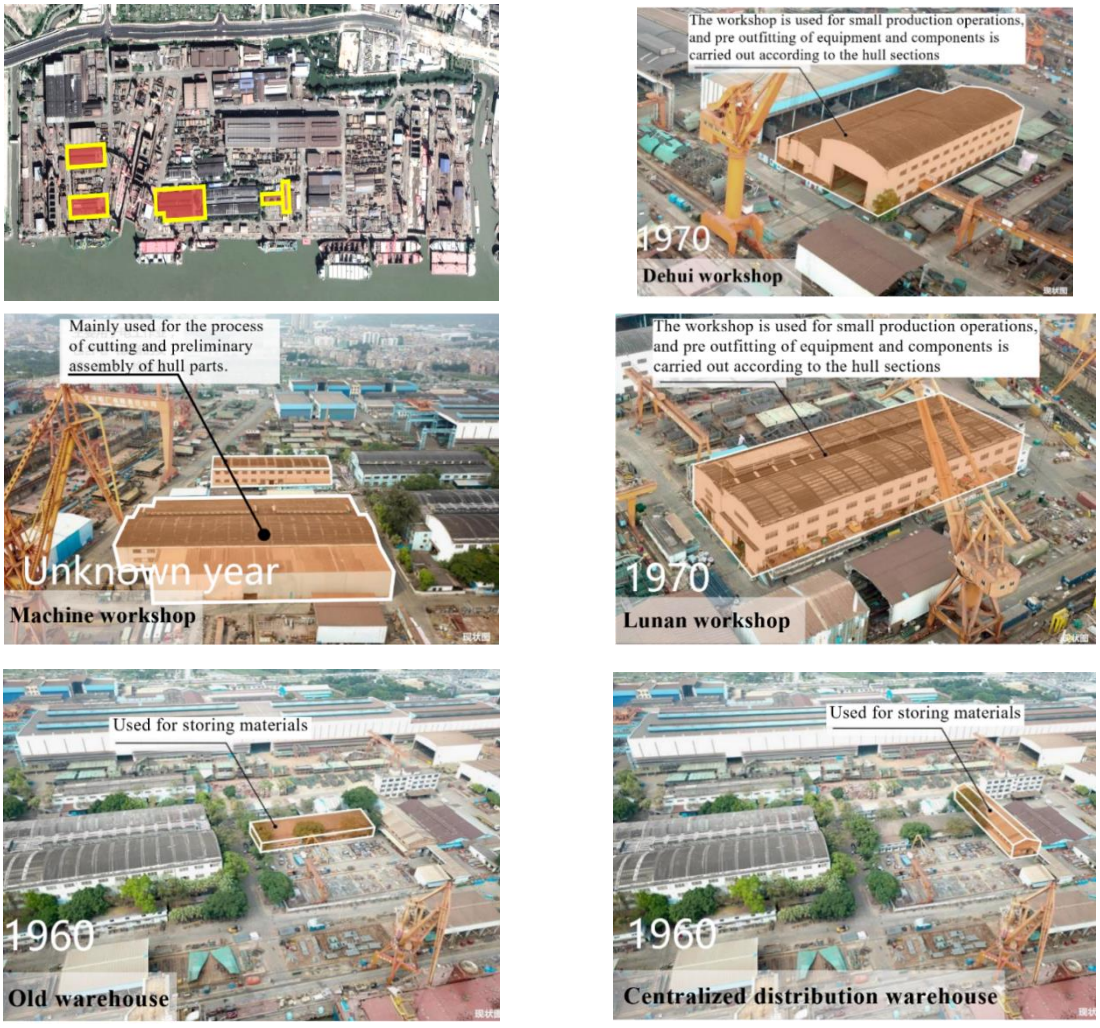


Figure 5-23 Industrial Heritage Buildings within the Wenchong Shipyard
(Source:Seft-Drawn by the Author)

Based on the previous catalyst strategy analysis, in addition to the industrial heritage buildings mentioned in government documents, priority should also be given to selecting buildings with distinctive exteriors, well-preserved structures, and value and significance. The selection of internal buildings within Wenchong Shipyard is primarily assessed from the following aspects: building location, architectural form, construction quality, and historical and cultural value. Based on the architectural catalyst value quantification assessment table referenced in Chapter Four, an analysis of the main buildings within Wenchong Shipyard is conducted (Table5-2). The final selection identified the comprehensive building, technology building, and the new ship body workshop as the architectural catalyst carriers.

Table 5-2 Quantitative Assessment of Architectural Catalyst Value within Wenchong Shipyard (Source:Seft-Drawn by the Author)

Category	Factor	Weight	Score	Comprehensive Building	Technology Building	Warehouse	Painting Workshop	E/F Painting Shed	Pipe Fitting Workshop	New Ship Body Workshop	Plate Cutting Workshop	Dehui North Outfitting Shed	Cutting Workshop	Canteen
Location	Accessibility	8%	10	√	√		√							
			5					√	√	√	√			√
			1			√						√	√	
Form	Overall Appearance	10%	10	√	√					√				
			5								√	√	√	
			1			√	√	√	√					√
	Iconic	10%	10	√	√					√				
			5											
			1			√	√	√	√		√	√	√	√
	Group-oriented	8%	10	√	√									
			5							√		√		
			1			√	√	√	√				√	√
Quality	Material	8%	10											
			5							√				
			1	√	√	√	√	√	√		√	√	√	√
	Structure	10%	10	√	√									
			5							√	√			
			1			√	√	√	√			√	√	√
	Spatial Pattern	10%	10	√	√									
			5							√		√		
			1			√	√	√	√		√	√	√	√
Historical and Cultural Value	Construction Year	8%	10											
			5											
			1	√	√	√	√	√	√	√	√	√	√	√
	Construction Techniques	10%	10											
			5											
			1	√	√	√	√	√	√	√	√	√	√	√
	Historical Events	8%	10											
			5											
			1	√	√	√	√	√	√	√	√	√	√	√
	Social and Emotional Memories	10%	10											
			5	√	√	√	√	√	√	√	√	√	√	√
			1											

Figure 5-24 Other Architectural Catalyst Carriers within the Wenchong Shipyard
(Source:Seft-Drawn by the Author)

② Structures and Equipment and Facilities

Structures: According to the "Planning for the 15-Kilometer Industrial Heritage Park in Huangpu Lingshui" (in progress), the first dry dock, second dry dock, third dry dock, and ship platform within the Wenchong Shipyard are classified as outstanding industrial heritage, with significant catalytic potential.

Equipment and Facilities: Within the Wenchong Shipyard, there are various equipment and facilities that can serve as catalyst carriers, such as cranes, gantry cranes, climbing ladders, and more. These possess an industrial and historical character, and through a variety of artistic techniques, these structures can be revitalized, creating a better urban riverside artistic ambiance (Figure5-25, Figure5-26, Figure5-27).

Figure 5-25 Point catalyst carrier——Tower crane
(Source: Self-Photographed by the Author)

Figure 5-26 Point catalyst carrier——Gantry crane
(Source: Self-Photographed by the Author)

Figure 5-27 Industrial Heritage Structures within the Wenchong Shipyard
(Source:Seft-Drawn by the Author)

(2) Identification of Catalyst Line Carriers

Due to the unique location of the Wenchong Shipyard, the current catalyst carriers mainly refer to the street spaces within the industrial factory area and the waterfront spaces formed along the Pearl River. Street spaces are essential linear catalyst carriers, playing a role in connecting various functional areas. Street spaces are also the most vibrant original catalyst carriers. The linear waterfront spaces along the Pearl River can be shaped into rich waterfront landscape belts through landscape transformation and ecological restoration.

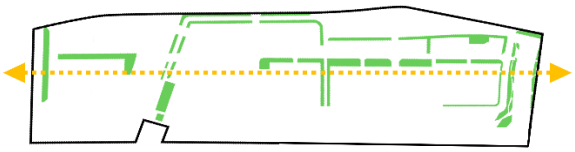


Figure 5-28 Corridor-Cental Green Belt
(Source:Seft-Drawn by the Author)

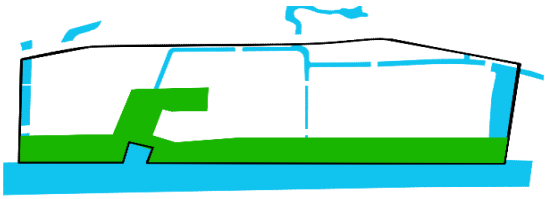


Figure 5-29 Waterfront Landscape Belt
(Source:Seft-Drawn by the Author)

(3) Identification of Catalyst Surface Carriers

The surface catalyst carriers in the Wenchong Shipyard are mainly contiguous spaces, including entrance plazas, public activity squares, material storage yards, and more. They exhibit significant spatial aggregation characteristics. As catalyst carriers, they can highlight industrial heritage features and intrinsic value. When these catalyst carriers are revitalized, they will bring about tremendous vitality and drive positive changes in the surrounding areas. Moreover, Wenchong Shipyard itself serves as a surface catalyst carrier. The goal of catalyst protection and activation is to reshape the industrial heritage entity into a new regional focal point through phased catalyst shaping, promoting positive changes in the surrounding environment within the regional scope.

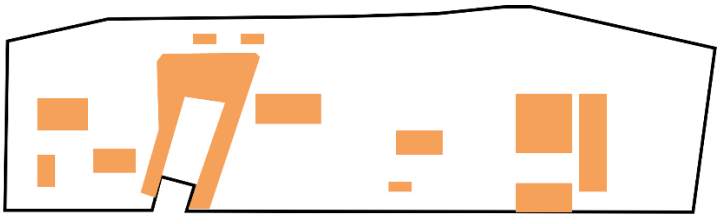


Figure 5-30 Distribution of Interior Surface Spaces in Wenchong Shipyard
(Source:Seft-Drawn by the Author)

5.4.3 Determining the Catalyst Elements for Wenchong Shipyard

As described in Chapter Four, the primary catalyst elements for waterfront industrial heritage can be categorized into three major classes: functional catalyst elements, cultural catalyst elements, and ecological catalyst elements. Functional catalyst elements serve as the foundation for other catalyst elements, ranging from the overall positioning of the entire park to the regeneration of each individual building's function and the layout of the park's space. Cultural catalyst elements, as the spiritual context of industrial site transformation and design, encompass both material and non-material cultural elements and are consistently integrated into the design strategies of functional and ecological catalyst elements. Given its status as a waterfront industrial heritage site, the ecological environment is relatively delicate. The site's internal areas are significantly polluted due to manufacturing processes, making ecological elements a crucial catalyst for the revitalization of the factory area.

5.5 Shaping and Revitalizing the Catalysts of Wenchong Shipyard

5.5.1 Implantation of Functional Elements into Catalyst Carriers

（1）Overall Planning of Wenchong Shipyard (Surface Catalyst Carrier)

This plan takes a perspective from the urban catalyst and focuses on the catalyst renewal potential of the waterfront industrial heritage. Taking into account upper-level planning, location resources, and spatial advantages, Wenchong Shipyard has policy support, resource foundation, and development potential for developing the marine economy and cultural industry. Furthermore, considering the current conditions, the base has abundant industrial heritage resources, historical and cultural resources, and natural waterfront advantages, making

it feasible to create a comprehensive region integrating industrial heritage tourism, business and leisure tourism, and waterfront ecological tourism.

The planned Wenchong Shipyard area includes eight major functional clusters, including the technology incubation and research and development zone, maritime service zone, marine economy headquarters zone, mixed-use complex, industrial heritage cultural and tourism zone, ecological restoration zone, riverside leisure belt, and urban vitality square.

The maritime service zone cluster, located in the western part of the site where characteristic industrial buildings and industrial structure heritage are relatively concentrated, combines industrial heritage with public spaces to create interactive, experiential, entertaining, and open heritage public spaces.

The riverside leisure belt is laid out along the Pearl River, utilizing the site's important "riverside" element, gathering dock-themed culture and fashionable waterfront culture, and constructing a distinctive riverside leisure culture corridor, including features like a yacht terminal and high-end riverside clubs.

