POLITECNICO DI TORINO

Dipartimento di Architettura e Design
Corso di Laurea Magistrale in Architettura Costruzione Citta'

Tesi di Laurea Magistrale

Industrial Heritage Renovation in Urban Environment

A Case Study of Qingdao Port

Supervisor :

Prof. Mario Artuso
Prof. Michele Bonino

Candidate:

Han Xiaowei

December. 2025

Acknowledgment

I extend my deepest gratitude to my supervisors, Professor Mario Artuso and Professor Michele Bonino. Professor Artuso's rigorous academic guidance was fundamental to this work, while Professor Bonino's visionary perspective consistently provided inspiration. I am profoundly thankful for their wisdom and trust.

My sincere thanks also go to the professors, colleagues, and friends who enriched my journey with their companionship and insightful discussions.

To my family and friends in China, your unwavering love and support across the distance have been my greatest strength.

This journey has taught me that perseverance is rooted in faith—in one's efforts, in the support of loved ones, and in the promise of the future.

Finally, I thank Politecnico di Torino, where I learned that dedication and curiosity, guided by great mentors, make the extraordinary possible.

Note on AI Use:
AI tools were utilized for English grammar checking and basic information retrieval.

Abstract

The global process of deindustrialization has prompted a significant urban shift from production-oriented centers to post-industrial hubs focused on information, services, and culture. This transformation has left behind numerous vacant industrial parks, now seen as "brownfields" with latent potential. Consequently, the preservation and adaptive reuse of industrial heritage have become central themes in global urban renewal discourse.

In China, the 2006 Wuxi Proposal formally recognized industrial heritage, initiating a systematic approach to its preservation. However, integrating these vast, often clustered sites into contemporary urban fabric remains a central challenge, requiring a balance between honoring cultural value and regenerating economic and social significance.

This research uses Qingdao Port as a pivotal case study to investigate these challenges and opportunities. As a century-old port facing functional obsolescence due to urban expansion and the relocation of its core operations, Qingdao Port epitomizes the struggle and potential of industrial heritage in a dynamic urban context. The study delves into the port's transformation under the "Retreat from Harbor, Return to City" strategy, analyzing the institutional framework, urban integration challenges, and the specific adaptive reuse potential of its iconic silo structures.

Through a mixed-method approach combining literature review, global case studies, and on-site analysis of Qingdao Port, this thesis proposes a design-led strategy for the port's renovation. It argues that the successful revitalization of such large-scale industrial heritage hinges on a symbiotic relationship between preserving historical identity and introducing new public and cultural functions. The findings from the Qingdao Port case offer a transferable model for medium-sized port cities in China and beyond, demonstrating how industrial heritage can act as a catalyst for sustainable urban regeneration, cultural continuity, and enhanced urban vitality.

Keywords: Industrial Heritage; Urban Regeneration; Adaptive Reuse; Qingdao Port; Post-Industrial City; Silo Architecture;

List of Charts

List of Figures

Table of Contents

Introduction

1.1 Reserach background

1.2 Aims and objectives

1.3 Research Methodology

1.1 Research Background

Overview

The conservation and adaptive reuse of industrial heritage have gained increasing global recognition as a significant aspect of urban regeneration and sustainable development. According to the Nizhny Tagil Charter, published by The International Committee for the Conservation of the Industrial Heritage (TICCIH, 2003), industrial heritage comprises "remains of industrial culture which are of historical, technological, social, architectural or scientific value." This authoritative definition not only establishes the multidimensional value of industrial heritage but also provides a theoretical foundation for its conservation worldwide.

In the post-industrial era, urban functions are changing from manufacturing to information, services, and culture (Bell, 2019). This is happening at the same time that global deindustrialisation is speeding up. This change has left behind many industrial sites, which are now called "brownfields" (Loures, 2008). These areas, which used to be urban "rust belts," are slowly being rethought as spatial resources with potential added value. This makes it very important to protect and restore them in modern urban development.

The uniqueness of industrial heritage lies in its role as a material testament to technological progress and a repository of social memory and cultural identity from specific historical periods. As emphasized in China's "National Industrial Heritage Management Measures" (Ministry of Industry and Information Technology [MIIT], 2023), industrial heritage includes not only tangible remnants such as factory buildings and machinery but also intangible elements like production processes, regulations, corporate culture, collectively forming a comprehensive industrial cultural system.

Emergence of Issues

The formal conservation of industrial heritage in China started relatively late but has developed rapidly. The issuance of the "Wuxi Proposal" in 2006 marked the official inclusion of industrial heritage protection into the national agenda, initiating a new phase of systematic and standardized conservation (State Administration of Cultural Heritage, 2006). With the deepening of urbanization and the optimization of industrial structures, vast industrial lands are confronting challenges of functional replacement and spatial restructuring.

However, the conservation of industrial heritage in China faces multiple challenges. Firstly, balancing protection and utilization is problematic. On one hand, there is a tendency towards over-commercialization, which can dilute the cultural significance of industrial heritage (Zhao, 2021). Secondly, awareness of holistic conservation is weak. Practices often focus on protecting individual buildings or specific areas, overlooking the overall value and interconnections of industrial heritage groups (Zheng et al., 2024). Furthermore, issues such as complex property rights, difficulties in land-use conversion, and a shortage of professional expertise also impede effective conservation (Gu, 2014).

It is noteworthy that China's industrial heritage possesses a unique historical context and developmental trajectory. From the nascent industrialization during the Westernization Movement, to the industrial construction after the founding of the People's Republic, and the distinctive spatial distribution during the "Third Front" construction period, a rich and diverse typology of industrial heritage has emerged. How to fully consider these characteristics in conservation practice and establish an industrial heritage protection system suited to China's national conditions is an urgent issue requiring resolution.

Significance and Contribution

This research holds significant theoretical value and practical importance. Theoretically, by systematically reviewing the theoretical evolution and practical models of industrial heritage conservation, it aims to construct a value assessment and adaptive reuse framework adapted to the Chinese context, thereby enriching the theoretical system of industrial heritage conservation. Particularly within the specific context of China's rapid urbanization, exploring pathways for the synergistic development of industrial heritage conservation and urban renewal can contribute Chinese insights to global industrial heritage conservation.

On a practical level, through in-depth analysis of typical domestic and international cases, this study summarizes adaptive reuse models for different types of industrial heritage, providing actionable strategic recommendations for urban managers, planners, designers, and community stakeholders. The research focusses on the challenges of industrial heritage in medium-sized industrial cities (like Qingdao), providing targeted recommendations for the enhancement of industrial heritage during their urban transformation.

This study also stresses the creative use of digital technologies, ideas for sustainable development, and community involvement in protecting industrial heritage. It wants to change "static preservation" to "dynamic revitalisation" and "material conservation" to "cultural transmission." The main goal is to protect industrial heritage in a way that lasts and sparks new ideas.

1.2 Research Aims and Objectives

Investigating the Current Situation

This research aims to achieve a comprehensive understanding of the current state and evolutionary trends of industrial heritage within urban transformation processes through multi-dimensional and multi-scale investigation and analysis. This would involve an analysis of the policy frameworks for the preservation of industrial heritage in different countries and regions, focussing on their institutional frameworks and outcomes of implementation. At the same time, it will look at conservation methods used in medium-sized Chinese industrial cities like Qingdao and how they affect the city's layout and function.

The research will employ both quantitative and qualitative methodologies to establish an industrial history database, meticulously cataloguing data such as spatial distribution, architectural characteristics, preservation status, and usage patterns. This analysis seeks to clarify the interplay between industrial legacy and urban growth, providing statistical evidence for the development of focused conservation strategies.

Identifying Challenges

Building on the situational investigation, this research will delve into the key issues and constraining factors facing industrial heritage conservation. Firstly, it will analyze institutional barriers, including incomplete regulatory frameworks, uncoordinated management mechanisms, and complex property rights (Gu, 2014). Secondly, it will examine socio-cultural problems, including low public awareness, inadequate community participation, and disruptions in the transmission of industrial culture (Xu, 2012).

Particular attention needs to be paid to the tension between industrial heritage conservation and urban development. As cities expand and land values increase, industrial heritage sites often face immense development pressure. Finding a balance between conservation and development, and coordinating the interests of multiple stakeholders, are key issues this study aims to address (Chen et al., 2023).

Proposing Strategies

Based on a thorough analysis of the current situation and identified challenges, this research will propose a systematic set of strategies for the conservation and adaptive reuse of industrial heritage:

Value Assessment and Targeted Conservation Strategies: Establish a comprehensive evaluation system encompassing historical, technological, aesthetic, economic, and social values to guide the graded and classified conservation of industrial heritage. Specifically, for heritage with outstanding value, develop specialized conservation plans and intervention measures to ensure the maintenance of its authenticity and integrity (MIIT, 2023).

Diversified Reuse Pathways: Move beyond the traditional "cultural and creative district" model to explore innovative integrations of industrial heritage with functions such as education, research, tourism, and commerce. For instance, utilize industrial heritage to establish specialized museums, research bases, experience centers, etc., fully leveraging its cultural education and public service functions (MIIT, 2023).

Community Participation and Collaborative Governance Mechanisms: Construct multi-stakeholder platforms involving government, enterprises, communities, professional institutions, and the public, establishing mechanisms for consultative decision-making and interest coordination. Enhance project identification and social sustainability through community workshops, public consultations, volunteer activities, and other forms of engagement (Lu et al., 2020).

Technological Innovation and Digital Application: Promote the application of new technologies such as Building Information Modeling (BIM), Geographic Information Systems (GIS), Augmented Reality (AR), and Virtual Reality (VR) in industrial heritage conservation. Establish digital archives and monitoring systems to enhance the scientific nature of conservation management and the interactivity of displays (MIIT, 2023).

Regional Coordination and Networked Development: Strengthen exchange and cooperation in industrial heritage conservation between regions. Achieve regional linkage and holistic enhancement of industrial heritage through the establishment of heritage corridors, thematic routes, etc. Participate in platforms like the "China Industrial Heritage Innovation and Creativity Alliance" to promote resource sharing and experience learning.

1.3 Research Methodology

Research Design

This study adopts a mixed-methods research approach, constructing a research framework that integrates theory and practice, and complements macro and micro perspectives. It begins with systematic literature research to review the theoretical development and practical evolution of industrial heritage conservation, establishing the theoretical foundation.

Subsequently, the case study method is employed to conduct in-depth analysis of representative industrial heritage conservation projects both domestically and internationally, summarizing experiences and lessons. Finally, combining the specific practices of Qingdao's industrial heritage, it proposes conservation and utilization strategies tailored to local characteristics through field research and participatory observation.

The research particularly emphasizes the integration of interdisciplinary perspectives, drawing on theories and methods from urban planning, architecture, heritage conservation, sociology, economics, and other disciplines to build a comprehensive research framework. Simultaneously, it stresses the application of comparative research, using comparisons between different countries, cities, and types of industrial heritage to reveal both the commonalities and specificities of industrial heritage conservation.

Data Collection Methods

Literature Review: Systematic retrieval of domestic and international academic databases, professional journals, and policy documents to collect literature related to industrial heritage conservation, urban regeneration, sustainable development, etc. Special attention is paid to recently published policy documents, such as the "National Industrial Heritage Management Measures" (2023) and local implementation rules, to grasp policy directions and requirements.

Case Study Data Collection: Selection of typical domestic and international cases (e.g., Nordstern Park in Germany, the New York High Line, Shougang Park in Beijing, Jingdezhen Taoxichuan). Information is gathered through multiple channels including project reports, design documents, academic research, and visual materials to build a case study database.

Field Research Data: Conduct systematic surveys of Qingdao's industrial heritage using methods such as site visits, architectural surveying, and photographic documentation to record in detail the spatial characteristics, preservation status, and usage conditions of the heritage sites. Simultaneously, conduct in-depth interviews and questionnaire surveys to understand the perceptions and demands of relevant stakeholders.

Historical Archival Research: Consult historical documents such as city archives, enterprise historical materials, and local chronicles to trace the historical evolution, functional changes, and cultural connotations of industrial heritage, providing a historical basis for value assessment.

Data Analysis Methods

Content Analysis: Systematic coding and thematic extraction of collected literature using qualitative analysis software like NVivo to identify key issues, theoretical frameworks, and development trends in industrial heritage conservation.

Comparative Analysis: Establish a multi-dimensional comparative framework to conduct horizontal and vertical comparisons of cases from aspects such as policy environment, adaptation models, and implementation effects, summarizing the similarities and differences in industrial heritage conservation under different contextual conditions.

Spatial Analysis: Use GIS technology to analyze the spatial distribution, spatial relationships, and spatial characteristics of industrial heritage, revealing the mechanisms of interaction with the urban spatial structure.

Statistical Analysis: Perform descriptive statistics and correlation analysis on questionnaire data and basic information to identify influencing factors and pathways related to industrial heritage conservation.

Research Limitations

This study has the following limitations: Firstly, due to language and resource constraints during the literature and case collection phase, it might not cover all relevant research findings and practical cases, introducing a potential selection bias. Secondly, field research is primarily concentrated in the Qingdao area, so the applicability of the research conclusions to other cities requires further verification. Thirdly, industrial heritage conservation is a dynamically evolving process, and this study, based mainly on investigations at a specific point in time, may find it challenging to fully reflect long-term evolutionary trends.