The mixed-use complex primarily focuses on residential functions, combining regional features, customer positioning, and market trends to create a creative living demonstration area that integrates cultural creativity and smart living.

The technology incubation and research and development zone is located in the northern part of the site, adjacent to urban arteries with convenient transportation. Through the introduction of industries such as maker spaces and innovative research and development offices, it attracts innovative talents and businesses, driving the upgrade of the regional innovation industry.

The marine economy headquarters zone is located in the central part of the base and aims to attract various enterprises to settle in, gather diverse resources, and support the development of the marine economy.

The industrial heritage cultural and tourism zone mainly utilizes large-scale industrial factory buildings in the current state, combining industrial culture and industrial memory to create a sports and leisure industrial heritage park.

The ecological restoration zone is located on the eastern side of the site and makes use of important docks and waterfront advantages. Through ecological restoration and other methods, it creates an ecological garden.

The Urban Vitality Square is located at the core of the site, utilizing the site's existing Dock No. 1 and Dock No. 2, in conjunction with the original material storage area within the site, to create an Urban Vitality Square that catalyzes the rejuvenation of the entire shipyard.

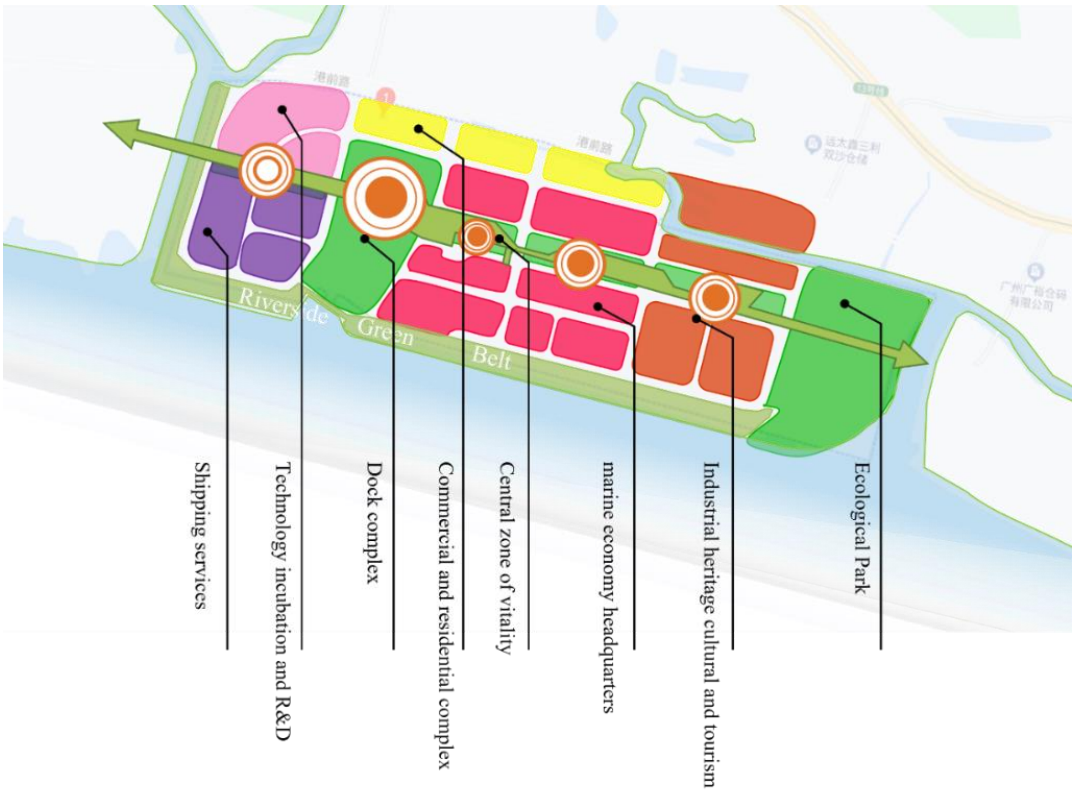


Figure 5-31 Functional Structure Plan (Source:Seft-Drawn by the Author)

(2) Public Spaces (Surface Catalyst Carriers)

Inside the Wenchong Shipyard, large areas of surface space were preserved due to industrial production requirements. These spaces were designed as plazas with diverse forms and functions, catering to various needs of the people. Additionally, they serve as focal points, revitalizing the entire cluster.

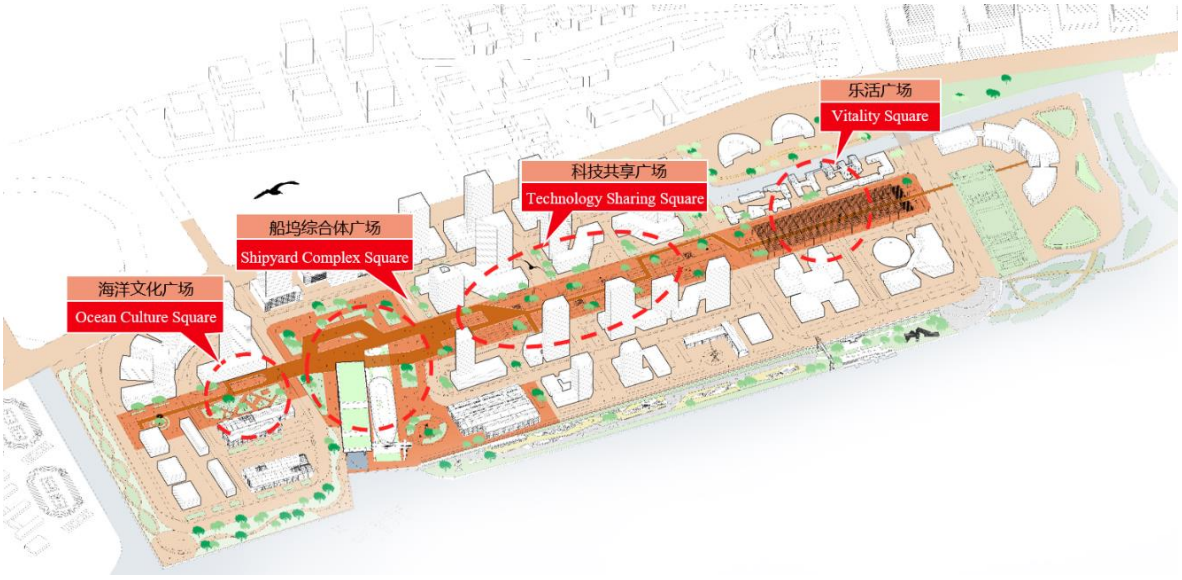


Figure 5-32 Design of Wenchong Shipyard Interior Courtyard Renovation
(Source:Seft-Drawn by the Author)

(3) Central Activity Belt (Linear Catalyst)

Centered around the City Vitality Plaza formed by the Dock No. 1and Dock No. 2, a network of spatial organization and multi-level corridors connects the industrial heritage sites with major functional clusters. Simultaneously, different-themed plazas are integrated along the Central Activity Belt, enhancing the richness and experiential quality of pedestrian routes.

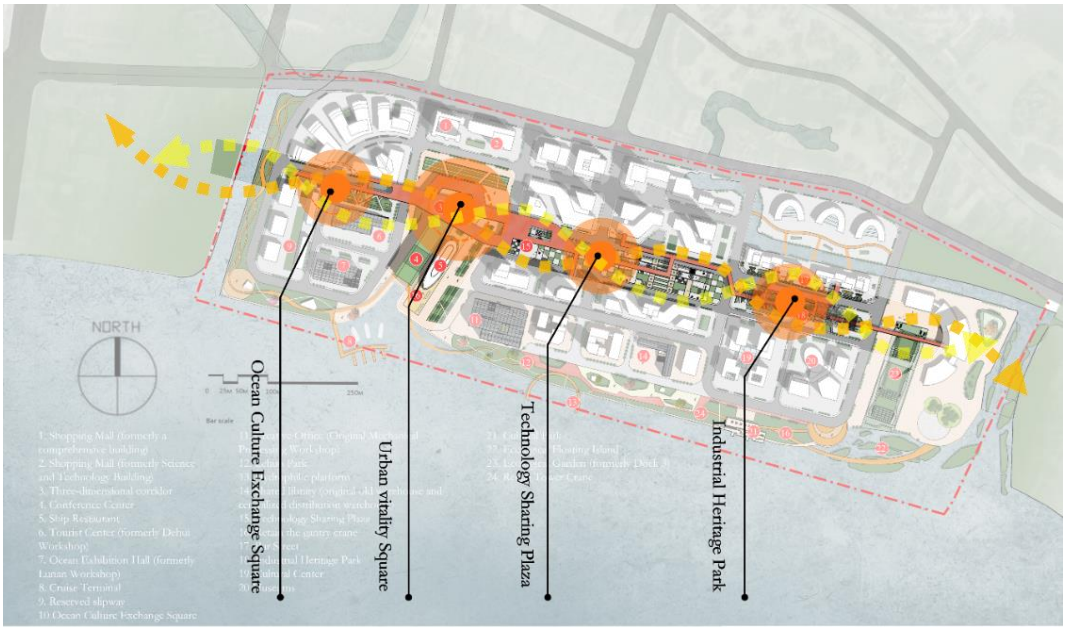


Figure 5-33 Central Activity Belt After the Renovation of Wenchong Shipyard
(Source:Seft-Drawn by the Author)

(4) Riverside Green Belt (Line Catalyst)

The Riverside Green Belt is a green landscape corridor along the Pearl River's northern bank. It is arranged in sequence with the Wharf Park, the Leisure Culture Park, and the Ecological Park. The functional layout corresponds to each section, forming four different themed parks. The riverside landscape permeates into the site, connecting with the Central Vitality Zone, providing a diverse range of experiences.

Figure 5-34 Riverside Green Belt After the Renovation of Wenchong Shipyard
(Source:Seft-Drawn by the Author)

(5) Functionality Renovation of Preserved Buildings(Point Catalyst)

The industrial factory buildings retained within Wenchong Shipyard possess varying spans and internal spatial characteristics. These buildings are subject to functional renewal based on their individual features and the functions of the respective clusters, thereby endowing them with new purposes and rejuvenating their vitality.

The Dehui Workshop, situated to the west of Dock No. 2, was originally used for small-scale operations, involving the pre-assembly of equipment and components for ship sections. It features a dual-span structure and comprises three stories in total. After renovation, the Dehui Workshop will serve as a visitor center catering to the entire Maritime Cluster.