Furthermore, industrial heritage involves multiple value stakeholders. Although this study strives for comprehensiveness, there is still room for improvement in the coverage scope and depth of participation of stakeholders. Future research could expand the scope of investigation, adopt longitudinal tracking study methods, and delve deeper into the long-term mechanisms of industrial heritage conservation. Simultaneously, enhancing dialogue with international research would allow for examining the characteristics and value of China's industrial heritage conservation within a global perspective.

Context: Industrial Heritage

2.1 Urban Transformation: From Industrial to Post-Industrial

2.2 Definition of Industrial Heritage

2.3 The value of industrial buildings

2.4 Current Status of Industrial Heritage in China

2.5 Challenges in Industrial Heritage Renovation in China

2.6 Industrial Heritage Preservation Models in China

2.1 Urban Transformation: From Industrial to Post-Industrial

From ancient times to the present, cities have continuously developed through cycles of destruction and reconstruction, evolving from early agrarian societies to industrial societies, and rapidly advancing to today's information society (post-industrial society). Changes associated with urban growth often involve the destruction of built characteristics and natural elements, eradicating the physical expression of former indigenous ways of life that are a very important part of people's culture (Loures, 2008)
.

Since 1900s, the most significant societal changes have been the decline of industry and the rapid development of various information technologies that began in the late 20th century. Scholar Kevin Gotham describes the period we are living in as a period of posts-industrial according to all the post-definition proposed by contemporary scholars related to various fields(Fox Gotham, 2001). The post-industrial society has been used as a concept by several experts from different fields to characterise the development stage reached by some societies, developed in their economic and social structure, which corresponds to the usual development condition subsequent to the industrialisation process derived from the industrial revolution(Moccia, 2022).

Sociologist Daniel Bell in his 1976 masterpiece “The coming of Post-industrial society” as a depiction of the various shifts within the social structure from a manufacturer-based economy to a service-based economy which occurs within the arising post-industrial world(Bell, 2019).

In the past sixty to seventy years, it is undeniable that the decline of small, medium, and large-scale industries has started to emerge in most countries, with the economic output from these industries gradually decreasing. These industrial areas have often occupied a significant portion of urban environments. The abandonment of industrial districts has led to subsequent issues such as unemployment, environmental problems, the reorganisation of housing markets, and a loss of vibrancy in urban spaces. As a result of this shift in society, governments, local authorities and scholars realised that in order to keep up with the times, cities must adapt to re-create themselves, providing solutions and contributing to the progression of urban society as well as the achievement of new urban quality and innovative competitiveness(Moccia, 2022).

In this context, former industrial cities became catalysts for innovative service employment and induced the manufacturing field less appealing to possible employees in many Western countries and some developing countries such as China, . As a result of this phenomenon, various factories and employment were relocated elsewhere, leaving behind real urban voids within the city (Ciaramella & Celani, 2019).

Therefore, with urban transformation and the migration of industrial areas, the industrial spaces in the original urban environment are in a state of abandonment. Some industrial areas are being redeveloped, while others remain rooted in urban spaces. The future destiny of these areas has become an inevitable question for architects and urban planners.

Historical Period	Main Characteristics
Pre-industrial Society	The city’s structure and layout centered on cottage industries showed no fundamental change from the cities in the previous feudal society.
industrial Society	Large areas dedicated to industry, transportation, warehouse docklands, and workers’ residential areas emerged in cities. The urban environment deteriorated, green spaces and public facilities were insufficient, leading to urban chaos.
Post-industrial Society	Cities have diversified functions with the tertiary sector at the center. They are relatively stable in size and form continuous urban areas. Modern municipal facilities and improved living conditions have transformed cities into tertiary industry hubs.

Chart. 1
The main characteristics of urban development in each period (summarized by author)

2.2 Definition of Industrial Heritage

The concept of industrial heritage has gradually gained attention over the past fifty years. The Industrial Revolution not only brought immense productivity but also transformed people's lifestyles. As deindustrialization progressed and industrial lands were gradually abandoned, people began to recognize the importance of understanding industrial heritage in the context of historical progress, According to Michael Falser, Industrial sites are significant landmarks in human history, demonstrating humanity’s dual ability of destruction and creation, which generates both annoyances and progress. They represent the promise for a better life and the ever-increasing power over matter(Falser & Yang, 2001).
In 2003, industrial heritage was formally defined for the first time in the Nizhny Tagil Charter. Industrial heritage consists of the remains of industrial culture which are of historical, technological, social, architectural or scientific value. These remains consist of buildings and machinery, workshops, mills and factories, mines and sites for processing and refining, warehouses and stores, places where energy is generated, transmitted and used, transport and all its infrastructure, as well as places used for social activities related to industry such as housing, religious worship or education(The Nizhny Tagil Charter for the Industrial Heritage, 2003).

The world order is changing. Inexorably, the economic centre of gravity is moving east. That progression is driven in the main by the industrial revolution taking place in China(Douet, 2016).

To define industrial heritage in China, one must take into account the country's unique circumstances. Since the early 1990s, many people and groups in China have helped people learn more about industrial heritage. This movement came about because more people in the country were interested in protecting industrial heritage and cities were changing quickly.

In 2006, the first National Industrial Heritage Symposium was held in Wuxi, where the first official document, the Wuxi Proposal, was released. The idea of Chinese 'industrial heritage' was therefore clearly elaborated in this document for the first time:

> The industrial heritage contains both the tangible and the intangible industrial remains of historical, sociological, architectural, technological or aesthetic value, including factories, workshops, mills, warehouses, shops and other industrial structures; mines, processing and smelting sites, energy production sites, transmission and usage sites, transportation facilities, social activities sites with industrial production, industrial equipment, production technology, data records, enterprise culture. […] Since the First Opium War, there have been various industrial remains left as the legacy of all phases of modern industrial construction in China, which constitute the principal part of China's industrial heritage, witness and record the change and development of modern Chinese society(State Administration of Cultural Heritage, 2006).

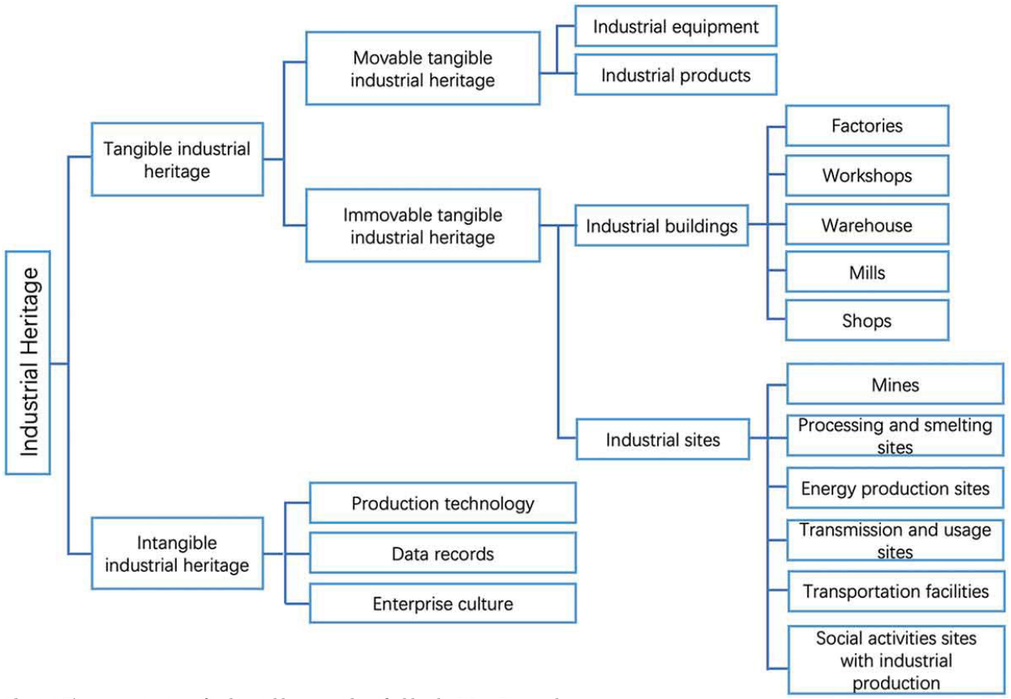


Chart. 2 The categorisation of industrial heritage identified by the Wuxi Proposal

2.3 The value of industrial heritage

The value of any heritage can generally be divided into two parts: first, the "intrinsic value" of the heritage itself, which refers to the historical, scientific, aesthetic, and other significances it carries; second, the "utilitarian value," primarily indicating the economic, political, and educational functions that the heritage possesses (Xu, 2005).The intrinsic value of industrial heritage primarily manifests as historical value, technological value, and aesthetic value, while its utilitarian value mainly lies in economic value and educational value(Xing et al., 2007).

i: Historical Significance

Industrial heritage is a physical record of past industrial efforts that shows how technology, the economy, and society have changed over time. These places are important because they remember important events and milestones in history, keeping the memory of industrial progress and innovation alive. By protecting their industrial heritage, societies keep ties to their industrial past, which helps them better understand their roots and heritage.

ii: Technological significance

Industrial heritage, on the other hand, mostly came about after modern science and the industrial revolution. It displays amazing scientific and technological advances that give us deep insights into natural laws and new ways of doing science.

iii: Aesthetic Significance

Industrial heritage encompasses a unique aesthetic appeal characterized by architectural styles, spatial layouts, and industrial landscapes. The large-scale industrial factories, as a unique urban landscape, provide a visual impact, possessing strong appeal and impressiveness(Wu, 2021).

iiii: Economic Value

The economic value of heritage can be defined as the amount of welfare that it generates for society. The welfare produced by heritage is greater than the financial benefits that certain historical objects or areas can produce through exploitation for tourism purposes; benefits external to the market economy should also be included(Li et al., 2024).

v: Educational Value

Like other cultural heritage sites, industrial heritage serves as invaluable on-site teaching materials for history and engineering education. Many industrial sites in Western countries have been utilized as educational bases, integrating the protection, promotion, and education of industrial heritage(Xing et al., 2007).

2.4 Current Status of Industrial Heritage in China

As mentioned above, the process of deindustrialization has led to urban transformations that have had a significant impact globally, giving rise to various social issues. These global phenomena also help explain the changes currently occurring in Chinese cities.

China's development since modern times has differed from that of most Western countries. Before the 1978 economic reforms, China's economy was underdeveloped, and urbanization progressed very slowly. The combined roles of urbanization and deindustrialization brought out great changes.

On one hand, there was a rapid urbanization which resulted inlarge quantities of rural immigrants moved to cities.(Xing et al., 2007). Since the Opening-up, the urban population as a percentage of the total population has grown from 18% in 1978, increasing at an average annual rate of 0.9%. By the end of 2020, China had 901.99 million urban residents, accounting for approximately 63.9% of the total population of 1.41177 billion(National Bureau of Statistics of China, 2024).
On the other hand, functions in finance, trade, technology, information, and culture had increasingly become the primary roles of cities.

In industrialised countries, modernisation of traditional manufacturing and trade has caused a lot of people to lose their jobs (Wang & Lu, 2001). During this time, big cities like Beijing, Shanghai, Shenyang, Xi'an, and Wuhan led the way in changing cities by moving from traditional to modern industries. But cities like Tangshan and Qingdao fell behind because of problems with their economies, which meant they had to start their changes later and keep some of their old industrial infrastructure.

This initiated a new era of urban renewal in certain cities during the 1990s. Initially, in response to rapid urbanization and limited urban space, the predominant approach was widespread clearance and demolition of industrial sites due to a lack of appreciation for their historical value. However, post-1990s, industrial heritage gained recognition, particularly among artists. They began repurposing warehouses and factory buildings along the Suzhou Creek, converting them into studio spaces. While retaining the original appearance of these old factory buildings and warehouses, they have created special spiritual spaces by introducing various modern fashion elements(Xu, 2012). With this as a start, municipal authorities promoted, on the one hand, the implementation of policies and strategies focused on culture and creativity and, on the other hand, territorial marketing operations that exploit the renovation of obsolete industrial structures to define a new image of the city(Bonino et al., 2021).

The current industrial heritage protection plan in Chinese cities is mainly based on the reutilization of industrial buildings with the main objective of “reutilization of idle space”(Li & Wei, 2005).

2.5 Challenges in Industrial Heritage Renovation in China

Compared with Western countries, the Chinese industrial heritage conservation and reuse initiatives have started much later(Niu et al., 2018). It is argued that conservation is a socially structured practice involving a variety of value construction and change. Therefore, the discourse on industrial heritage is often reproduced by drawing on different values and interests within a wider context of urban development (Lu et al., 2020). In summary, the challenges encountered in the development of industrial heritage primarily stem from the following aspects:

i: Industrial heritage often encompasses large structures, making it impractical to preserve every piece as meticulously as cultural relics. Under real-world conditions, determining how to classify and rate different categories of industrial heritage is a pressing issue for professionals in the field.

ii: Local governments often have a vague understanding of the significance, role, scope, priorities, challenges, and market demand related to the preservation and utilization of industrial heritage(Zhao, 2021). Due to the prevalence of a pragmatic approach in China, economic interests are the primary goal, with land use aimed at maximizing land value. Consequently, the potential cultural and artistic values of heritage are frequently overlooked.

iii: According to the provisions and interpretations of the "Law of the People's Republic of China on the State-Owned Assets of Enterprises," state-owned enterprises and their assets are owned by the state, which means they are owned by all the people(Law of the People's Republic of China on the State-Owned Assets of Enterprises, 2008).Artists do not own any land property rights, leading to a weak voice after the official endorsement of the creative park. They could not control the physical environment change, or participate in the place-making process. At the same time, under Chinese policy, it is very hard to change land use(Gu, 2014).

iv: From the perspective of the urban environment, industrial areas typically occupy large spaces, which are often disconnected from the overall development of the city, presenting a lagging status. The industrialized patches thus formed become a fragmentation of the overall spatial texture and structure of the city, with the boundaries of industrial production areas and the transportation routes provided by railways serving as physical barriers that separate factory zones from the urban areas(Chuangfengshi, 2023).

Even though there are laws and rules in place, bad policy and legal protection make it very hard to protect and reuse industrial heritage.

Not knowing enough about other cultures means that people don't realise how important industrial heritage is to history and culture, which makes it harder to protect and use.

2.6 Industrial Heritage Preservation Models in China

Industrial heritage architecture is characterized by large structural spans, steel-framed roofs, and substantial single-building volumes. However, variations in building spaces are dictated by the diverse needs of industrial manufacturing. Hence, industrial heritage buildings can be classified into at least three types based on their spatial forms(See Chart 3).
In summary, industrial architectural heritage, given its spatial and volumetric advantages along with the advantageous location within urban areas, possesses strong adaptability and multifunctional convenience.

Under the premise of reasonable preservation and utilization, it has the potential to meet diverse needs in the context of urban renewal(Li, 2023). The scarcity of land resources and the changing public aesthetic tastes have provided opportunities for the reuse of industrial heritage. The reintroduced functions mainly include urban open spaces, tourist resorts, museums and exhibition centers, and creative industry parks, with some degree of intersection and integration(Yu & Fang, 2006).

Urban Open Spaces

A prominent case of urban open space renovation is the transformation of Zhongshan Qijiang Park. Originally the Guangdong Zhongzhong Shipyard, established in 1953, it was decommissioned in 1999 due to bankruptcy. Designers repurposed the site's factory remnants, such as chimneys and gantry cranes, interspersing them with landscape features to provide urban recreational spaces while showcasing industrial aesthetics. The design preserved the site's original banyan trees, and embankment treatments and plantings reflected principles of nature and ecology(Yu, 2001).

Spatial Forms	Structure	Usage Characteristics
Single-Story Factory Building	Column-and-Beam Structure with a Large Span	Commonly found in heavy industrial workshops or warehouses requiring heavy-duty cranes and other equipment, these facilities feature tall, spacious interiors with regular layouts, offering high adaptability and utilization rates for renovation.
Combination Type	Characterized by smaller spans and multiple spans, with the interior sometimes featuring multiple levels or partial mezzanines.	Commonly found in light industrial plants, warehouses, or spaces combining office and production areas.
Equipment and facility	In a strict sense, they are industrial structures, such as chimneys, cranes, large industrial equipment, etc.	They possess distinctive and aesthetic qualities and can serve as design materials for industrial-themed landscapes. However, their value in terms of space utilization is relatively low.

Chart. 3 Classification of Industrial Heritage Based on Spatial Form (summarized by author)

Tourist Resorts

The fundamental purpose of developing industrial heritage tourism is to attract visitors and achieve economic benefits(Zhang et al., 2023). Famous cases include the tourism redevelopment of Baltimore's Inner Harbor in the United States and the regional tourism planning in Germany's Ruhr area. These projects use diverse heritage tourism models to attract visitors and stimulate the economy or develop green retirement cities to attract population relocation(Nefs et al., 2013). Additionally, the construction of tourist attractions is also a key method of tourism development.

Museums And Exhibition Centers

The creation of industrial heritage museums has successfully safeguarded certain important contemporary industrial artefacts ((Zhong et al., 2024)). China has built at least sixty to seventy industrial heritage museums, such as the Shougang Industrial Museum, the China WISCO Museum, and the Qingdao Beer Museum. These museums of industrial heritage not only show off modern industrial artefacts, but they also embody and show off their own industrial value, acting as carriers of the city's collective memory.
Creative Industry Parks

The most common way to change things in China is to renovate a creative industry park. Some examples are Tianzifang, Beijing's 798 Art District, and Shanghai's Chunming Creative Industry Park. The old factories and warehouses are full of industrial history and collective memory, which can easily spark creative ideas. Also, the buildings' large, open spaces make it easy to divide them up and move things around, which is why artists and other people in the creative industries like them so much (Yu & Fang, 2006).

Renovation Cases Studies in China and Abroad

Fig.1 *Perspective view of 80,000-ton silos (Source: https://www.archdaily.cn/cn/909360/)*

Project Name:
Renovation of 80,000-ton silos on Minsheng Wharf
Architect: Atelier Deshaus
Location: Minsheng Road,Pudong District, Shanghai
Original use: Store Grain
Program: Temporary Exhibition
Completion: 2017.10
Floor Area: 16 322m2

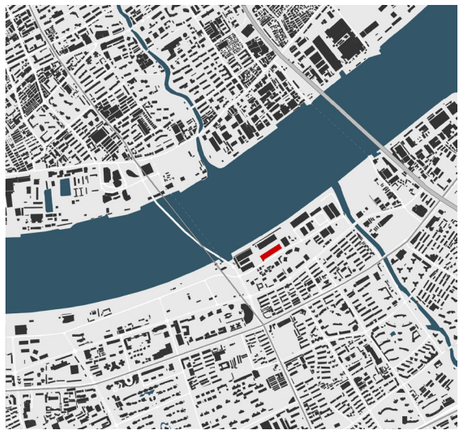


Fig.2 *Location 80,000-ton silos (Drawn by author)*

The background of the renovation

Minsheng Wharf in Shanghai's Pudong New Area has a rich history dating back to its establishment by British merchants over a century ago. Originally known as Blue Chimney Wharf, it was renowned for its extensive facilities and bustling transportation activities. Renamed Minsheng Wharf later on, it played a vital role in distributing goods like grain and sugar, closely intertwined with daily life.

After 2000, the wharf's 80,000-ton silo, which used to be a major grain storage facility, had trouble keeping up with new ways of storing things. Grain storage technology changed, and factories moved along the Huangpu River, which made it less useful. Even after many renovations, it lost its significance and closed down in 2005.

But the 2017 Shanghai Urban Space Art Exhibition was a turning point that gave people a chance to change. Dashan Architectural Firm led the renovation, turning it into a "public cultural space" that mixes art with everyday life. It now serves as an urban hub for art exhibitions, breathing new life into its historic setting. The area has been redesigned to be 16,322 square meters.

The 80,000-ton silo is the most imposing industrial heritage at Minsheng Wharf. Despite its short lifespan of only 28 years, it holds significant historical and heritage value as a unique architectural space type that will not be replicated.

Challenges and Approaches

During the renovation process, adhering to the principle of adaptive reuse, the transformation of the 80,000-ton silo faced the following challenges:

1. Traffic flow: With a height of 48 meters, the silo's exhibition requirements necessitated the use of both the top and bottom levels as the main exhibition areas. Organizing smooth circulation pathways is a primary concern.

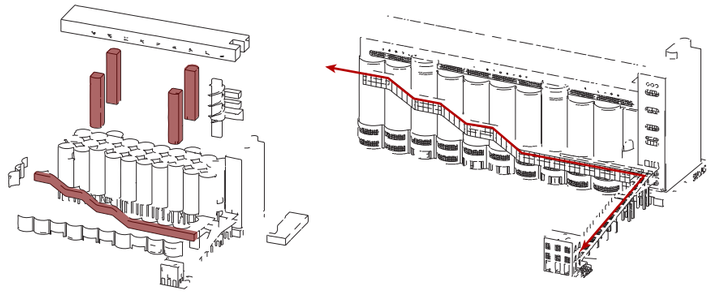


Fig.3 *Traffic flow (Drawn by author)*

By installing a set of escalators externally, visitors are directly guided from the third level to the top-level exhibition hall. Apart from the external escalators suspended outside the silo, minimal alterations are made to the silo itself, thus preserving its original appearance to a great extent.

2. Openness: The silo was originally enclosed, so acquiring necessary openness during its transformation into a public exhibition space and establishing a new sense of place cannot be overlooked.

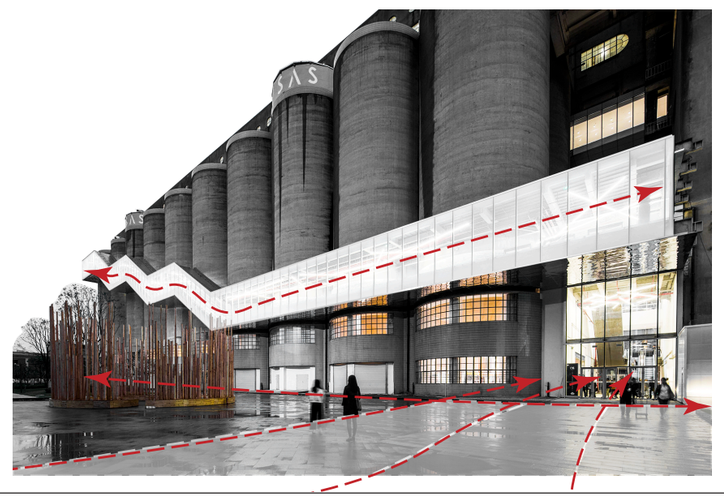


Fig.4 *Entrance Plaza (public and private) (Drawn by author)*

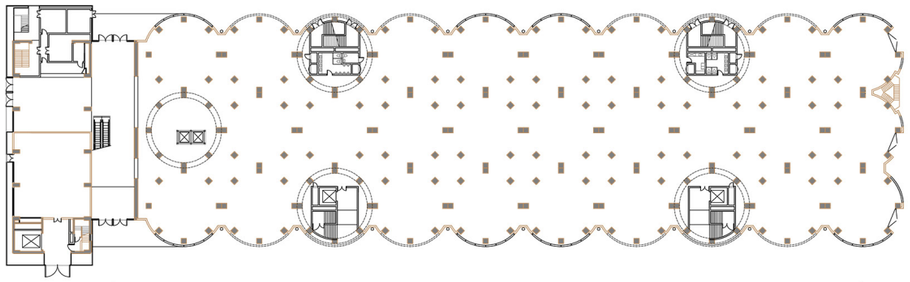
This set of external escalators undoubtedly repositions the 80,000-ton silo. By introducing views of the Huangpu River, it highlights its waterfront location while integrating riverside public space into the building. The reconstruction of the ground floor, new windows, and the high-ceiling design of the entrance hall further enhance the openness of the enclosed silo.

3. Relationship between internal spatial organization and structure: Preserving the original characteristics of the silo while integrating them with its new use is also a consideration.

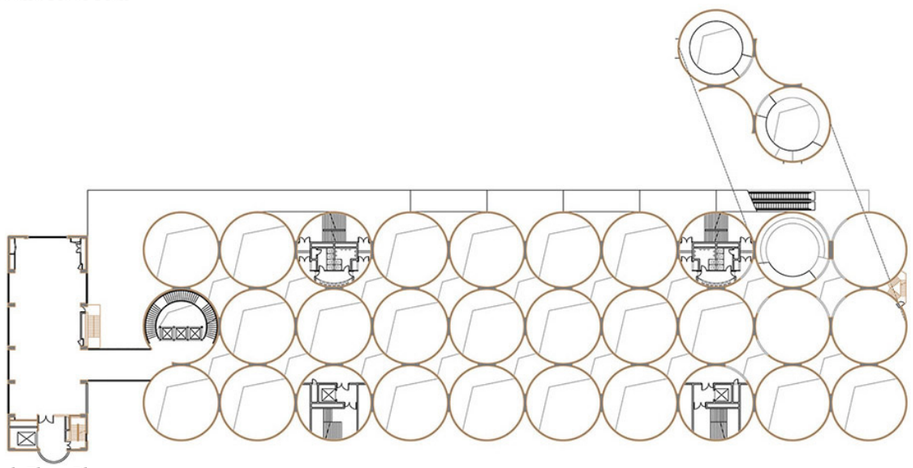
Fig.5 *The interior space and structure (Source: https://www.archiposition.com/items/20180525113834)*

The preservation of the internal structure enables the utilization of multi-level high-ceiling spaces. It facilitates communication both internally and externally, fostering interaction between interior spaces as well as between the interior and the exterior.