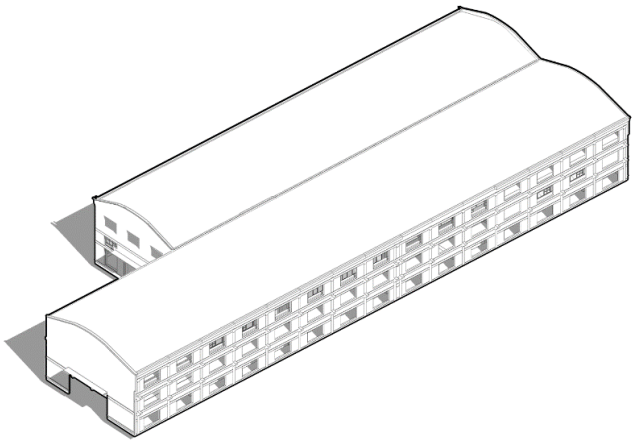


Figure 5-35 Original Appearance of Dehui Workshop (Source:Seft-Drawn by the Author)

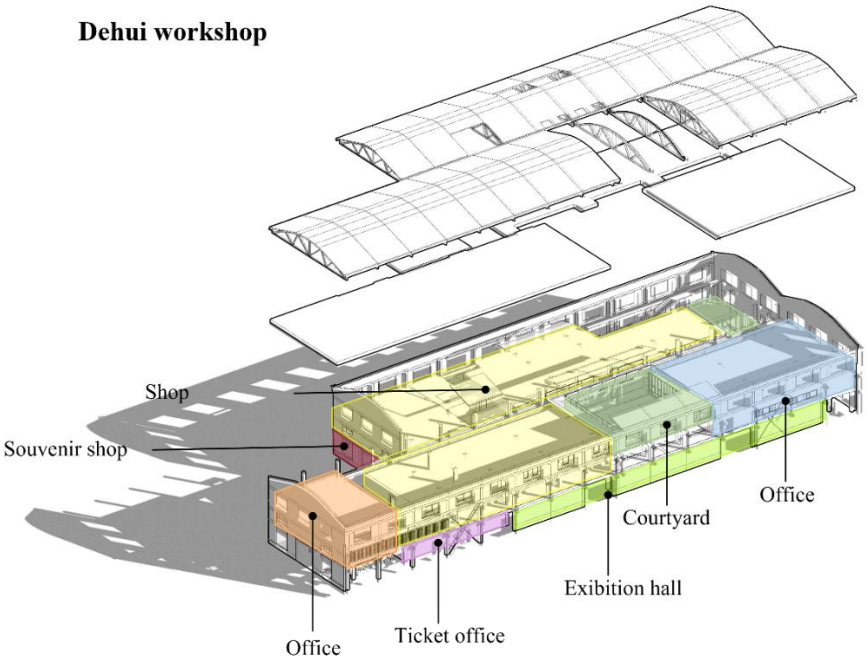


Figure 5-36 Functional Zoning of Dehui Workshop After Renovation
(Source:Seft-Drawn by the Author)

The Lun'an Workshop is located south of the Dehui Workshop and offers a good waterfront view. Its original function was similar to that of the Dehui Workshop, responsible for the pre-outfitting of ship sections. The workshop has a double-span, single-story layout. After renovation, the Lun'an Workshop serves as a small maritime exhibition hall, showcasing ship history and maritime culture to visitors.

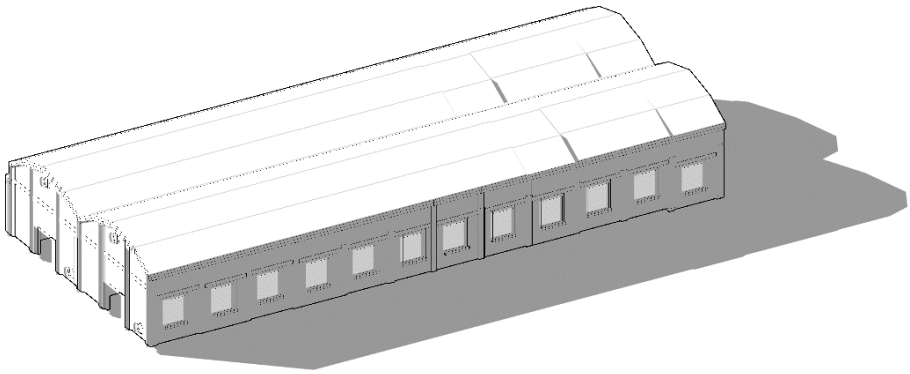


Figure 5-37 Original Appearance of Lunan Workshop (Source:Seft-Drawn by the Author)

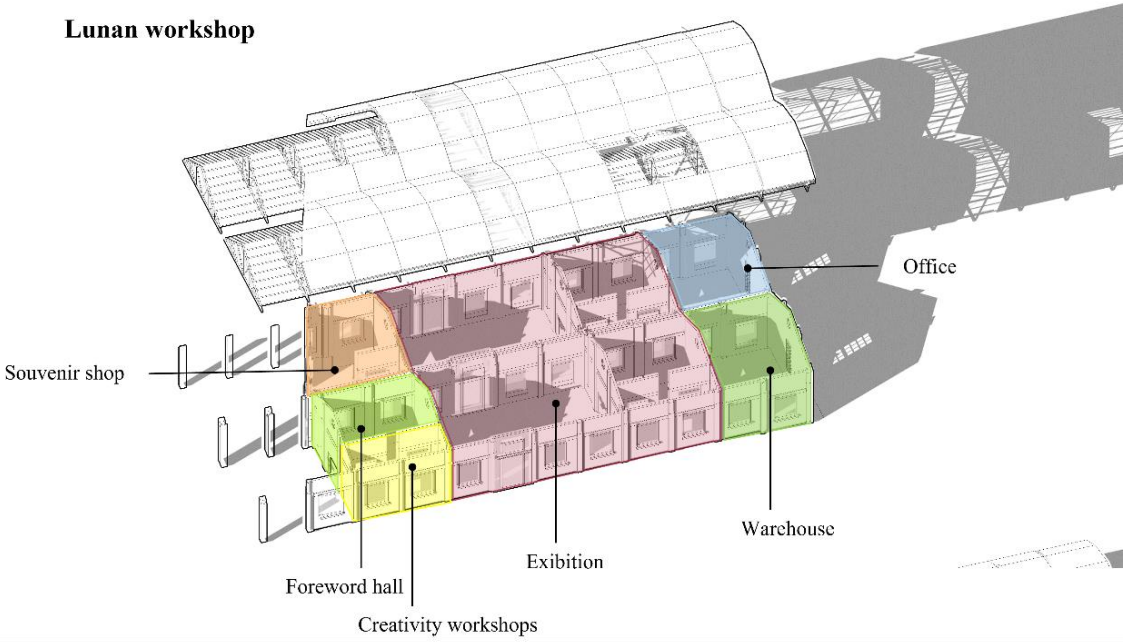


Figure 5-38 Functional Zoning of Lunan Workshop After Renovation
(Source:Seft-Drawn by the Author)

The Mechanical Machining Workshop is located on the east side of the first dry dock, near the Pearl River, originally used for cutting ship components and assembly. The workshop features a four-span, three-story large-span structure. After renovation, it is part of the Marine Economy Headquarters cluster and, given its waterfront location, serves as a creative co-working space.

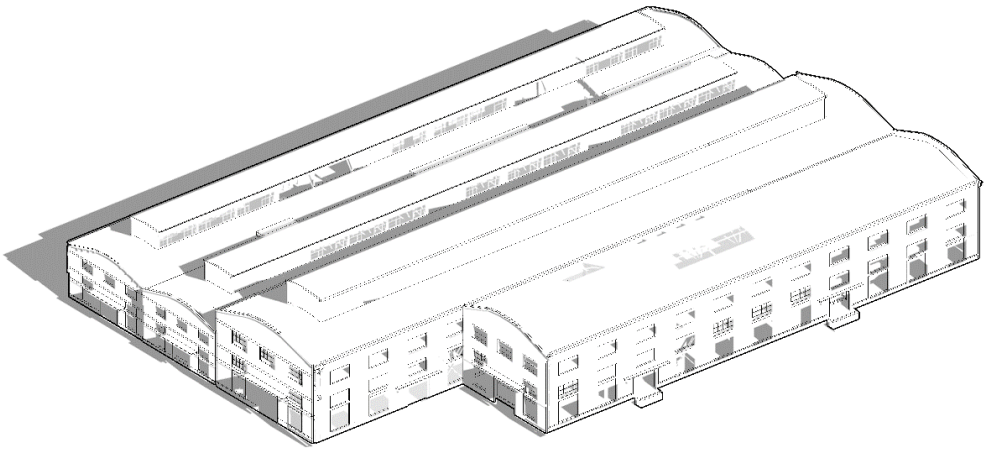


Figure 5-39 Original Appearance of Machine Workshop (Source:Seft-Drawn by the Author)

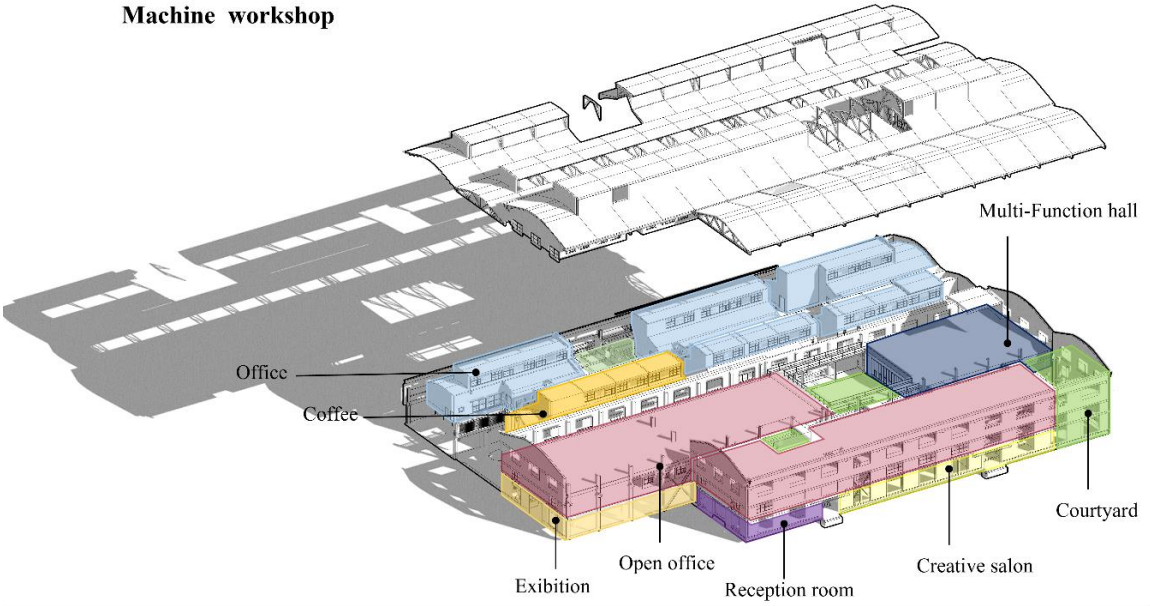


Figure 5-40 Functional Zoning of Machine Workshop After Renovation
(Source:Seft-Drawn by the Author)

The old warehouse and distribution warehouse are located by the Pearl River and were originally used for storing raw materials. They have a single-span, two-story structure with a small span. After renovation, the old warehouse and distribution warehouse have been transformed into a riverside shared library, closely integrated with the riverside green belt, and open to the public.

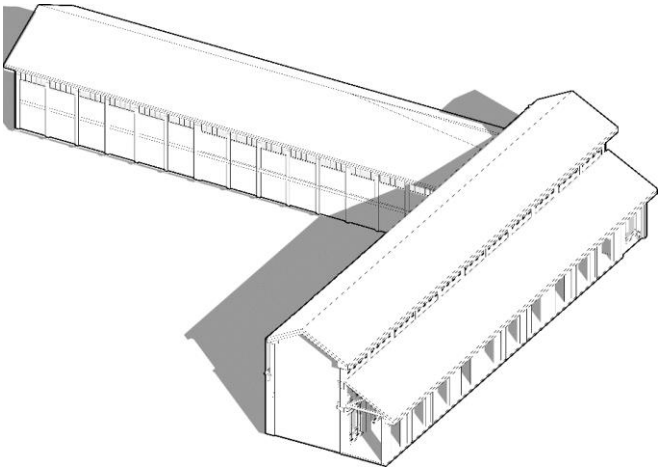


Figure 5-41 Original Appearance of Old Warehouse and Distribution Warehouse
(Source:Seft-Drawn by the Author)