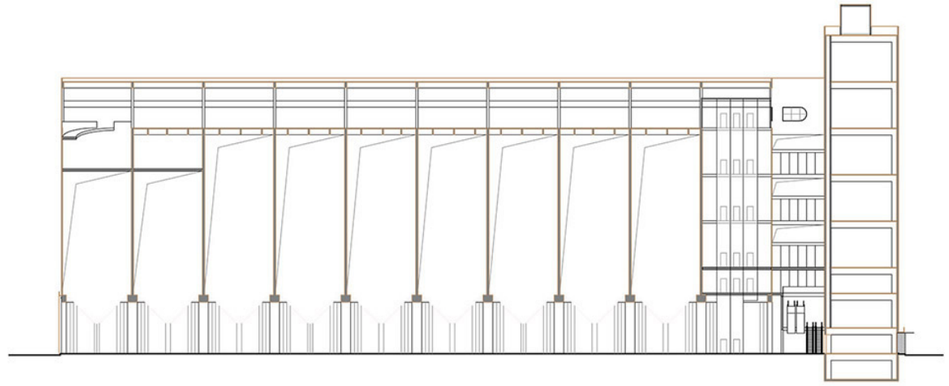
Technical Drawings



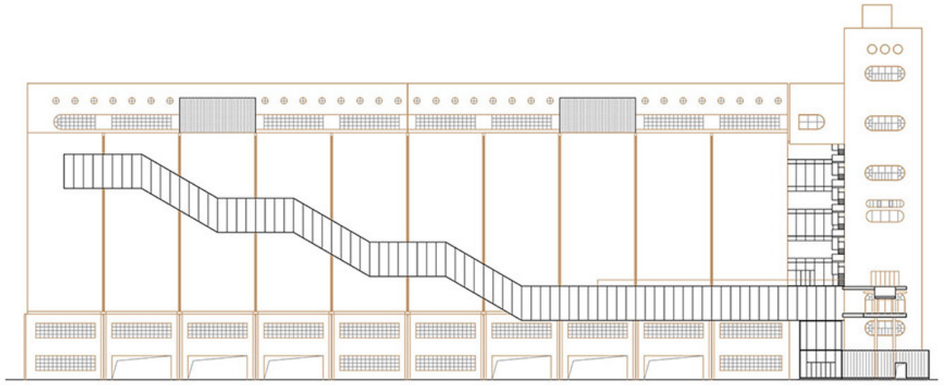
Ground Floor Plan



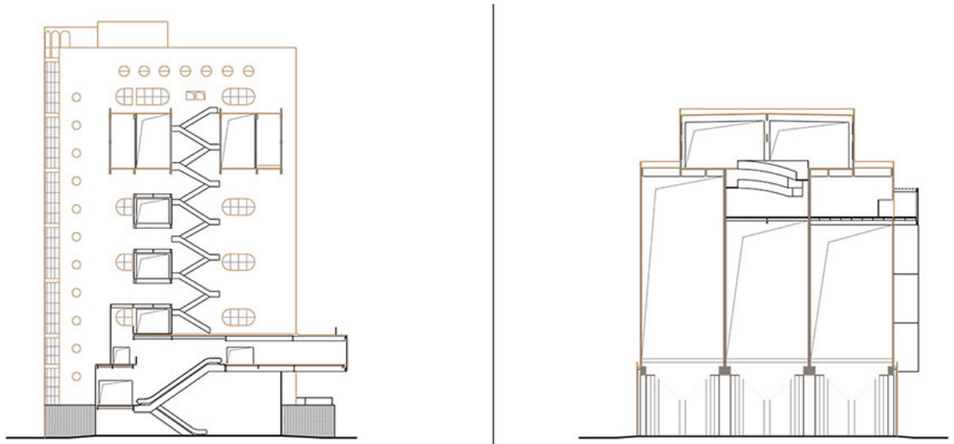
Sixth Floor Plan



Section



Elevation



Sections

Fig.6 *Technical Drawings (Source: https://www.archiposition.com/items/20180525113834)*

Fig.7 *Perspective view of West Ten Winter Olympics Square (Source: https://www.archdaily.cn/cn/900725/)*

Project Name: 2022 Shougang
West Ten Winter Olympics Square
Architect: CCTN Design
Location: Shougang Industrial Park North Area, Shijingshan District, Beijing
Original use: Steel Plant
Program: Office, Meeting, Exhibition
Completion: 08.2017
Floor Area: 87 000 m2

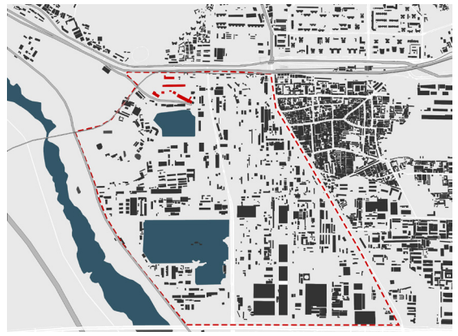


Fig.8 *Location of West Ten Winter Olympics Square (Drawn by author)*

The background of the renovation

In 1919, the Beiyang Government established the "Longyan Iron Mine Joint Stock Company Shijingshan Refinery," the predecessor of today's Beijing Shougang Group. In April 1938, it was renamed the Shijingshan Ironworks, then in November 1945, it became the Shijingshan Steel Plant under the Nationalist Government, abbreviated as Shigang. On December 17, 1948, the People's Liberation Army liberated it, making Shigang Beijing's first state-owned steel enterprise. Though little steel was produced until 1948, in September 1958, Shigang produced its first batch. In 1967, approved by the Ministry of Metallurgical Industry, it was renamed the Capital Iron and Steel Company. By 1994, its steel output soared from 1.79 to 8.24 million tons, surpassing Anshan Iron and Steel, ranking first in China. Shougang Group was officially established in 1996.

Facing pollution concerns, Shougang ceased production increase in 1994, focusing on pollution control and environmental transformation. In August 2004, it decided on strategic relocation. By 2010, relocation was completed, with Shougang Beijing Park ceasing operation. With Beijing winning the bid for the 2015 Winter Olympics, in May 2016, the Beijing 2022 Winter Olympics Organizing Committee settled in Shougang Park's West Ten Tube Warehouse, marking its first customer.

Design Concept

The industrial relics within the park are laid out entirely based on the production process, lacking a sense of urban spatial order. The massive industrial scale also makes people feel distant and insecure." The 'courtyard' is a space model full of human warmth in old Beijing for living and working, and the design aims to return to the most authentic Eastern lifestyle attitude about 'gathering' in the form of a 'courtyard' language."

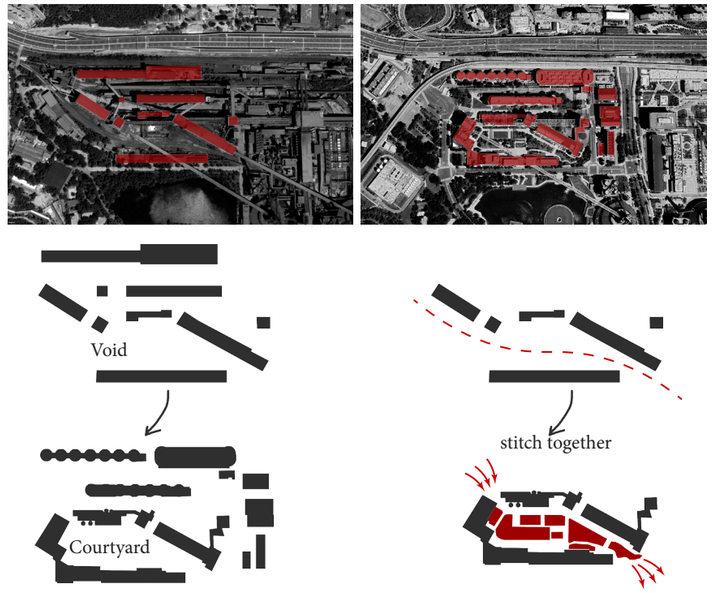


Fig.9
The development of courtyards (Drawn by author)

Approaches

Through a series of insertions and additional constructions, the scattered industrial structures within the original site have been delicately "sewn together," transforming the layout established under the guidance of craftsmanship into a charming and vibrant irregular pentagonal courtyard.

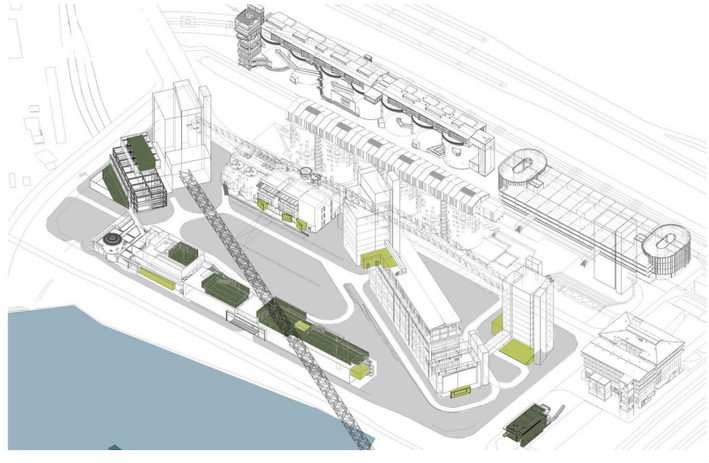


Fig.10
Space implantation and stitching (Source: https://www.archdaily.cn/cn/900725/)

The design incorporates medium-scale new buildings, one to two stories high, between the industrial scale of tens to hundreds of meters and the delicate ergonomic scale of the human body. Structures such as weathered steel gatehouses, glass lobbies and edge courts, and sunshade canopies endeavor to bridge the gap between the original large and small scales.

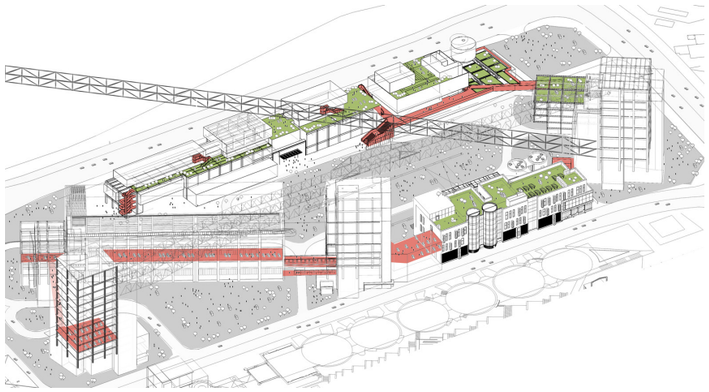


Fig.11
Three-dimensional pedestrian system (Source: https://www.archdaily.cn/cn/900725/)

The designers have implemented an outdoor staircase and skywalk system that meanders through the buildings and rooftops, adding a garden-like quality to the entire complex while preserving the authenticity of the industrial heritage. The ensemble of buildings forms a three-dimensional industrial garden, where each step reveals a unique view, embodying a unique spatial dynamic reading method inherent to Chinese culture.

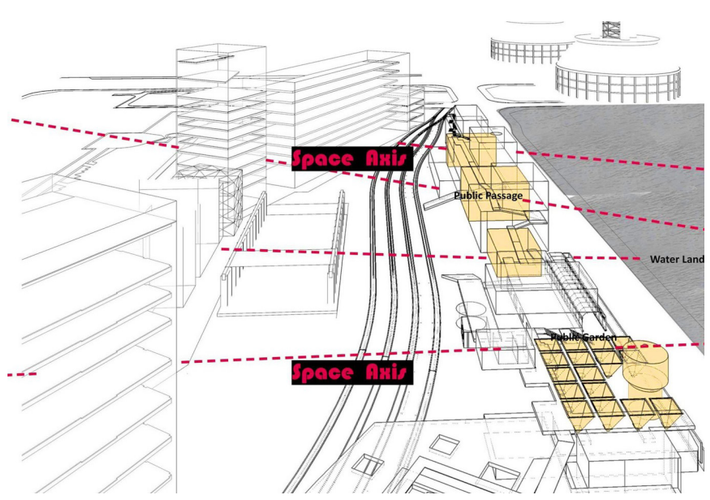


Fig.12
The spatial corridor relationship (Source: https://www.archdaily.cn/cn/900725/)

The design approach of "weaving," "linking," and "seaming" has reorganized the spatial scale relationships of the structures, placing humans at the core.

Fig.13
Scale transformation. (Drawn by author)

Technical drawings

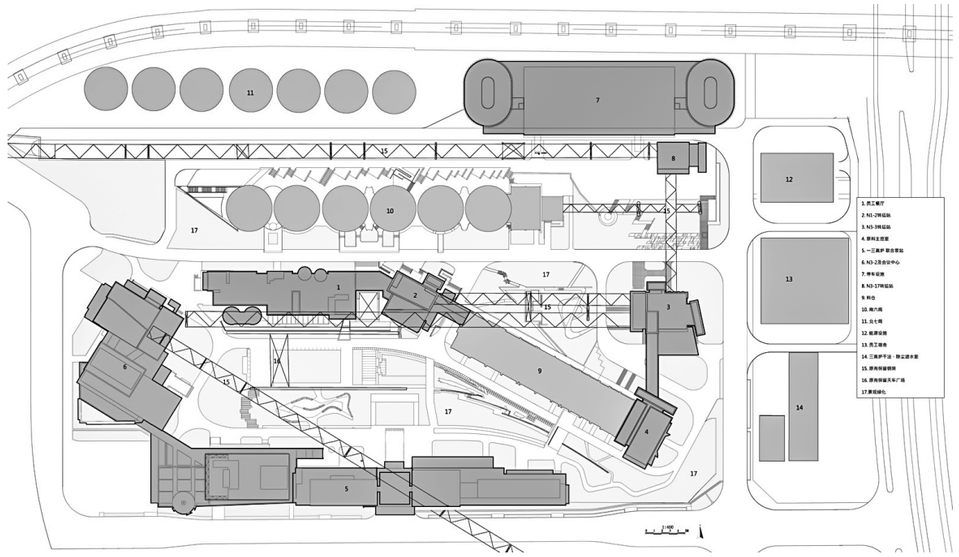


Fig.14 *Site Plan (Source: http://www.acctn.com/en/index.php?s=/home/index/casexq/content/22.html)*

1. Employee cafeteria
2. N1-2 transfer station
3. N3-3 transfer station
4. Raw material control room
5. Blast Furnace 1-3 Combined Pump Station
6. N3-2 and Conference Center
7. Parking facilities
8. N3-17 transfer station
9. Material silo
10. South No. 6 flue
11. North No. 7 flue
12. Energy facilities
13. Employee dormitory
14. Blast Furnace 3 Dry Method - Dust Removal and Filtration Room
15. Existing retained steel frame
16. Existing retained parking plaza
17. Landscape greening

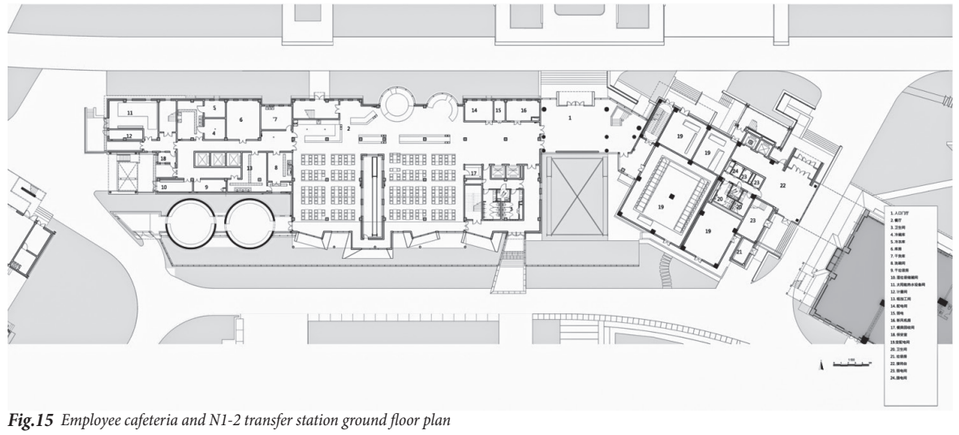


Fig.15 *Employee cafeteria and N1-2 transfer station ground floor plan*
(Source: CCTN Design(Source: http://www.acctn.com/en/index.php?s=/home/index/casexq/content/22.html)

Fig.16 *Perspective View Of Dachan Flour Mills (Source: http://www.nodeoffice.com/ch/show/?id=412)*

Project Name: Concept Design
Redevelopment of DaChan Flour Mills
——Interconnected Silos
Architect: NODE Architecture & Urbanism
Location: Shenzhen, China
Original use: Store Grain
Program: Cultural, Educational
Completion: 2015
Floor Area: 1 752m2

Fig.17 *Location Of Dachan Flour Mills (Drawn by author)*

The background of the renovation

In 1978, Shekou was nothing but vast stretches of barren land. On July 8, 1979, China's first open industrial park, the China Merchants Shekou Industrial Zone, was officially established. Countless enterprises gradually settled in Shekou, leading to its rapid rise as a "window" and "special zone within a special zone" of China's reform and opening up. The Shekou Dacheng Flour Factory, formerly known as the Far East (China) Flour Factory, was established in 1980 and was the first wholly foreign-owned and solely operated enterprise introduced by China Merchants Group to the Shekou Industrial Zone. By 2009, the Shekou Industrial Zone had initiated the "Reinventing New Shekou" project, marking the beginning of its transformation. Traditional industrial buildings were abandoned, posing an urgent problem that needed to be addressed.

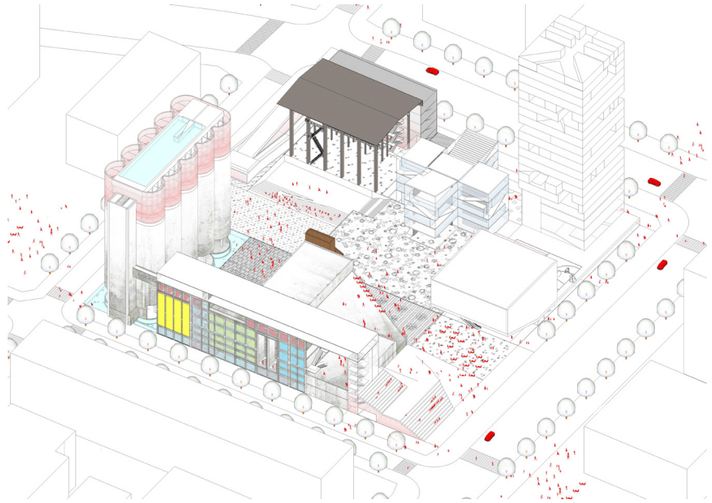


Fig.18 *Axonometric Drawing (Source: https://www.eeeetop.com/forum.php?mod=viewthread&tid=34358&extra=page%3D1&ordertype=1&mobile=2)*

Renovation Approach

The scales of buildings in industrial building sites vary, and more diverse forms can be formed through disassembly and stitching.

The top floor of the silo adheres to its cloud-like contour, adding a transparent volume and transforming it into office space for conferences. The main space of the silo will be used as a contemporary art museum. A continuous public steel staircase will be inserted from the center of one cylinder to another, connecting the floors and forming the main exhibition route. Additionally, spaces such as a library and a double-height meditation room will be interspersed, further enhancing the spatial and spiritual characteristics of the silo and elevating the visitor experience to another level.

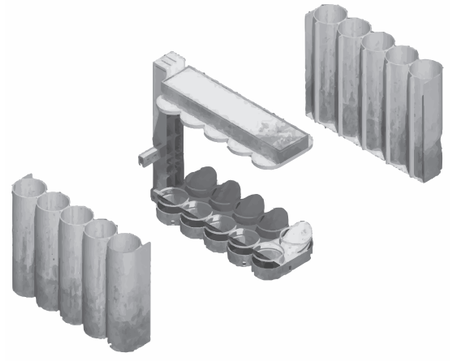
Through the addition of floor slabs, the large space in the silo is broken down into small spaces of various sizes to meet the needs of use.

Fig.19 *Section Of The Silos (Source: https://www.eeeetop.com/forum.php?mod=viewthread&tid=34358&extra=page%3D1&ordertype=1&mobile=2)*

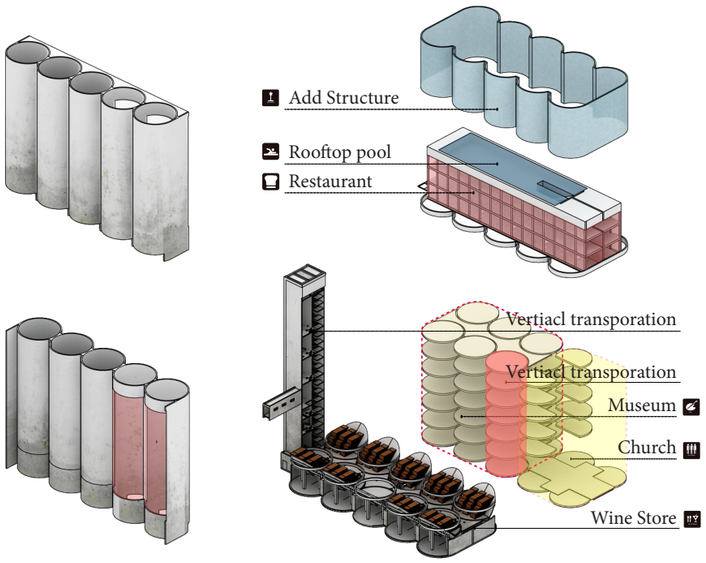
The silo, as the most iconic structure within the site, exudes a sense of history and power with its solid concrete texture, preserving the industrial spirit of the area. The exterior of the silo is kept as close to its original state as possible. Therefore, our renovation strategy focuses on reorganizing the internal space and implementing lightweight additions at the top.

The silo structure

The original structure and the distinctive sloped space on the ground floor have been preserved.



Axonometric Diagramof Existing Silo

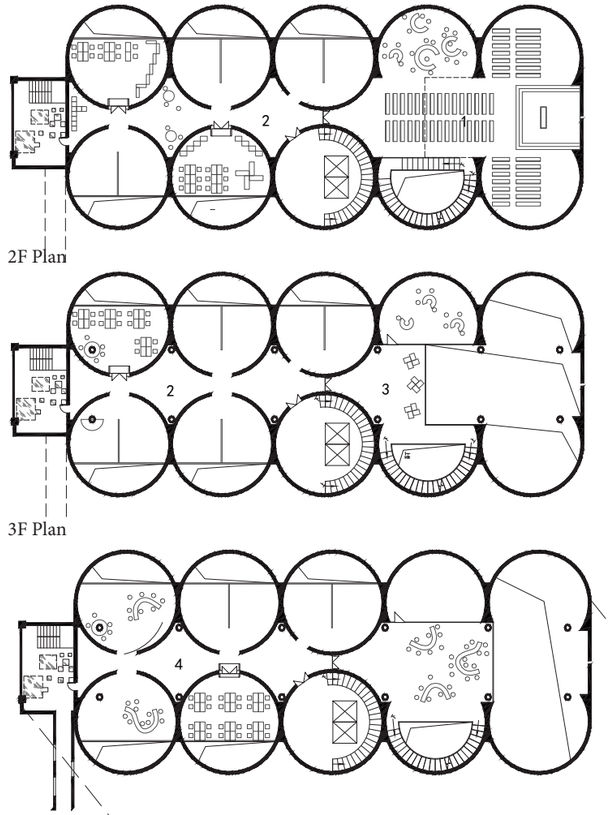


Open the silo wall

Fig.20 *Exploded View*
(Source: https://www.eeeetop.com/forum.php?mod=viewthread&tid=34358&extra=page%3D1&ordertype=1&mobile=2)

After being repurposed, the silo is endowed with new functionalities. While preserving the original structure, new slabs are added to enhance spatial utilization. Opening up the inner walls of the silo creates a void space, serving as a church. At the top of the silo, a lightweight glass structure is added to house a restaurant and a rooftop pool.

Technical drawings



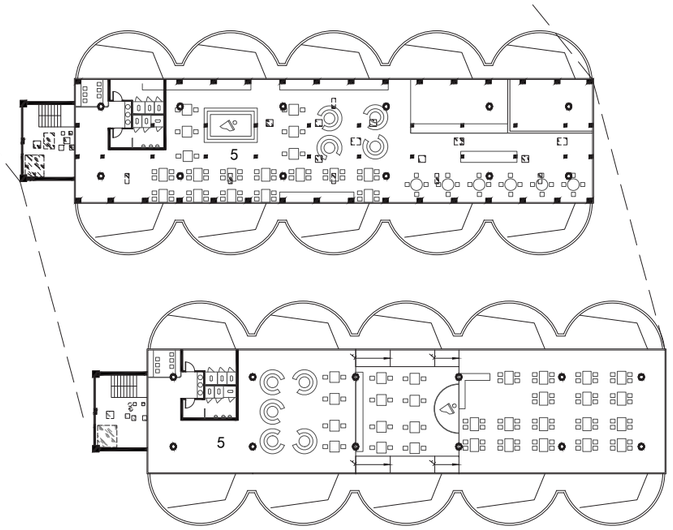


Fig.21 *Floor Plans*
(Source: https://www.eeeetop.com/forum.php?mod=viewthread&tid=34358&extra=page%3D1&ordertype=1&mobile=2)

Fig.22 Perspective View Of KANAAL (Source: http://www.nodeoffice.com/ch/show/?id=412)

Project Name: KANAAL
Architect: BEEL Architecten
Location: Wijnegem, Belgium
Original use: Store Grain
Program: Office, Residential
Completion: 2017
Floor Area: 8 000m2

Fig.23 Location Of KANAAL (Drawn by author)

The background of the renovation

A valuable, 19th-century industrial site along the Albert Canal near Antwerp (BE) is transformed into a contemporary site for mixed use. Besides workshops, museum space, offices and underground parking, the majority of the site are converted into housing units. Stéphane Beel Architects is responsible for the transformation of the silos of the old malt house, a part of the overall development project.

Renovation Approach

Upgrading the grey silos is a challenging task. The design allows the existing buildings to keep their functions while adding new uses without harming the silos' unique features. Careful changes make it possible to create residential spaces that are livable with available landscapes and natural light. Two grey silos, originally 31 meters and 28 meters tall, were removed and replaced with new, slender, and transparent structures.