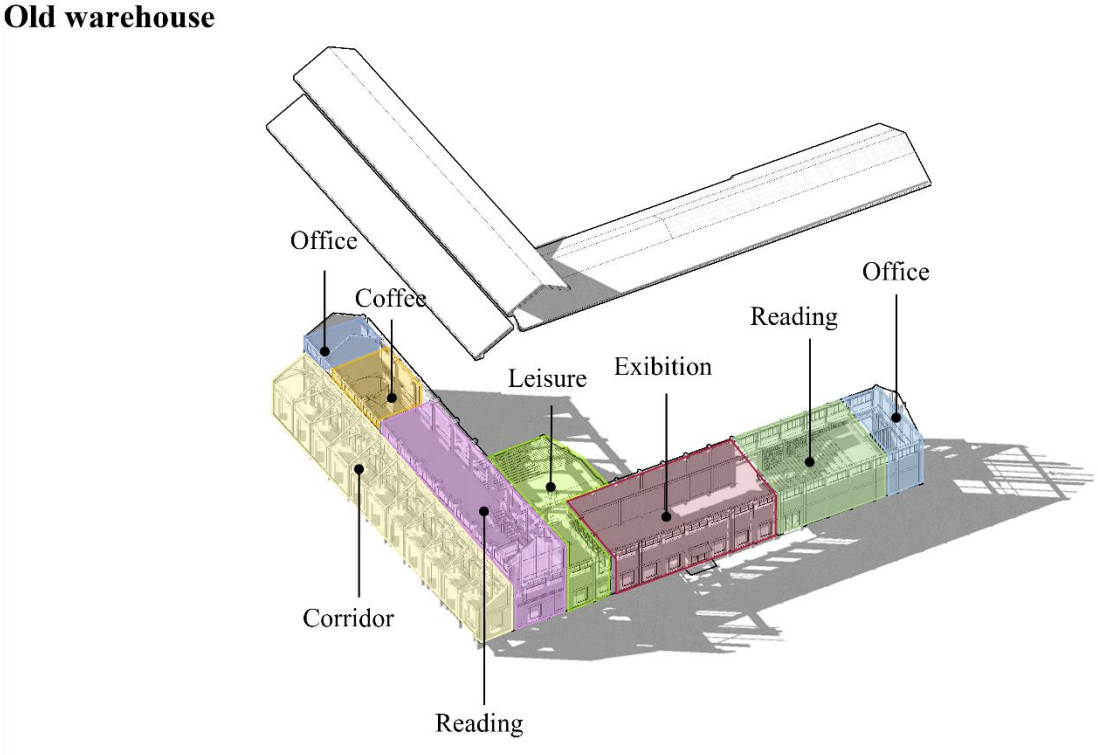


Figure 5-42 Functional Zoning of Old Warehouse and Distribution Warehouse After Renovation
(Source:Seft-Drawn by the Author)

The Technology Building and the Complex Building are located at the main entrance of the Wenchong Shipyard, with a prime and easily accessible location. Originally, they were two office buildings constructed with reinforced concrete frame structures. During the renovation, these two office buildings were preserved and transformed into two shopping malls, enhancing their significance as the main entrance landmarks.

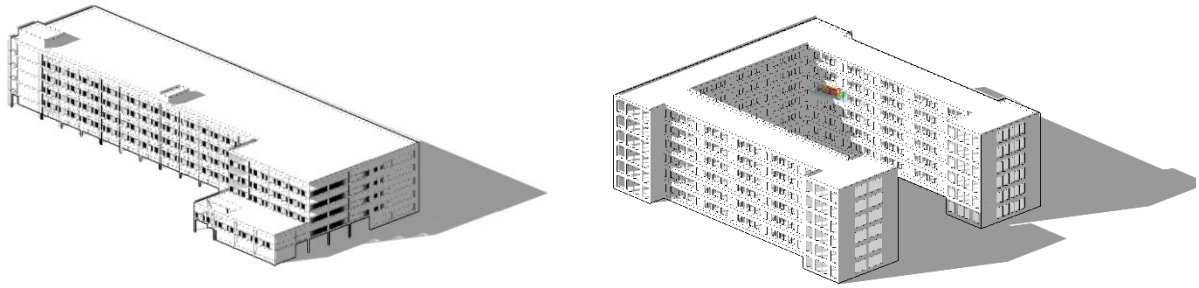


Figure 5-43 Original Appearance of the Technology Building and the Complex Building (Source:Seft-Drawn by the Author)

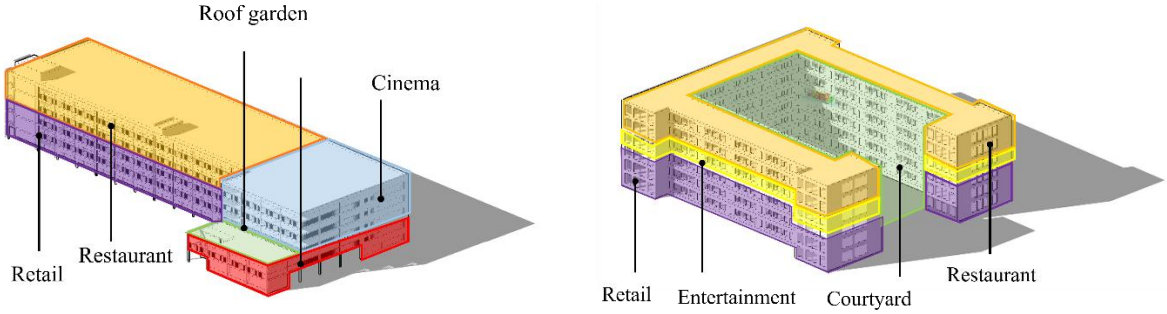


Figure 5-44 Functional Zoning of the Technology Building and the Complex Building After Renovation (Source:Seft-Drawn by the Author)

Inside Wenchong Shipyard, there are many gantry cranes and tower cranes, which are essential equipment for ship manufacturing. Some of them have been preserved as landmarks, showcasing the industrial culture of Wenchong Shipyard.

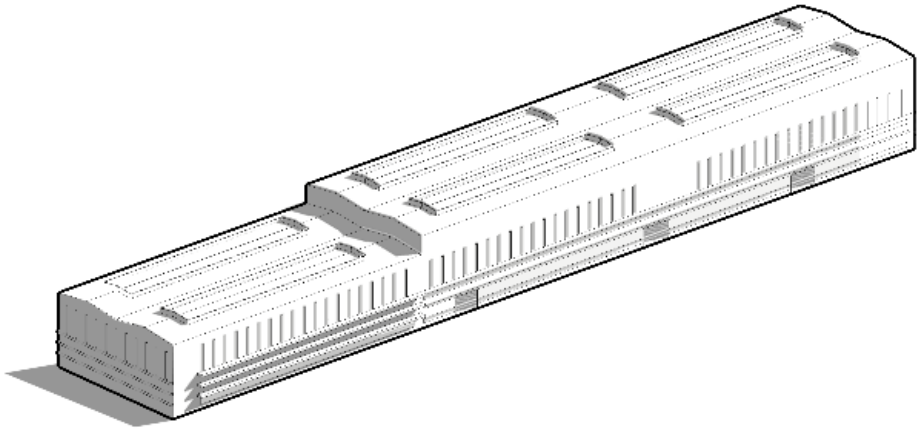


Figure 5-45 Original Appearance of the New Shipyard Workshop (Source:Seft-Drawn by the Author)

Figure 5-46 Functional Zoning of the New Shipyard Workshop After Renovation - Industrial Heritage Park (Source:Seft-Drawn by the Author)

5.5.2 Implantation of Cultural Elements into Catalyst Carriers

(1) Themed Squares (Surface Catalyst)

The Dock NO.1 and the Dock NO.2 both outstanding industrial heritage sites, have been preserved in their entirety and transformed into urban vitality squares. These two docks have been renovated into ship-themed restaurants and business exchange centers, featuring sunken squares, vibrant squares, as well as natural landscapes like rooftop gardens and relaxation lawns.

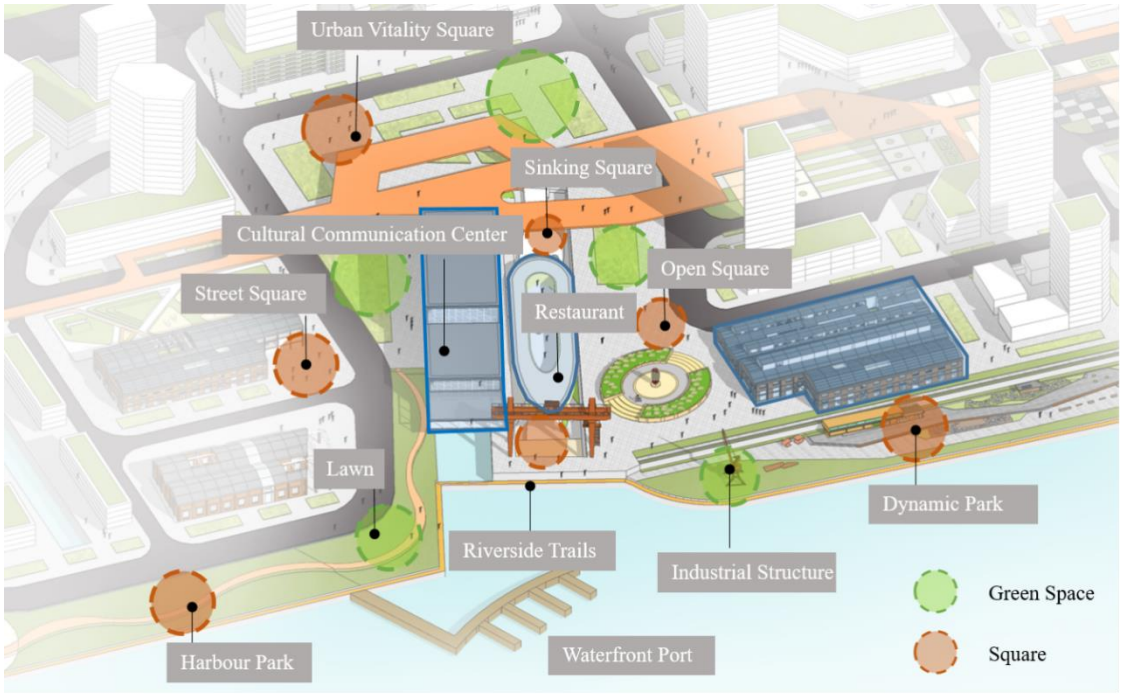


Figure 5-47 the Layout of the Shipyard Complex (Source:Seft-Drawn by the Author)

(2) Industrial Heritage Corridor (Line Catalyst)

Within the Wenchong Shipyard, there are five structurally robust and well-preserved buildings: the Lun'an Workshop, Old Warehouse, Machine Workshop, Dehui Workshop, and Distribution Warehouse. These buildings vary in size and span, showcasing typical industrial characteristics. Originally, these buildings were arranged based on the ship's production process. During the renovation process, utilizing large strip-like spaces to connect these heritage buildings, creating an Industrial Heritage Corridor that can vividly demonstrate the ship production process. Combining the heritage itself and the surrounding planning conditions, different themed and functional nodes are established, creating a green steel landscape corridor that integrates interactivity, cultural elements, experiential features, and entertainment.

Figure 5-48 Industrial Heritage Corridor in Wenchong Shipyard After Renovation
(Source:Seft-Drawn by the Author)

(3) Preservation and Renovation of Existing Buildings and Structures (Point Catalyst)

The industrial heritage buildings preserved within the factory area include the Lunan Workshop, Dehui Workshop, Old Warehouse, Distribution Warehouse, and the MachineWorkshop. The retained industrial equipment includes gantry cranes and tower cranes. These industrial heritage buildings are relatively old, mostly dating back to the 1970s and 1980s, bearing witness to a certain period in the history of Wenchong Shipyard and possessing strong industrial memories.

In this renovation design, the existing industrial heritage buildings underwent exterior repairs and structural reinforcement based on their current condition. The Lunan Workshop, originally

a single-story factory with a mostly closed white exterior, had parts of its roof hollowed out to create an internal courtyard. A section of the front of the workshop was partially removed to expose the structure, and the updated facade is now red brick. Additionally, part of the roof was replaced with a glass roof to improve interior lighting.

The Machine Workshop, with its large span and poor internal lighting and ventilation, underwent similar changes. The old blue exterior was replaced with brick walls, and parts of the roof were hollowed out to introduce courtyards for improved lighting and ventilation.
In addition to the changes mentioned above, the Dehui Workshop had its ground-level space partially elevated, creating a contrast between solid and void on the facade, enhancing its exterior appearance.