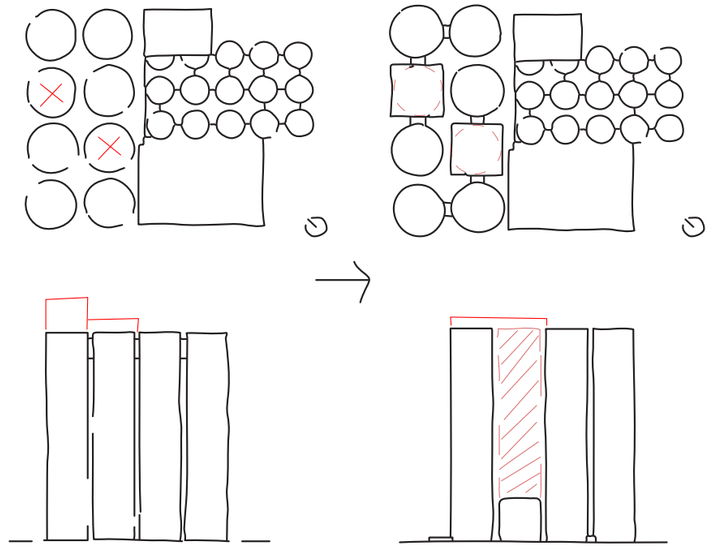


Fig.24
Silo Demolition And New Construction
(Drawn by author)

The six remaining silos were preserved, each with small openings. This approach enabled the creation of multiple housing units. These units consist of three enclosed spaces with circular floor plans (existing silos) and either one open space with a square floor plan (new silo) or six enclosed spaces with circular floor plans (existing silos) and two open spaces with square floor plans (new silos). The open layout of the square spaces, which include living areas, allows for the retention of the enclosed and sturdy concrete silos. The openings in the existing silos maintain their structural integrity while outlining specific distant views.

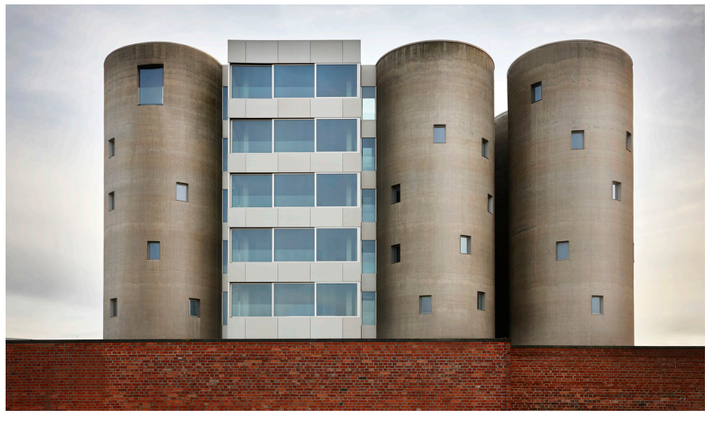


Fig.25 *View Of The Front Elevation*
(Source: https://www.kanaal.be/)

The existing white silos are removed for technical reasons of stability and are replaced by a new housing volume on top of the existing 'karnak' space. The new volume is clad entirely in white or bare wood and is in clear contrast to the existing grey silos. The glazing is in silver/white reflective glass and the wood is in the same colour.
The new housing function enables the silo complex to remain in existence. In their turn, the interventions and conversions ensure the implementation of contemporary requirements in terms of comfort and safety, improve the admission of natural light into the complex and form a positive contrast to the existing construction. The appeal and appearance of the silos are thereby retained.

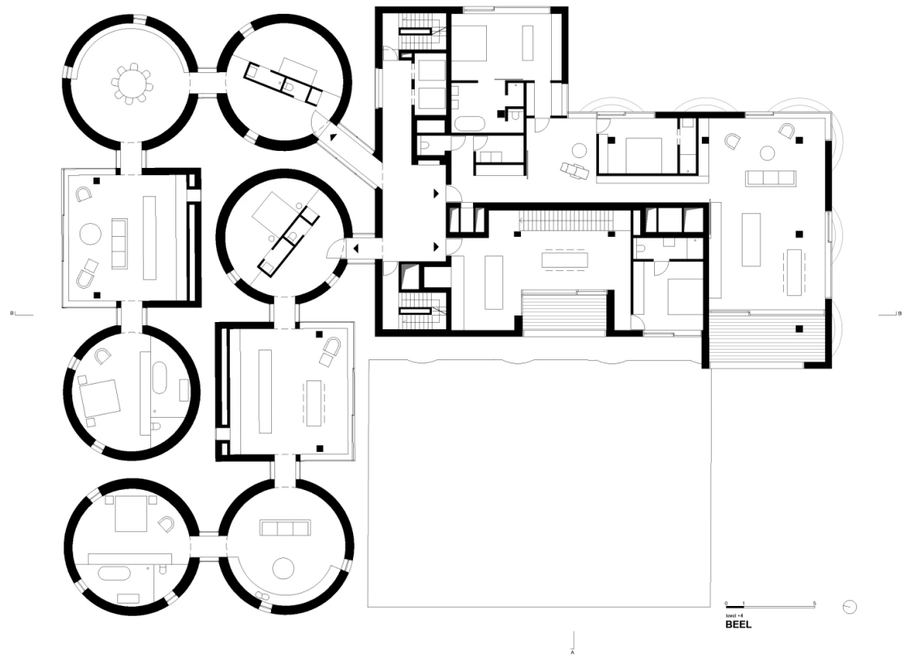
Fig.26 *Facade Contrast*
(modern and old)
(Source: https://www.kanaal.be/)

The contrast between old and new materials is reflected in the facade, which not only retains respect for the original industrial site and its unique appearance and appeal, but also gives new functions and forms.

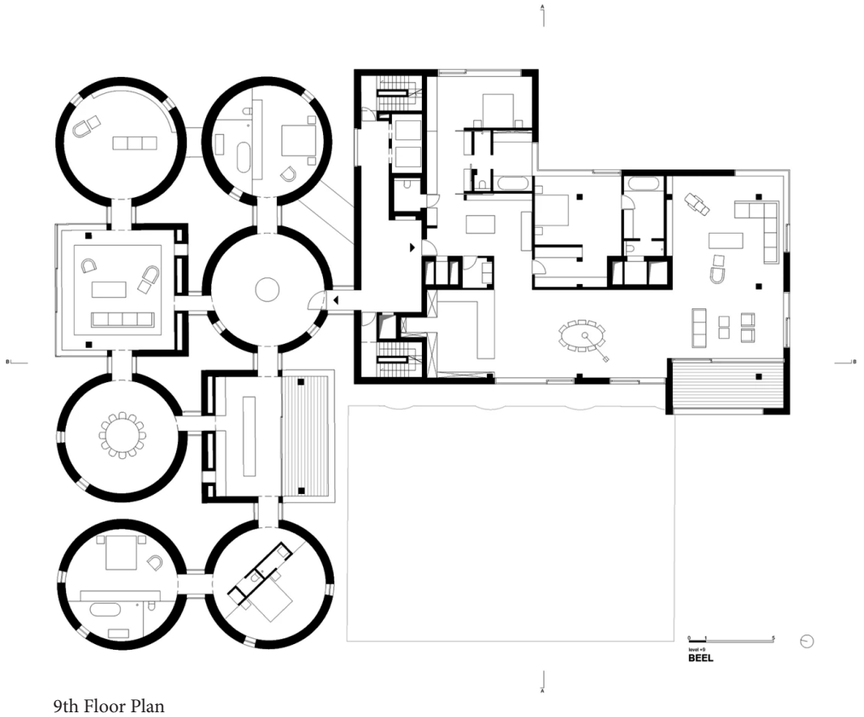
Fig.27 *Detail Design*
(Source: https://www.kanaal.be/)

The fusion of concrete material, modern glass and white walls creates a unique spatial experience. The concrete walls give people a sense of historical heaviness, which corresponds to the lightness brought by modern materials, and some of the details between the silos perfectly reflect the two feelings.

Technical drawings



3rd Floor Plan



9th Floor Plan

Fig.28 *Floor Plans (Source: https://www.kanaal.be/)*

Fig.29 *Perspective view of FRØSILO (Source: https://www.mvrdv.com/projects/143/fr%C3%B8silo)*

Project Name: FRØSILO
Architect: MVRDV
Location: Islands Brygge, Copenhagen, Denmark
Original use: Warehouse
Program: Residential
Completion: 2005
Floor Area: 10 700 m²

Fig.30 *Location of FRØSILO (Drawn by author)*

The background of the renovation

The Frøsilo is a radical waterfront conversion located in the old harbour area of Copenhagen. All over Europe, old, non-functional harbour areas are being redeveloped into high-end residential areas. As well as boasting excellent waterfront views and close proximity to the city, these former silos have a seemingly incomplete character; a bare structure. In these structural limitations lies the solution through intervention allowing the possibility of openings in the concrete rings, restricted and complicated with the desire to retain the quality of emptiness within.

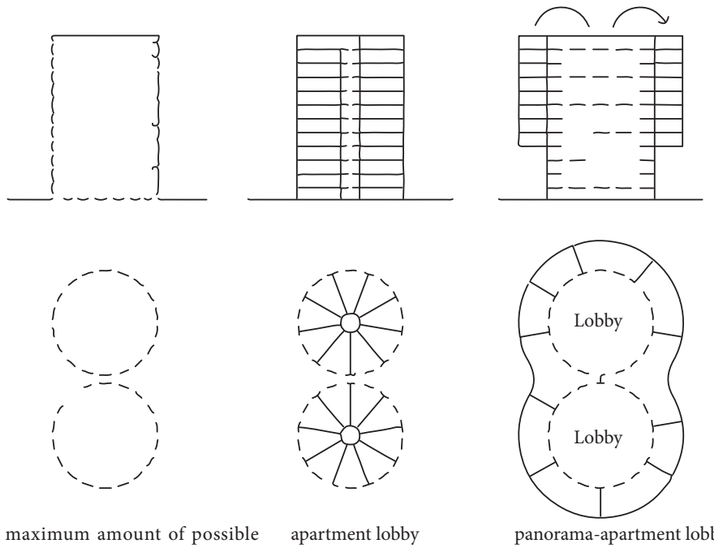
Renovation Approach

Warehouses are often seen as complete structures, with architects treating them respectfully, careful not to lose their original qualities; whereas silos are unfinished, exposed structures. This is also the challenge this project presents to architects.

The silo structure itself presents many limitations. For example, building entrances at the same height as the doors in the concrete circular ring of the silo is possible but extremely complex. If apartment units were to be placed within the silo, it would mean that, for necessary views, the units could only be arranged radially along the circumference.

Given the immense volume of the warehouse, this might be acceptable, but it's not suitable for this project. Filling the silo with houses and floors would destroy the most exciting aspect of the current state - the vast, open space. By placing the prefabricated floor slabs externally, the potential issues are resolved, turning them into an advantage: maximizing views and meeting flexibility requirements.

Both core silos can be covered with glass roofs, forming atriums for people to move through. In this way, the silo creates new cores for all available space in the building, with each room benefiting from the project's unique geographical location.



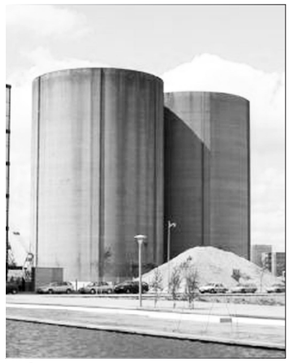
maximum amount of possible new windowopenings in existing silo

apartment lobby

panorama-apartment lobby

Fig.31 *Generation process (Source: https://www.mvrdv.com/projects/143/frosilo)*

Fig.32 *Before and After Renovation (Source: https://www.mvrdv.com/projects/143/frosilo)*



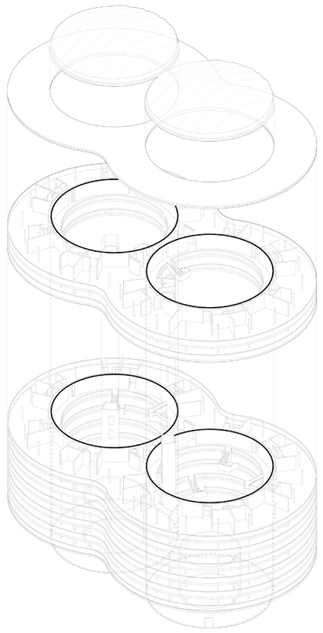
Before

After

After the renovation, the original silo structure is repurposed as a tall internal hall, ensuring transparency within the interior space. Prefabricated floor slabs are added externally to the silo to serve as the main usable space, preserving the original spacious attributes of the silo while providing ample area for balconies on the outside. Stairs are suspended inside to organize traffic flow, addressing the circulation issue in a more engaging manner.

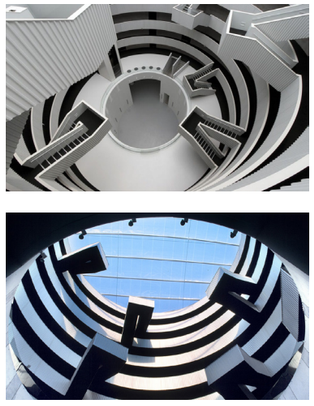
Structurally, no new load-bearing system is required as prefabricated floor slabs are utilized throughout. The existing concrete outer walls of the silo bear the load. From these load-bearing walls, an inner corridor extends inward, forming a combined system of inner and outer corridors for the overall building.