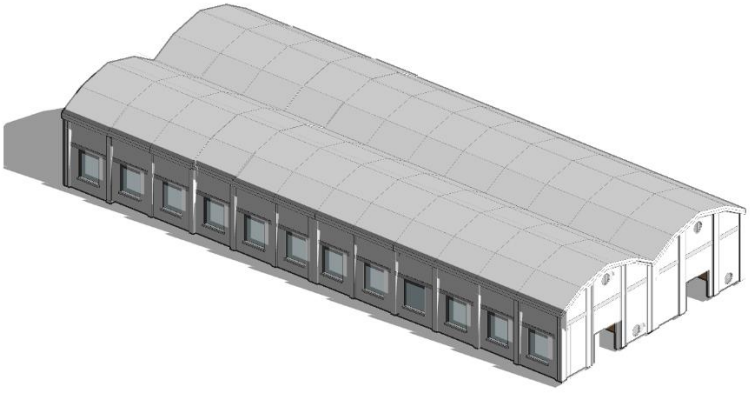


Figure 5-49 Original Appearance of Lunan Workshop
(Source:Seft-Drawn by the Author)

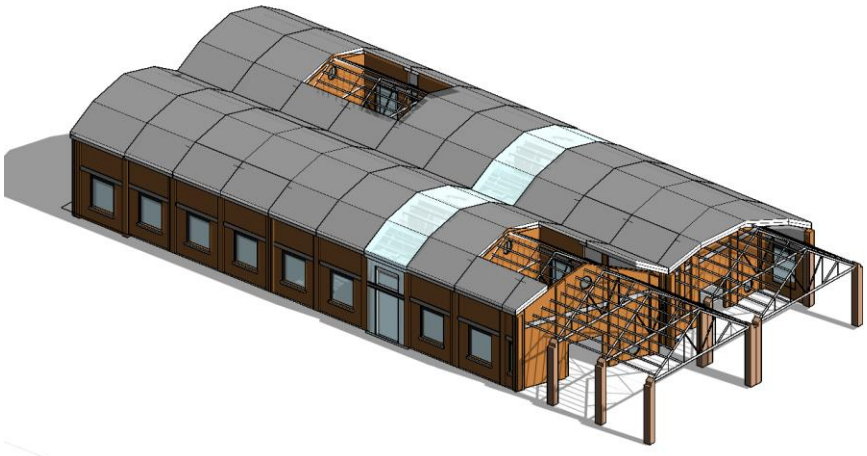


Figure 5-50 the Lunan Workshop After Renovation
(Source: Self-Drawn by the Author)

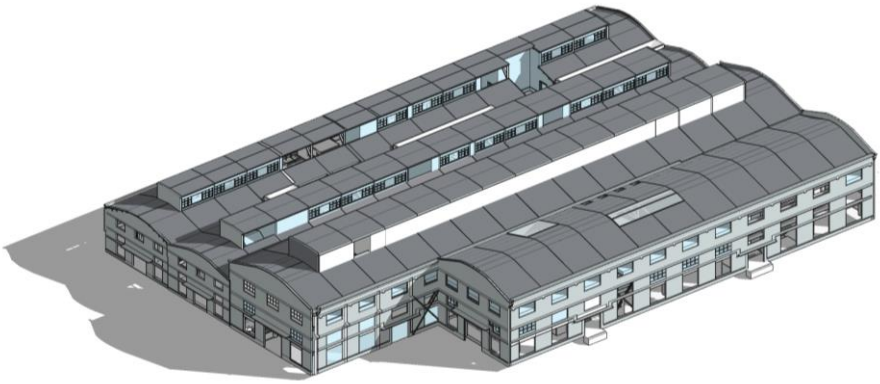


Figure 5-51 Original Appearance of Machine Workshop
(Source:Seft-Drawn by the Author)

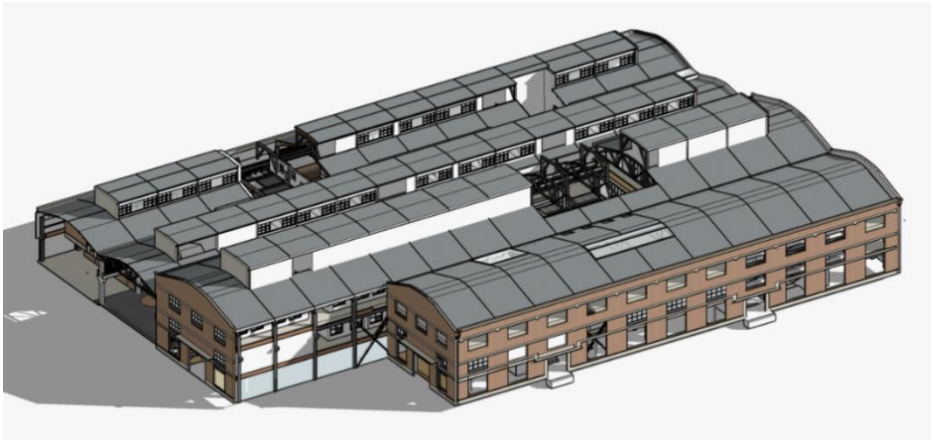


Figure 5-52 the Machine Workshop After Renovation
(Source: Self-Drawn by the Author)

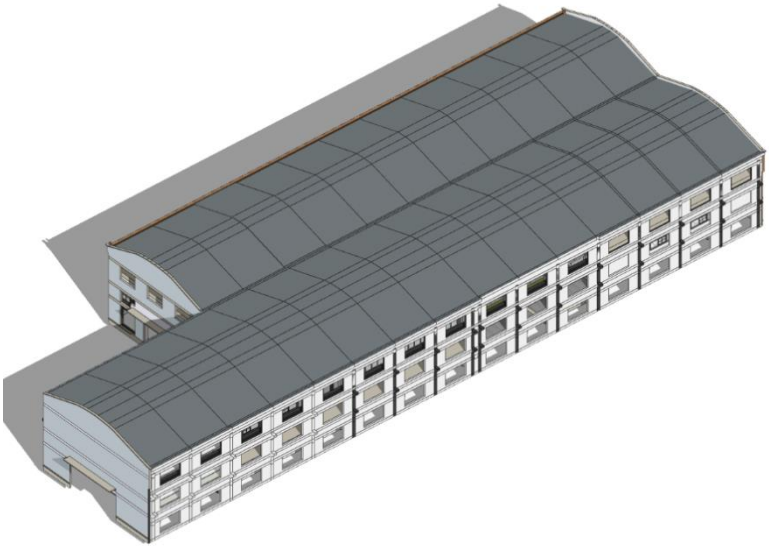


Figure 5-53 Original Appearance of Dehui Workshop
(Source:Seft-Drawn by the Author)

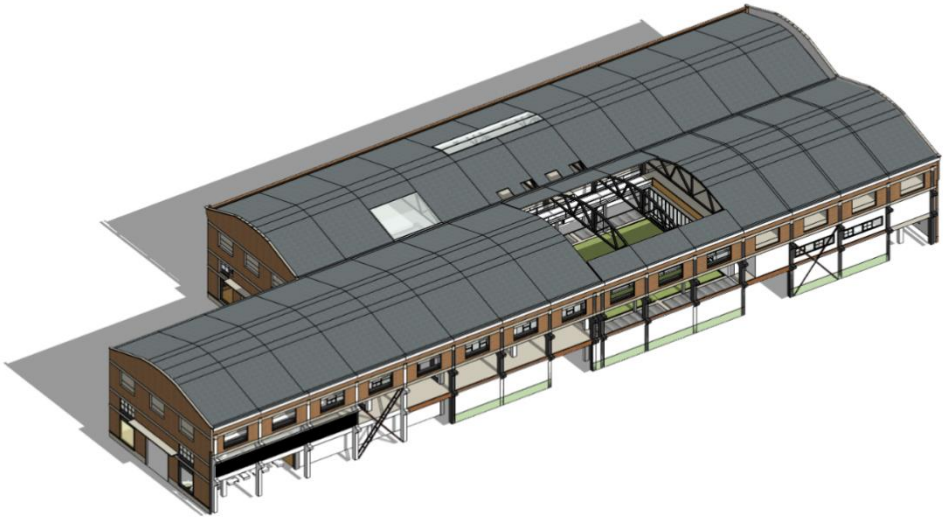


Figure 5-54 the Dehui Workshop After Renovation
(Source: Self-Drawn by the Author)

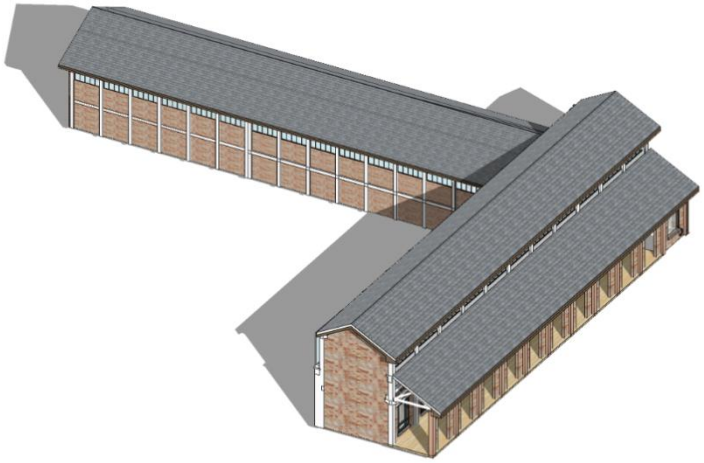


Figure 5-55 Original Appearance of Old Warehouse and Distribution Warehouse
(Source:Seft-Drawn by the Author)

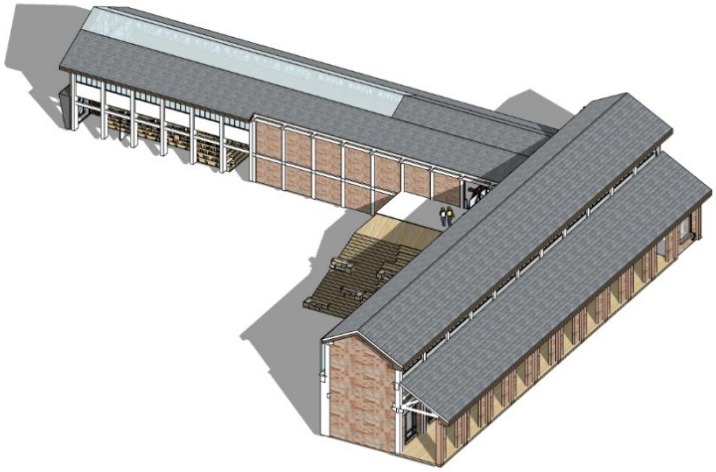


Figure 5-56 the Old Warehouse and Distribution Warehouse After Renovation
(Source: Self-Drawn by the Author)

Inside Wenchong Shipyard, there are many gantry cranes and tower cranes, which are essential equipment for ship manufacturing. Some of them have been preserved as landmarks, showcasing the industrial culture of Wenchong Shipyard.

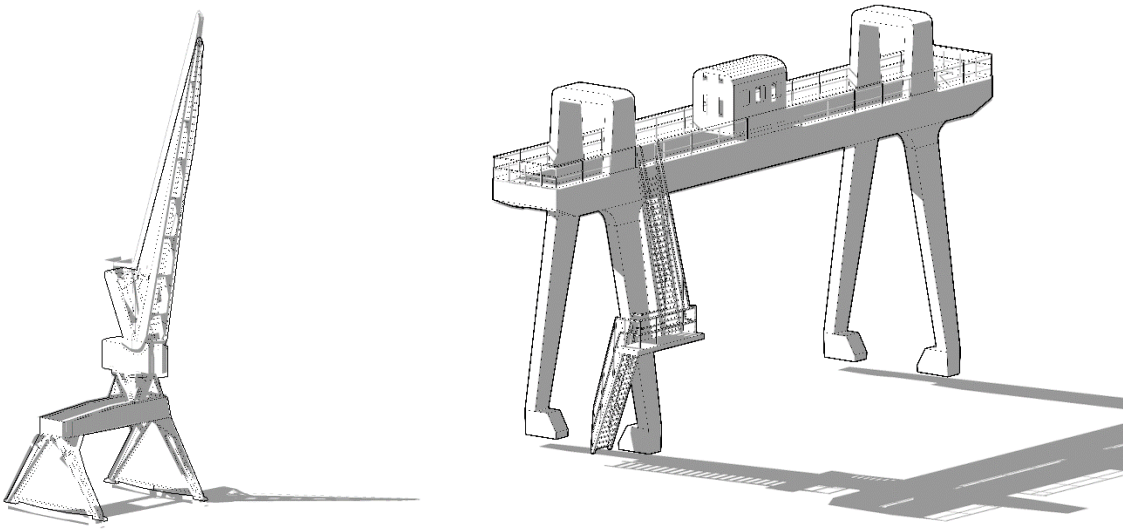


Figure 5-57 Original Appearance of gantry cranes and tower cranes
(Source: Self-Drawn by the Author)

Figure 5-58 Original Appearance of gantry cranes and tower cranes
(Source: Self-Drawn by the Author)

5.5.3 Implantation of Ecological Elements into Catalyst Carriers

(1) Ecological Park (Surface Catalyst)

The Dock NO.3, an important industrial heritage within the factory area, has been preserved. Based on this dry dock, an ecological park has been designed. It includes a riverside boardwalk

and wetland floating islands for both citizens and wildlife, aimed at restoring the ecological environment while also serving as flood control for the site.

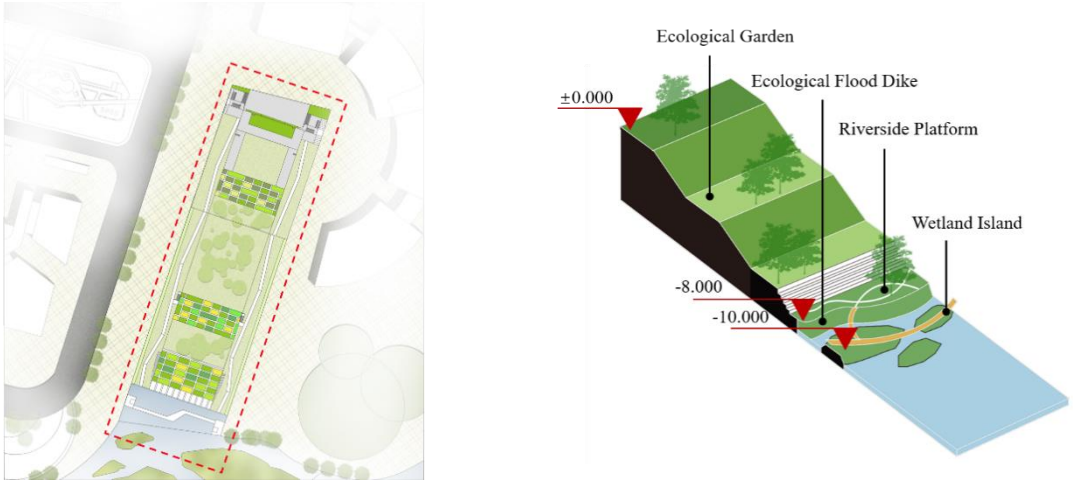


Figure 5-59 Ecological Park -the Dock NO.3 after Regeneration
(Source:Seft-Drawn by the Author)

(2) Riverside Landscape Corridor (Line Catalyst)

The Riverside Leisure Belt provides a rich and diverse continuous open waterfront activity space for local residents, office workers, and visiting tourists, taking into account water quality and the threats posed by flooding to the site. Here, people can experience water-based activities, enjoy views of the river, immerse themselves in industrial culture and artistic influences, get closer to nature, and learn about wetlands.

To meet people's desire for waterfront experiences, a continuous network of slow pathways, including sidewalks and non-motorized lanes, has been established along the waterfront area, achieving a true separation of pedestrians and vehicles. This provides a continuous, safe, and comfortable green landscape path and waterfront leisure path. Additionally, secondary slow pathways have been established to ensure a network of green pedestrian public spaces, connecting various functional zones within the site, creating a comprehensive and safe slow living path.

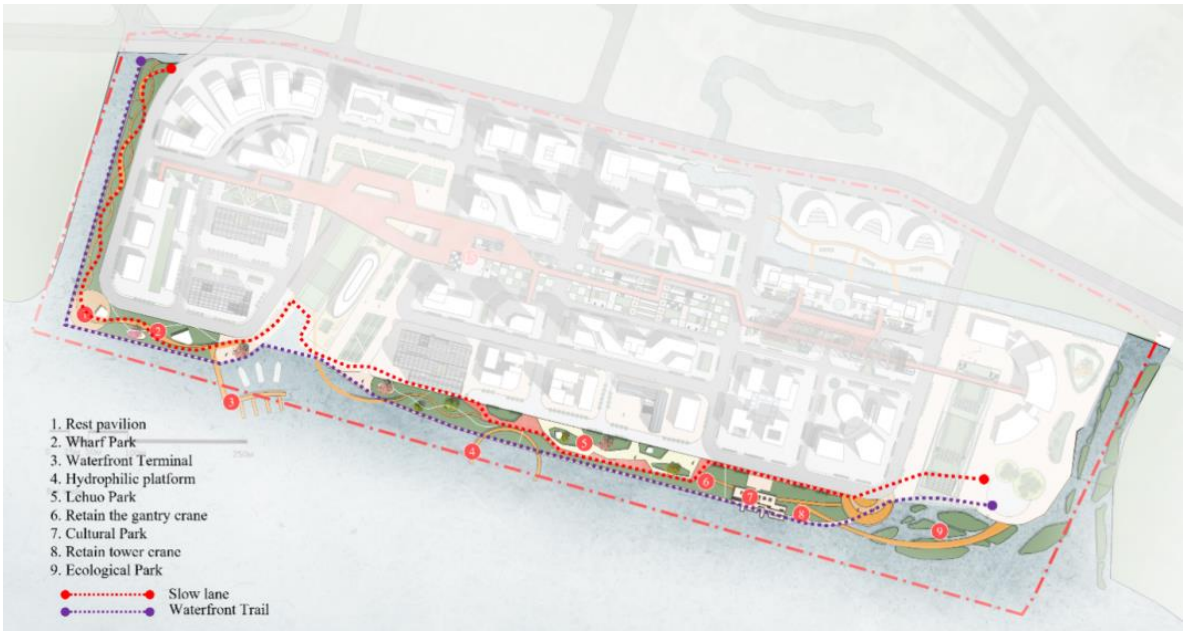


Figure 5-60 Waterside Green Belt After Renovation of Wenchong Shipyard
(Source:Seft-Drawn by the Author)

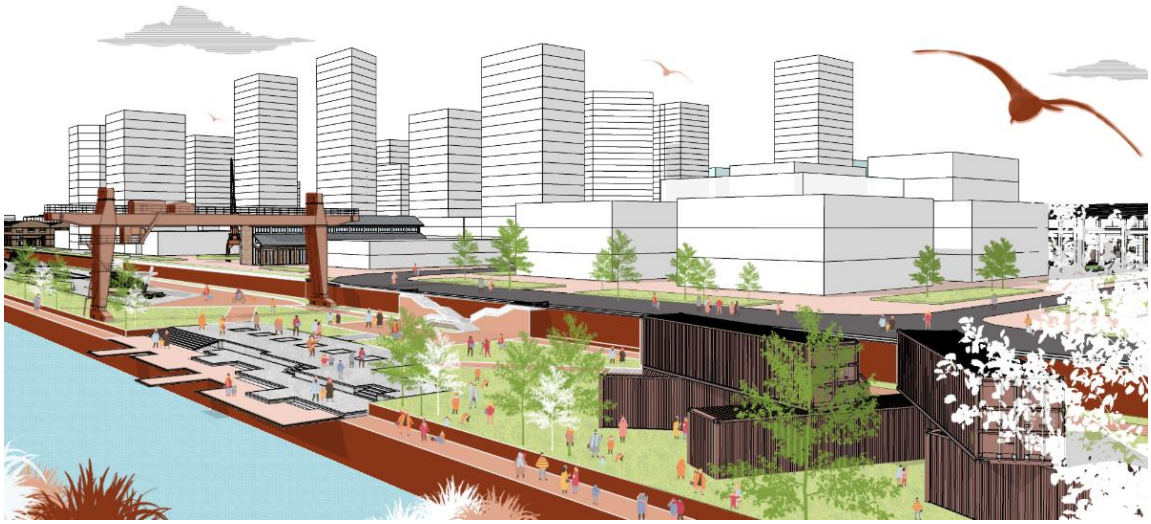


Figure 5-61 Riverside Cultural Park After Renovation of Wenchong Shipyard
(Source:Seft-Drawn by the Author)

Figure 5-62 Riverside Harbour Park After Renovation of Wenchong Shipyard
(Source:Seft-Drawn by the Author)

Figure 5-63 Riverside Leisure Park After Renovation of Wenchong Shipyard
(Source:Seft-Drawn by the Author)

5.5.4 Reshaping Public Spaces

(1) Plazas

In addition to transforming existing open spaces within the factory area into smaller plazas such as the Urban Vitality Plaza, three large plazas have been incorporated along the Central Vitality Axis in this planning. Each plaza has a unique design theme to cater to various activity needs

of the people. Among them, the Sports Plaza has been created by demolishing and repurposing the new shipbody workshop within the original factory area, incorporating sports facilities such as a basketball court on its original site. The Technology Plaza is located within the Marine Economic Headquarters area, adjacent to the Urban Vitality Plaza. These plazas constitute new catalyst points within the factory area, interconnected by the Central Vitality Belt and elevated walkways, influencing the entire factory area.

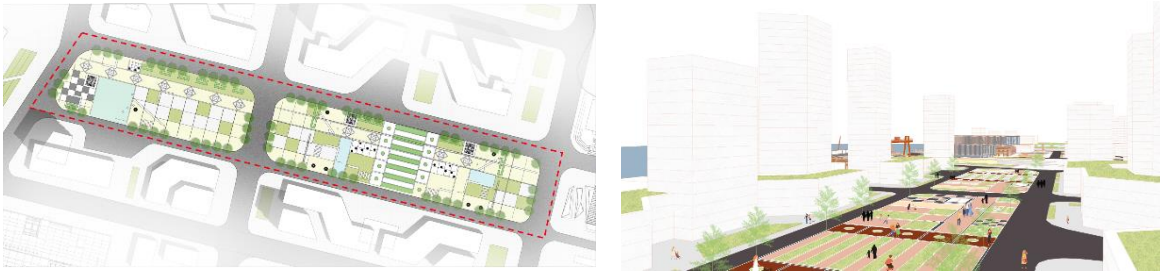


Figure 5-64 The Design of the Technology Plaza (Source:Seft-Drawn by the Author)

Figure 5-65 The Design of the Sports Plaza (Source:Seft-Drawn by the Author)

5.5.5 Reshaping the Transportation System

The current plan preserves the internal roads of the factory area while optimizing the vehicular road network. Building upon this foundation, an extensive ground-level pedestrian system has been designed, connecting the waterfront spaces with the city. Additionally, elevated walkways have been designed at approximately the height of the first floor to enhance the pedestrian experience.