Fig.33 *Exploded View (Source: https://www.amaneceresdomesticos.es/recargas/)*



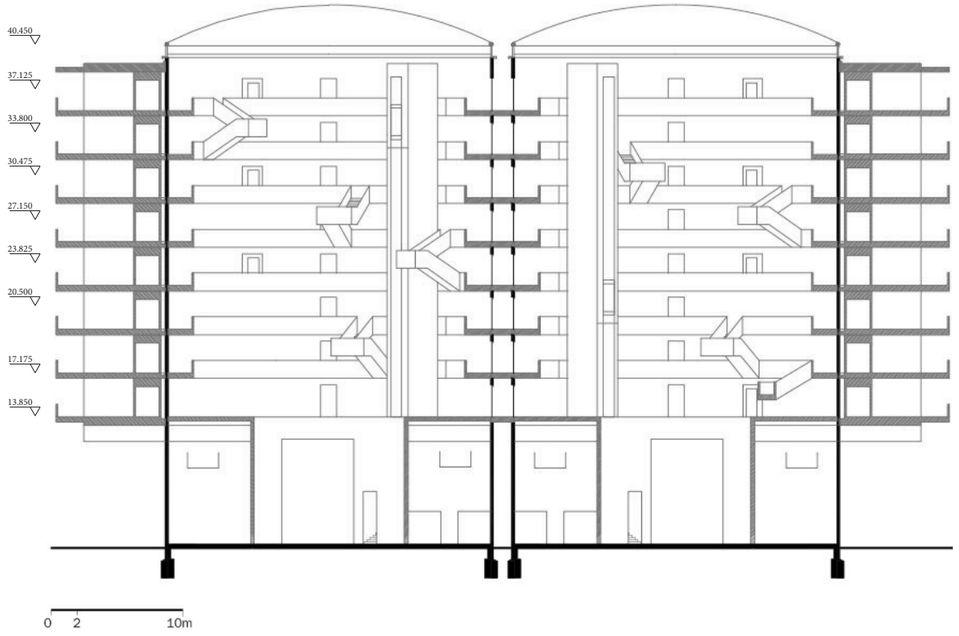
Exploded View

Fig.34 *Interior lobby space (Source: https://www.mvrdv.com/projects/143/frosilo)*

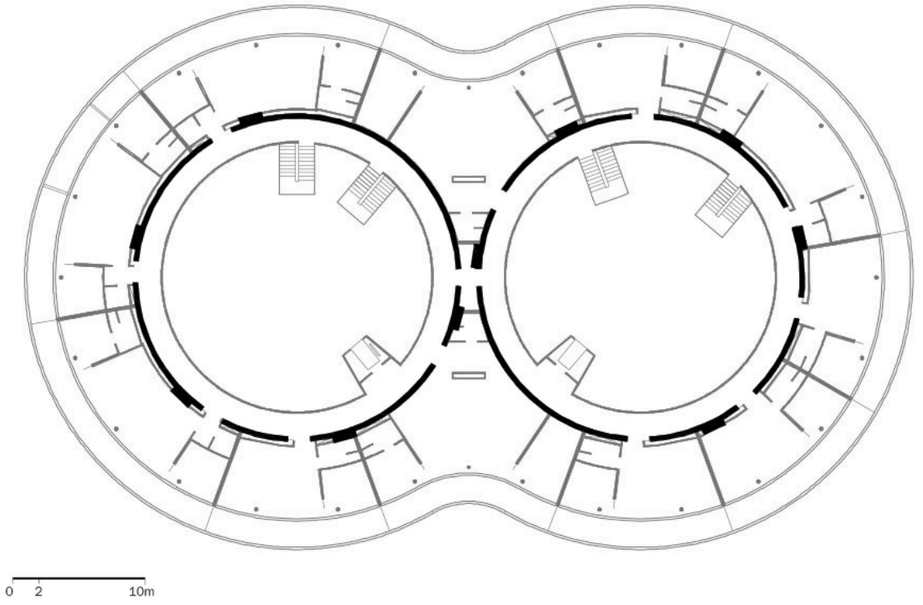


Interior lobby space

Technical drawings



Section



Strandard Floor Plan

Fig.35 *Section and Floor Plan (Source: https://www.amaneceresdomesticos.es/recargas/)*

Fig.36 *Perspective view of Zeitz Museum*

Project Name:
Zeitz Museum of Contemporary Art Africa
Architect: Heatherwick Studio
Location:
Cape Town , South Africa
Original use: Warehouse
Program: Residential
Completion: 2017
Floor Area: 9500 m²

Fig.37 *Location of Zeitz Museum*

The background of the renovation

At the southern tip of Africa, Cape Town sits on a peninsula between the heights of Table Mountain and the sea, on a coastline that snakes south-westerly, facing out to where the Indian Ocean meets the Atlantic. The city maintains a varied and rich relationship with the ocean, from a seaside village feel at sandy Camps Bay to the well-used and popular public space along the promenade at Seapoint. One of the oldest parts is the Victoria and Alfred Waterfront, which sits around two historic basins. Like many coastal cities, Cape Town's historic port (built by the British in 1860) was largely abandoned in the 1970s, as the expansion of ships meant that terminal activity had to be moved to nearby container ports. In 1987, plans were launched to transform the abandoned docks, effectively following the model of many other port cities, such as London's Docklands development, but this time transformed into a tourist attraction.

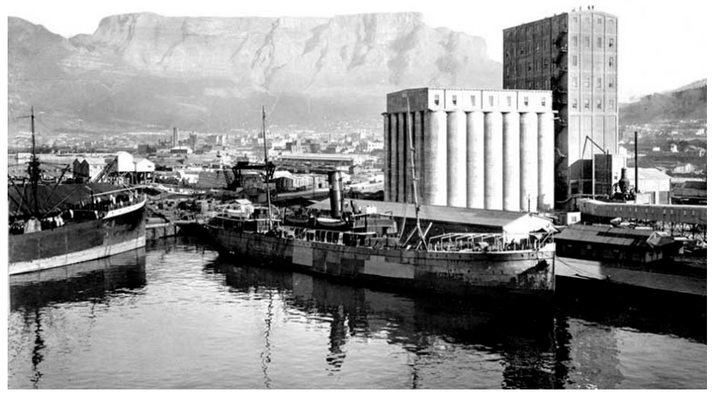


Fig.38 *Before Renovation (Source: https://www.architectsjournal.co.uk/buildings/building-study-heatherwick-studios-zeitz-mocaa-gallery-in-cape-town)*

Renovation Approach

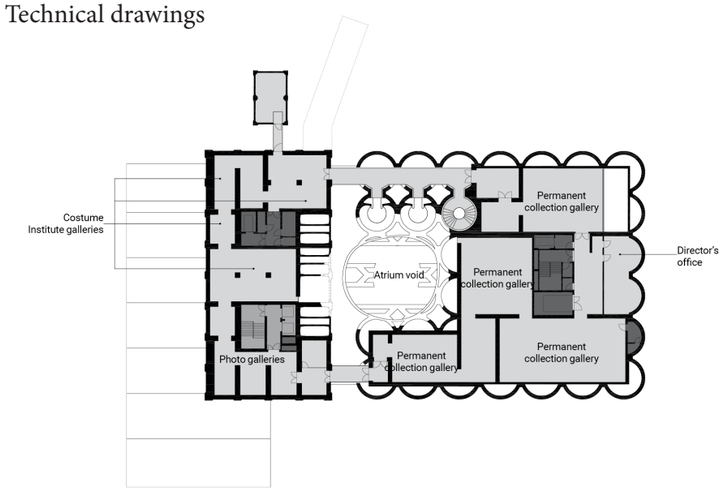
The museum is located in a limited space of 9,500 square meters and consists of nine floors, combining monumental and historical grain silo buildings. Abandoned since 1990, the silo once served as South Africa's tallest building and now serves as a monument to Cape Town's industrial history.The project includes 6,000 square meters of exhibition space, including eighty gallery spaces, a rooftop sculpture garden, state-of-the-art heritage warehouse and conservation area, a bookstore, a restaurant, a bar and reading rooms. Provides space for a center for costume research, photography, administrative offices, moving image, performance practice and arts education.

For designers, the main challenge is to modify the narrow volume occupied by the cylindrical structures to make them suitable for contemporary art exhibitions while maintaining their sense of scale, solidity, and dynamism, as well as the unique characteristics and industrial heritage of the building.

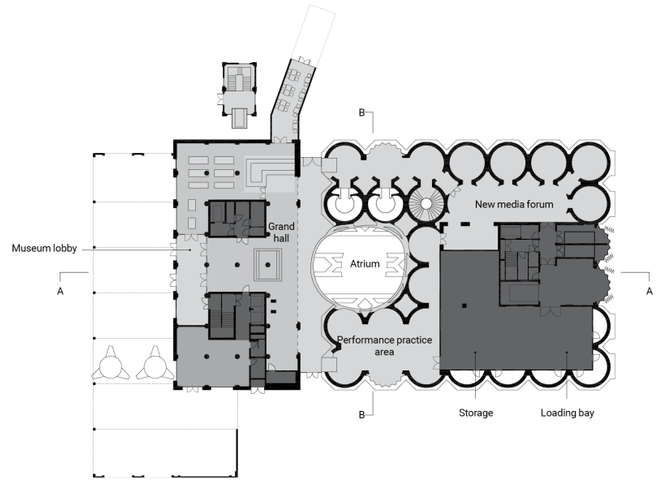
Inside the building, visitors experience a different kind of surprise. The interior, instead of being constrained by the original concrete silo structure, has been transformed into a spectacular full-height space. This space not only showcases the beauty of the original building materials but also serves as the central hub that connects all individual parts of the building, making the interior feel open and cohesive.

The atrium also reveals the tunnels beneath the building complex. These tunnels, along with new educational spaces, are open to the public. The primary circulation path is located within two concrete silos that house cylindrical elevators. The remaining internal silos have been removed to provide platforms for art display. At the bottom of the atrium, where the tunnels are exposed, the curved silo walls have spontaneously become a playground—a play area consisting of concrete slides and cave-like hideouts.

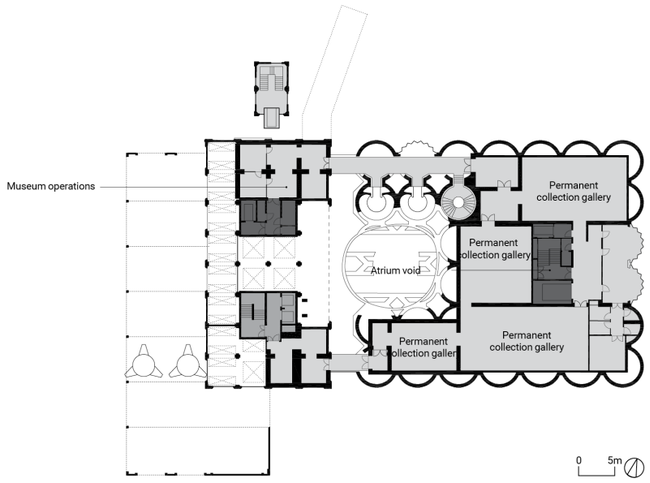
Technical drawings



Ground Floor Plan



Fir Floor Plan



Second Floor Plan

Fig.39 *Floor Plans (Source: https://www.architectsjournal.co.uk/buildings/building-study-heatherwick-studios-zeitz-mocaa-gallery-in-cape-town)*

Fig.40 *Atrium Void Space (Source: https://www.architectsjournal.co.uk/buildings/building-study-heatherwick-studios-zeitz-mocaa-gallery-in-cape-town)*

The building's atrium is formed by the imagined expansion of a 27-meter-tall corn kernel, which cuts through the original concrete walls.

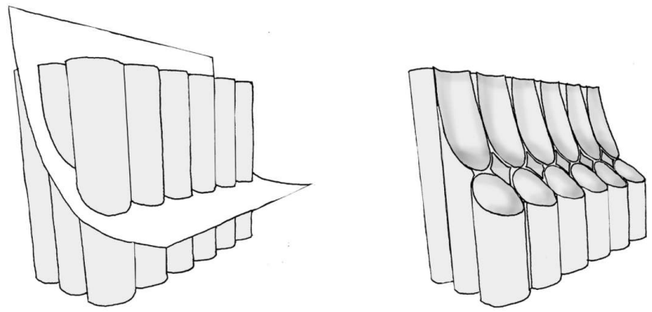
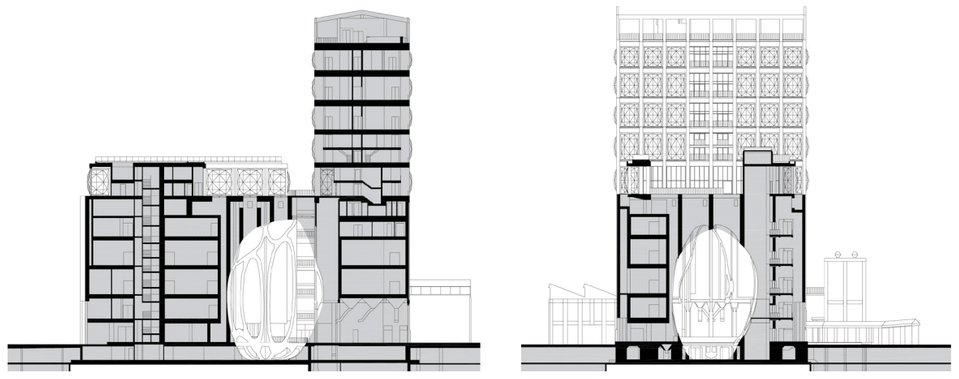


Fig. 41 *Cutting Diagram (Source: https://www.architectsjournal.co.uk/buildings/building-study-heatherwick-studios-zeitz-mocaa-gallery-in-cape-town)*



Section A-A

Section B-B

Fig.42 *Sections (Source: https://www.architectsjournal.co.uk/buildings/building-study-heatherwick-studios-zeitz-mocaa-gallery-in-cape-town)*

3.7 Summary

The role of industrial heritage in urban environments is crucial. Industrial heritage buildings are generally large in scale, and addressing their relationship with urban space and implementing distinctive transformations for different types of industrial heritage are urgent issues. These structures, often remnants of the city's industrial past, require careful integration into modern urban planning to ensure their preservation while meeting contemporary needs. The silo is a typical heritage element, a symbolic industrial heritage of the warehousing industry, suitable for flexible use. As urban landscapes evolve, silos serve as iconic reminders of industrial advancement and economic history, bridging the gap between past and present. Its unique form, cylindrical body, gives people a sense of roundness and towering height, often possessing landmark characteristics.(Wang et al., 2021) These characteristics not only contribute to the city's skyline but also offer unique opportunities for innovative architectural reuse. In addition, silos, due to their unique characteristics, have become carriers of collective urban memory. They encapsulate the historical narratives of industrial growth and transformation, becoming cultural touchstones within the urban fabric. As a highly representative building type within industrial heritage, the transformation of silos is worth studying.