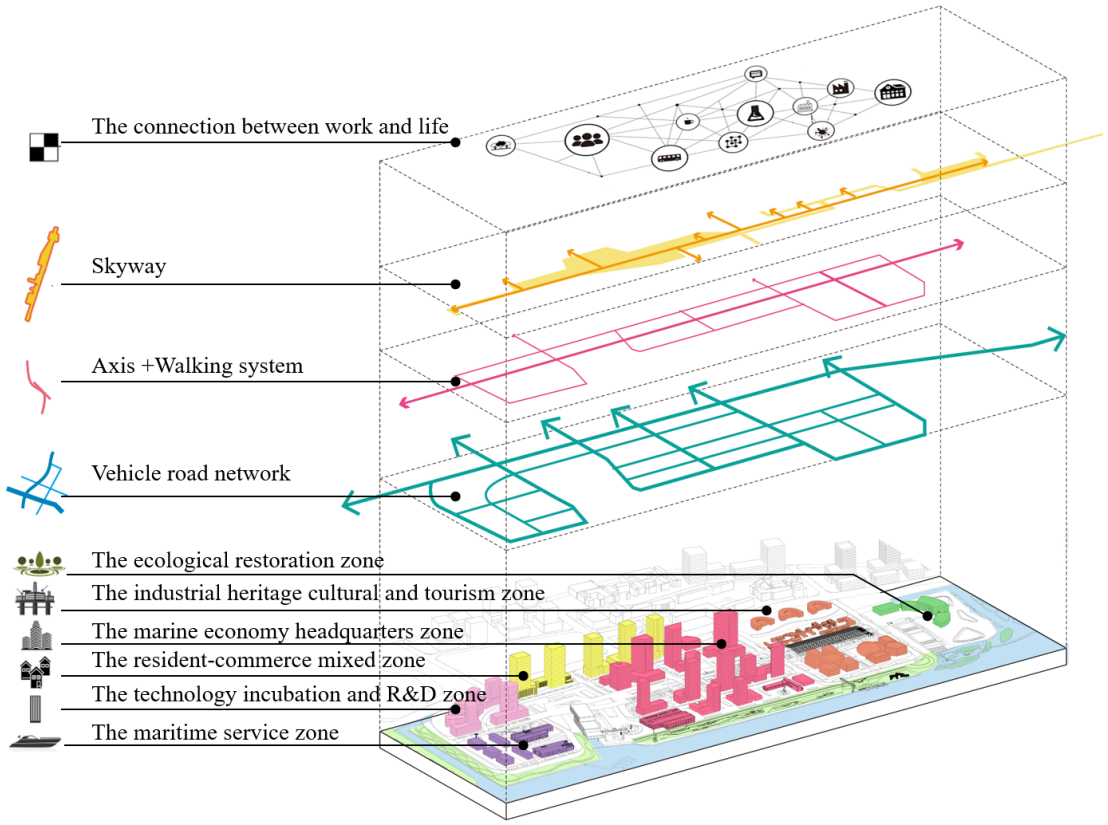


Figure 5-66 Spatial Structure Diagram of the Plan (Source:Seft-Drawn by the Author)

5.5.6 Constructing new buildings

On the north side of the site, there is a river, and the original factory cafeteria was built along the river. Considering the excellent landscape and accessibility in this area, a bar street has been designed, following the architectural texture of the original site, with the buildings facing east and west. Several enclosed gray spaces have been created inside, providing opportunities for various outdoor activities.

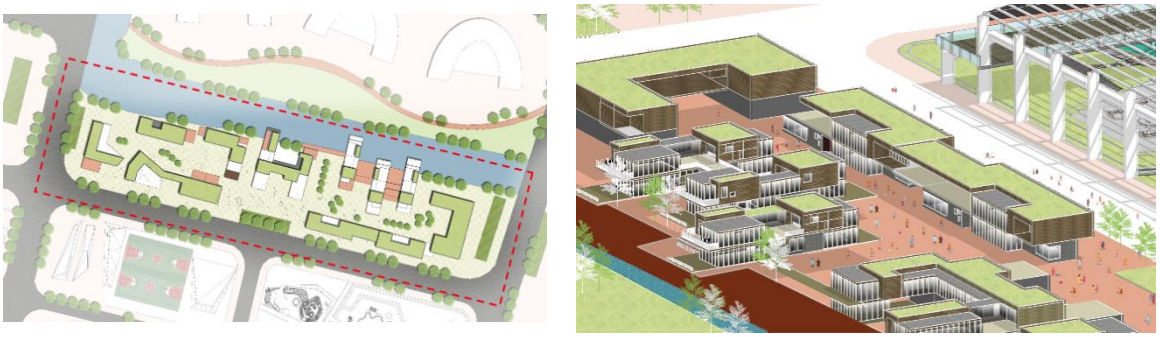


Figure 5-67 The Design of the Bar Street (Source:Seft-Drawn by the Author)

5.6 Regeneration Design for Wenchong Shipyard

Figure 5-68 Wenchong Shipyard Renovation Master Plan
(Source:Seft-Drawn by the Author)

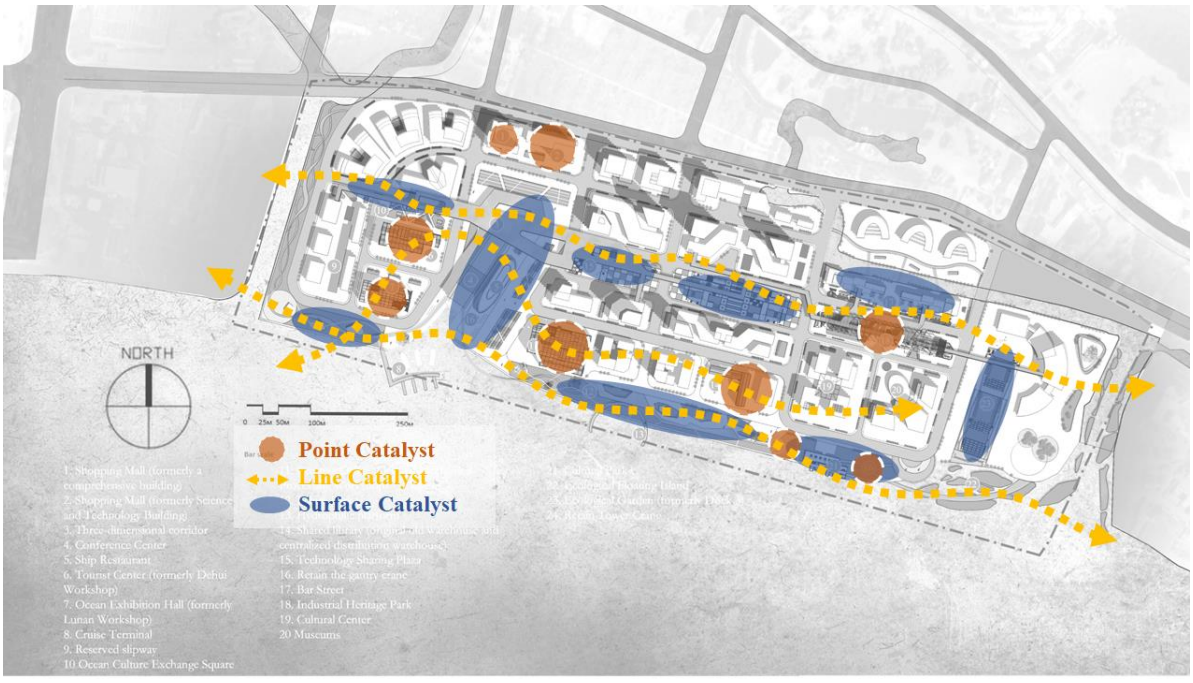


Figure 5-69 Concept of Catalyst Elements within the Renovated Wenchong Shipyard
(Source:Seft-Drawn by the Author)

Figure 5-70 Aerial View of Wenchong Shipyard After Renovation
(Source:Seft-Drawn by the Author）

5.7 Control and Guidance of Catalyst Effects

The role of catalysts cannot be achieved simply by aggregating catalyst elements. It operates in stages within the project and the city, and this process can be guided. In the phased construction plan, the chain reaction of catalysts is guided primarily based on economic benefits and human behavior. The specific process can be summarized as the progressive impact of "element - factory area - city." These stages include the technology incubation and research development zone, shipping service zone, maritime economic headquarters zone, mixed-use complex, industrial heritage and cultural tourism zone, ecological restoration zone, waterfront leisure belt, and urban vitality square.

Based on optimized funding allocation and expected catalyst reactions, the project can be constructed in three phases. In the first phase, the construction includes the urban vitality square, mixed-use complex cluster, shipping service zone, technology incubation and research development zone, and guiding catalysts around the main entrance. In the second phase, the focus shifts to gradually perfecting the maritime economic headquarters zone and industrial

heritage and cultural tourism cluster, as well as inter-cluster guiding catalysts, along with assessments of the economic, cultural, and environmental conditions upon completion. In the third phase, considering catalyst development and assessment results, the construction scale of the ecological restoration zone is contemplated. Site may be replanned if necessary to expand or enhance functional catalysts with insufficient construction or increased demand, ultimately completing the factory area development.

As the phased construction progresses, the role of catalysts is sequentially manifested. This process can be roughly simulated in three stages.

5.7.1 Phase One: Catalyst Reaction Control and Guidance

Considering the limited impact of the initial construction phase, the first step in Phase One is to establish the project's image and distinctive cultural identity, enhancing the area's recognizability and laying the foundation for people's initial awareness of the project(Figure 5-63).

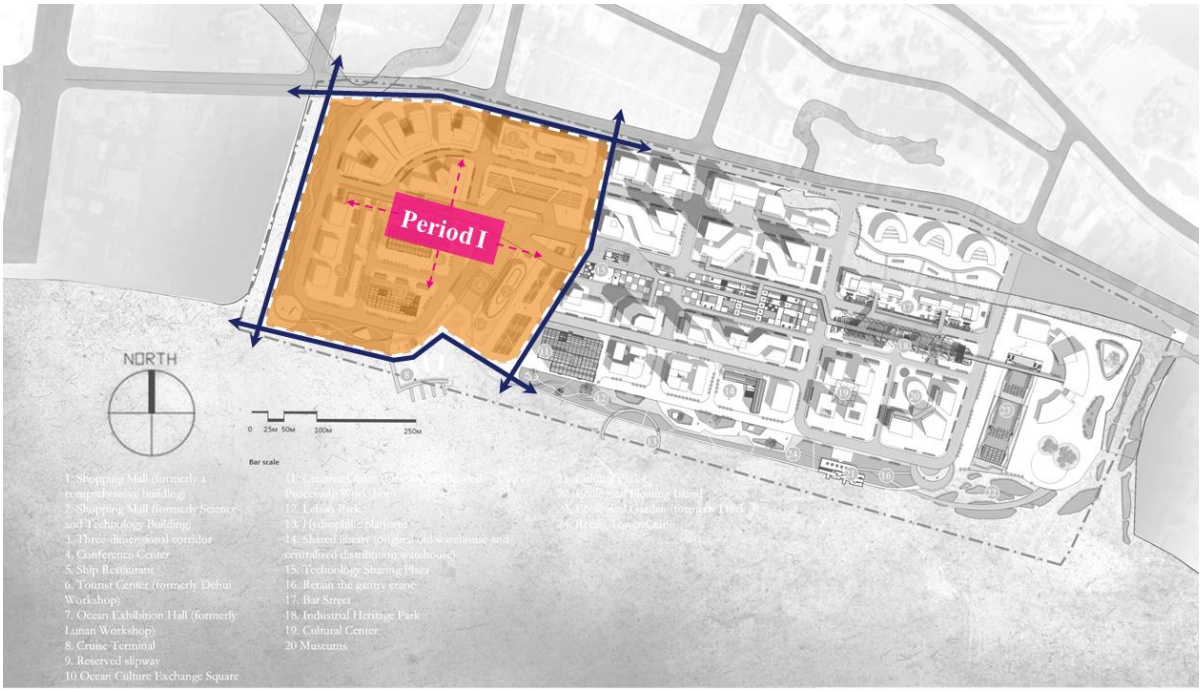


Figure 5-71 Phase One Construction Area of Wenchong Shipyard Renovation
(Source:Seft-Drawn by the Author)

5.7.2 Phase Two Catalyst Reaction Control and Guidance

After the construction and initial operation of Phase One, the primary catalyst begins to take effect.

In Phase Two, adjustments are made to the spatial layout and functions based on the dynamic changes in the tourist population, cultural consumption, and consumer demographics. Commercial and industrial office functions are introduced to provide services to the surrounding residents and promote economic development within the park. The addition of spaces like dining areas, shopping centers, and industrial offices contributes to the economic growth of the area. Simultaneously, the introduction of landscape features such as culinary culture squares, observation towers, and recreational green spaces enhances the vibrancy of the area, expanding the catalytic effect.

During this phase, the environmental catalyst effect is maximized as the vegetation grows, and the micro-ecosystem takes shape. Industrial structures gradually blend with natural landscapes, creating a harmonious spatial sequence. The refinement of landscape axes and shopping flow lines further facilitates the revitalization of the site in terms of society, culture, and economy(Figure 5-64).

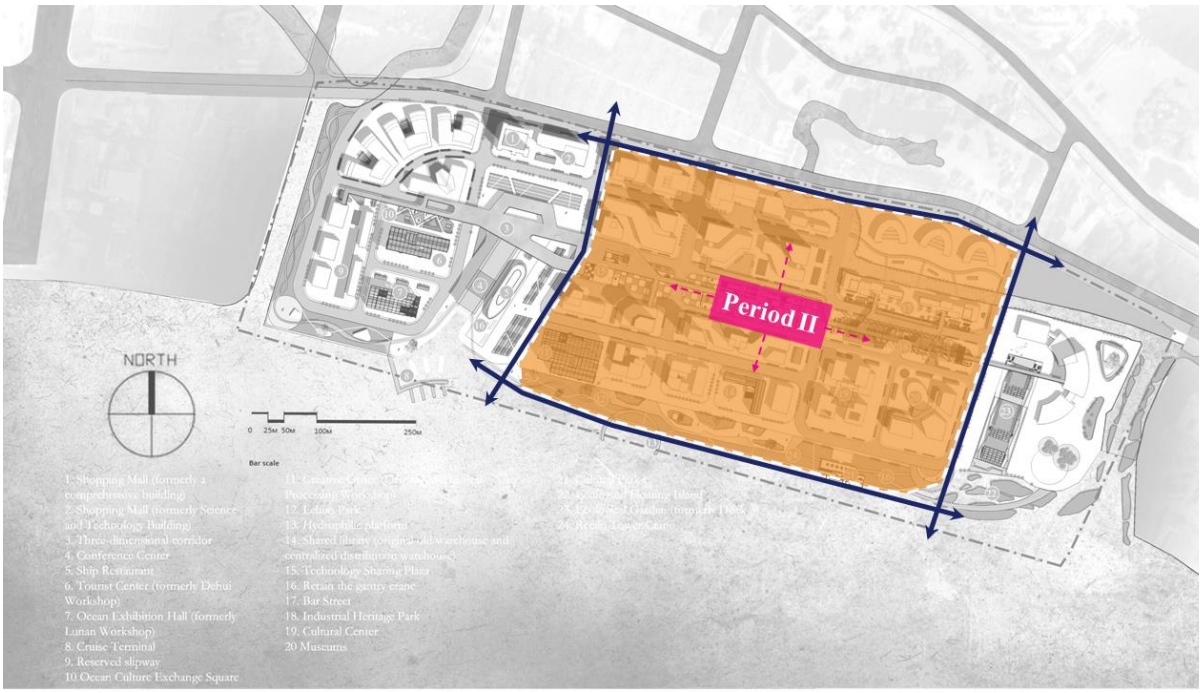


Figure 5-72 Phase Two Construction Area of Wenchong Shipyard Renovation
(Source:Seft-Drawn by the Author)

5.7.3 Phase Three Catalyst Response Control and Guidance

The third phase primarily involves the enrichment of park space functions through the Art Exhibition Center and the tourist boat terminal, creating an ecological landscape environment to activate site vitality and promote the integrated development of industrial, commercial, and business functions in the park. With the catalytic effect of the catalyst and subsequent control adjustments, industrial heritage is transformed into an urban complex that integrates business, exhibitions, dining, culture, and industry. Through this progressive and phased development, subsequent updates can be adjusted based on feedback from earlier updates, guiding the continuous activation of catalysts and promoting site vitality and economic recovery at Wenchong Shipyard(Figure 5-65).

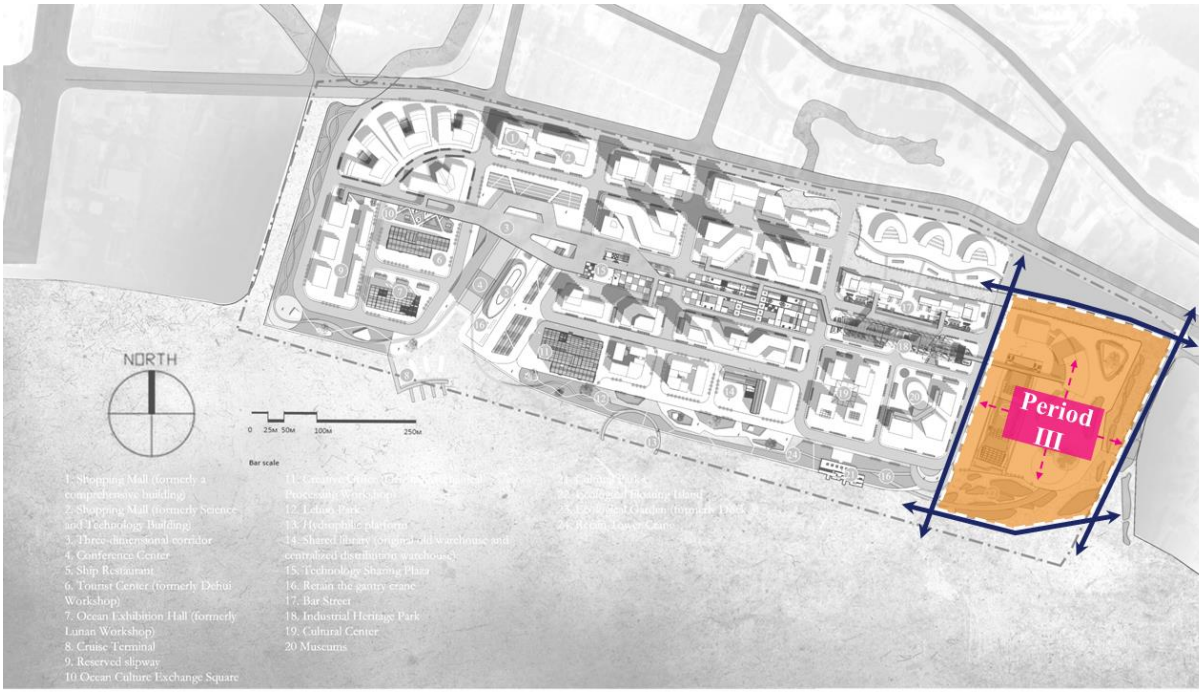


Figure 5-73 Phase Three Construction Area of Wenchong Shipyard Renovation
(Source:Seft-Drawn by the Author)

5.8 Prediction of Catalyst Effect After the Renovation of Wenchong Shipyard

Wenchong Shipyard is an important base for promoting the development of the marine cultural and creative industries. Through preservation and revitalization, it has been transformed into an

integrated hub for scientific and technological innovation, residential and commercial use, culture, and ecology, contributing to significant economic, cultural, and social impacts.

Economically, as a development focus within the second CBD of the Pearl River, the park has substantial economic potential. There are already multiple urban commercial centers in the surrounding areas, forming a well-developed commercial district system. The renovated Wenchong Shipyard can create strong economic catalyst effects by synergizing with these nearby commercial hubs.

Culturally, Wenchong Shipyard carries the industrial history and memories of the last century. During its transformation, many industrial buildings and structures have been preserved. As a hub for innovation and science, the revitalized Wenchong Shipyard can collaborate with the nearby university town and become a center for humanities and arts, fostering cultural catalyst linkages. Additionally, with the revitalization, the riverside area is open to the public and can create ecological catalyst effects by connecting with neighboring sites such as Longtou Mountain Forest Park, Nanhai Temple, and Changzhou Island.

On a societal level, the revitalized public square within Wenchong Shipyard can serve as a gathering place for community residents in the surrounding area. Moreover, the exhibition and exchange spaces and office facilities within the park can attract a significant talent pool, invigorating the vitality of the surrounding urban areas.

5.9 Summary of this Chapter

This chapter primarily focuses on the design and practical research, using Guangzhou Wenchong Shipyard as an example to explore the feasibility of catalyst design strategies. Firstly, an analysis of the project background, location, and site conditions of Guangzhou Wenchong Shipyard is conducted, and design objectives guided by catalyst theory are proposed in response to the site conditions. The first step is to analyze and select the catalyst carrier. Next is the

activation of the catalyst, primarily shaping the catalyst from three aspects: functionality, culture, and ecology. Finally, the catalyst effect is guided and adjusted through phased control. The chapter discusses the positive role of catalyst theory in the renewal of Guangzhou's waterfront industrial heritage through design and practical research.

Conclusion and Prospects

(1) Main Conclusions of the Study

Urban waterfront industrial heritage revitalization is an essential component of urban renewal. However, in China, the conventional approach to urban waterfront industrial heritage revitalization often involves demolition and reconstruction, focusing solely on the land's economic value. This approach not only disregards the industrial cultural memory preserved within old industrial sites but also neglects the comprehensive potential of the sites in terms of location, space, culture, ecology, and more. If these potentials are harnessed correctly, urban waterfront industrial heritage can become a strategic focal point for area or urban transformation and development, serving as an engine for the surrounding region.

First, based on this context, this paper explores the feasibility of applying the "urban catalyst" concept to the field of urban waterfront industrial heritage revitalization, using the Guangzhou Wenchong Shipyard as a case study. After analyzing the project background, location, and site conditions of the Guangzhou Wenchong Shipyard, this study sets design goals guided by the principles of catalyst theory. It starts by identifying the original catalyst, mainly analyzing and selecting the existing catalyst carriers. Next, it activates the catalyst by shaping and revitalizing it from three aspects: functionality, culture, and ecology. Lastly, it introduces new catalyst elements as needed, creating a network of catalyst points within the industrial complex, thereby driving development in the surrounding areas.

Furthermore, this research outlines the relationship between the catalytic reaction process and project renovation planning, analyzing the catalytic potential of the Guangzhou Wenchong Shipyard from four aspects: regional, cultural, internal space, and ecological. It selects the existing catalyst within the shipyard from three perspectives: catalyst angle, catalyst carrier, and catalyst elements. By integrating functionality, culture, and ecology, it shapes and activates the catalyst. Additionally, it introduces new catalyst elements according to planning

requirements, seamlessly transitioning from individual points to interconnected lines and areas within the industrial complex, transforming the entire area into a catalyst hub for the region's development.

(2) Innovations in the Study

This study constructs a functional transformation and redesign strategy for the Guangzhou Wenchong Shipyard from a urban perspective, encompassing the determination of catalyst elements, activation and reshaping of catalysts, and the control and guidance of catalytic reactions. This new design approach offers strategic and reference guidance for the future utilization and renovation of the Guangzhou Wenchong Shipyard.

By introducing the concept of an "urban catalyst" into the revitalization strategy for the Guangzhou Wenchong Shipyard, this study expands the application of the "urban catalyst" concept and offers new ideas and methods for the redesign of industrial heritage sites in Guangzhou. Beyond physical renovation, it emphasizes the activation and utilization of these sites in the context of the city and its surrounding region. It goes beyond the material aspects of renovation to focus on the activation and utilization of non-material aspects as well.

(3) Limitations and Future Prospects

The revitalization of waterfront industrial heritage involves a multidisciplinary and comprehensive subject, influenced by various factors such as social, economic, cultural, and policy-related aspects. This study primarily focuses on urban design and architectural renovation, which has certain limitations in terms of depth and breadth. Future research should engage in multidisciplinary studies to achieve a more comprehensive understanding.

While this study constructs a practical framework for the Guangzhou Wenchong Shipyard's revitalization from a catalyst perspective and applies it to the initial planning phase, there is still a need for long-term verification and testing to determine how the catalytic effects will unfold

during subsequent phases and how to guide and adjust them in the face of uncertainties in the construction process.

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