Based on the materials used, silos can be classified into two types: steel plate silos and reinforced concrete silos. Reinforced concrete silos were utilized earlier. These early structures represent significant technological advancements in construction and materials science. With the rapid growth of demand for bulk material storage at the beginning of the 20th century, along with the advantages of large capacity, small footprint, and high labor productivity, cylindrical silos began to be constructed internationally (Liu et al., 2018). This international trend reflected a global shift towards industrial efficiency and large-scale production capabilities. Currently, almost all silo renovations worldwide are for reinforced concrete silos. The preference for reinforced concrete is due to its durability and adaptability to various modern uses. The six cases mentioned earlier are all transformations of reinforced concrete silos. Each case demonstrates different approaches to adaptive reuse, highlighting the potential of these structures to be repurposed for contemporary functions while retaining their historical significance. Below is a summary of these cases(see chart 4).

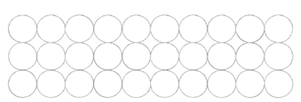
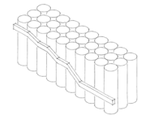
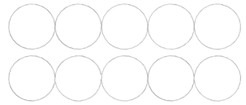
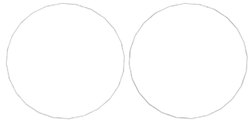
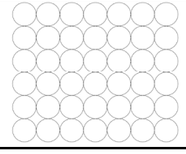
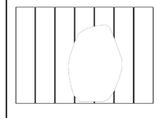
Case Study	Construction Time / Renovation Time	Location	Number	Diameter (m)	Height (m)	Original use/ After Renovation
80,000-ton silos on Minsheng Wharf	1997/2017	Shanghai	30	12	48	Warehouse/Exhibition
Prototype			Reuse Strategy		1. External Staircase 2. Addition of Steel Frame and Reinforced Concrete Structure 3. Addition of Traffic Core Inside the Silo	
Case Study	Construction Time / Renovation Time	Location	Number	Diameter (m)	Height (m)	Original use/ After Renovation
Shougang West Ten Silos	1919/2016	Beijing	6	20	30	Warehouse/Office
Prototype			Reuse Strategy		1. Adding a steel frame to form a reinforced concrete shear wall structure for the silo 2. Renovating the building facade by creating light wells and atriums 3. Adding extensions to the top of the silo	
Case Study	Construction Time / Renovation Time	Location	Number	Diameter (m)	Height (m)	Original use/ After Renovation
DaChan Flour Mills Interconnected Silos	1980/2015	Shenzhen	10	12	33	Warehouse/ Cultural, Educational
Prototype			Reuse Strategy		Reorganizing the interior space and adding lightweight structures to the top.	
Case Study	Construction Time / Renovation Time	Location	Number	Diameter (m)	Height (m)	Original use/ After Renovation
KANAAL	1857/2017	Wijnegem, Belgium	8	8	31	Warehouse/Residential
Prototype			Reuse Strategy		1. Replace two of the circular silos with square silos. 2. Use irregularly shaped windows for natural lighting.	
Case Study	Construction Time / Renovation Time	Location	Number	Diameter (m)	Height (m)	Original use/ After Renovation
FRØSILO	1997/2005	Shanghai	2	25	42	Warehouse/Residential
Prototype			Reuse Strategy		1. Apartments hang on the exterior of the silos, forming two "super vertical shafts". 2. Both cores are covered by transparent roofs.	
Case Study	Construction Time / Renovation Time	Location	Number	Diameter (m)	Height (m)	Original use/ After Renovation
Zeitz MOCAA	1990/2017	CAPE TOWN	42	5.5	27	Warehouse/ Museum
Prototype			Reuse Strategy		1. Reduce the original concrete to form a concrete core structure. 2. Carve out a central atrium resembling the dome of a cathedral.	

Chart.4 Summary of case studies (Drawn by author)

3.8 Case Analysis and Design Implications

The preservation and adaptive reuse of industrial heritage have become critical themes in contemporary urban regeneration. This chapter selects six representative silo renovation projects for detailed analysis. Through multidimensional comparison and evaluation, it aims to extract design strategies and methodological frameworks applicable to the protection and innovative reuse of industrial heritage within Qingdao Port, a site with its own unique set of challenges and opportunities.

3.8.1 Shanghai Minsheng Wharf 80,000-ton Silo: A Synergy of Tradition and Innovation

The Minsheng Wharf Silo Renovation Project exemplifies the notion of "minimum intervention" (Cheng, 2024). This concept is crucial for the preservation of industrial legacy, seeking to enhance spatial flexibility while respecting the original design. The project addressed three primary issues: facilitating vertical movement, enhancing accessibility to enclosed areas, and integrating new and existing structures.

The design team implemented an external escalator system to facilitate the seamless transit of individuals from the third floor to the exhibition hall on the uppermost level. This method not only resolved circulation issues but also provided individuals with a unique visual and spatial experience. The renovation of the first floor, with the installation of expansive windows and doors that are double the height, transformed the former storage space into an open "urban living room." The design retained the multi-story vertical voids within the silos, enhancing the spacious and industrial ambiance, ideal for an exhibition.

The central concept of the project is "new-old coexistence" (Yan et al., 2025), signifying that time serves as a design element that unites the past and present. The new pieces differ from the old ones, however they complement them effectively. They honour the basic framework while revitalising it. This approach exemplifies Qingdao Port by demonstrating how minor, deliberate modifications can enhance operational efficiency while preserving the aesthetic value of industrial heritage.

3.8.2 Beijing Shougang Xishi Silo: Translating Industrial Scale into Human Experience

The Shougang Industrial Park renovation demonstrates the humanization of super-scale industrial structures. The design team innovatively introduced the concept of “courtyard spaces,” transforming industrial layouts based on production logic into inviting urban environments (Zhu & Li, 2022).

Three strategies were adopted: the insertion of medium-scale infill buildings to bridge the gap between industrial and human scales; the creation of a three-dimensional pedestrian network connecting dispersed structures through aerial corridors and rooftop walkways; and the use of lightweight materials such as weathering steel and glass curtain walls to accommodate new functions while retaining the industrial texture.

This fusion of traditional spatial wisdom and contemporary industrial heritage design provides cultural insights for Qingdao Port’s redevelopment. It highlights the importance of translating local identity and cultural narratives into design language to foster spaces with strong urban and emotional resonance, a key aspect of high-quality landscape design in such projects.

3.8.3 Shenzhen Dachan Flour Mill Silo: Spatial Reconstruction and Functional Integration

The Dachan Flour Mill renovation illustrates how diversified programs can be integrated within limited structural envelopes(Zhang et al., 2012), reflecting a reuse model that enhances value and design. Through internal spatial reorganization and lightweight extensions, the silos were transformed into a multifunctional cultural complex comprising an art museum, library, meditation chamber, and office spaces.

A continuous public steel staircase was inserted as the central circulation spine, serving both as a vertical connector and as a spatial organizer for the exhibition flow. Additionally, a transparent volume added atop the silos accommodates offices and meeting rooms, establishing a dialogue between the historic and the contemporary.

The project embodies the concept of “maximized structural intervention, minimized morphological change,” achieving functional renewal while maintaining the building’s historical exterior. This design strategy is directly relevant to Qingdao Port, where functional diversification must coexist with the preservation of industrial identity.

3.8.4 KANAAL Project, Belgium: Temporal Dialogue through Materiality

The KANAAL project exemplifies Europe’s balanced approach to industrial heritage regeneration. Its distinctive feature lies in material contrast: retaining the original gray concrete silos while introducing new volumes of reflective white glass and timber.

This duality enhances natural lighting and environmental comfort while emphasizing the historic fabric’s visual and tactile presence. The project integrates residential, studio, museum, and office functions, forming a self-sustaining mixed-use community.

The case suggests that adaptive reuse need not adhere strictly to full preservation; selective replacement and deliberate contrast can, in fact, strengthen historical memory(Yan et al., 2025), treating the old structure as a living document layered with history. For Qingdao Port, this approach provides valuable insight into achieving equilibrium between preservation and innovation.

3.8.5 FRØSILO, Copenhagen: Structural Innovation and Radical Adaptation

The FRØSILO project represents one of the most radical approaches to silo transformation. Prefabricated floor plates were attached externally to the silos to create residential units, while the internal cylindrical voids were preserved to maintain their monumental spatial experience.

A glass roof encloses the central silos, forming a naturally lit atrium, while housing units radiate around the perimeter to maximize landscape views.

Though technically demanding and costly, this project offers a critical lesson for Qingdao Port: unconventional structural thinking can yield remarkable spatial outcomes(Feng & Wang, 2010). Particularly in waterfront contexts, maximizing visual potential through innovative spatial configurations can significantly enhance user experience and urban vitality.

3.8.6 Zeitz MOCAA, Cape Town: Sculptural Transformation and Spatial Drama

The Zeitz Museum of Contemporary Art Africa (MOCAA) stands as one of the most dramatic examples of industrial heritage transformation. Through sculptural subtraction, the design carved out a cathedral-like atrium from the dense concrete silos, creating a monumental interior experience reminiscent of organic grain forms(Yan et al., 2025).

The project successfully converted a functional industrial complex into a powerful cultural landmark, preserving both the physical evidence and the emotional memory of its industrial past. By selectively removing certain silos and retaining others for circulation and services, the design achieved a delicate balance between destruction and preservation.

This project exemplifies how strategic demolition and spatial reconfiguration can unlock the latent potential of industrial structures—offering a compelling precedent for Qingdao Port, where redundant silo volumes could be similarly reinterpreted. This approach aligns with the concept of using time as a design material, creating a powerful dialogue between the historical and the contemporary.

3.8.7 Comparative Analysis and Implications for Qingdao Port

A comparative review of these six cases reveals three dominant models of adaptive reuse(Cheng, 2024):

i: Minimal Intervention Model – exemplified by Minsheng Wharf;
ii: Cultural Translation Model – exemplified by Shougang and Dachan Flour Mill;
iii: Structural Innovation Model – exemplified by KANAAL, FRØSILO, and Zeitz MOCAA.

These cases show what is most difficult about restoring industrial heritage: finding a creative balance between keeping the past alive and meeting modern needs.

The insights for Qingdao Port can be summed up as follows:

i: Context for Spatial Strategy and Policy: Interventions should be in line with the needs of the city and the structural integrity of the buildings. They can also be based on Shandong's policies for redeveloping low-efficiency urban land. Silos that are in good shape and have a strong industrial look may take a "light-touch" approach like Minsheng Wharf. Those that need programmatic integration can use Dachan's internal reconstruction model.

ii: Cultural & Local Identity Dimension: Design should reinterpret Qingdao's maritime and industrial culture into tangible architectural language(Ding et al., 2014), avoiding generic, placeless solutions. This requires a deep understanding of the port-city relationship and the characteristics of Qingdao's port industrial heritage. The Shougang project demonstrates that embedding local identity fosters spatial authenticity and public connection.

iii: Technical & Economic Sustainability: The dialogue between new materials and existing structures must account for coastal climate durability and structural safety, ensuring long-term sustainability. Furthermore, exploring diverse reuse modes is essential for improving the value and economic sustainability of the regeneration effort(Wang, 2023).

In conclusion, Qingdao Port's industrial heritage regeneration should critically absorb lessons from international precedents while responding to its specific urban and cultural context. The ultimate goal is to develop a comprehensive design approach that integrates cultural depth, technical feasibility, and economic sustainability—thereby transforming the site into a living interface between history and contemporary urban life.

Introduction to Qingdao

4.1 The urban development history of Qingdao

4.2 Qingdao industry development

4.3 Characteristics of Qingdao's industrial heritage

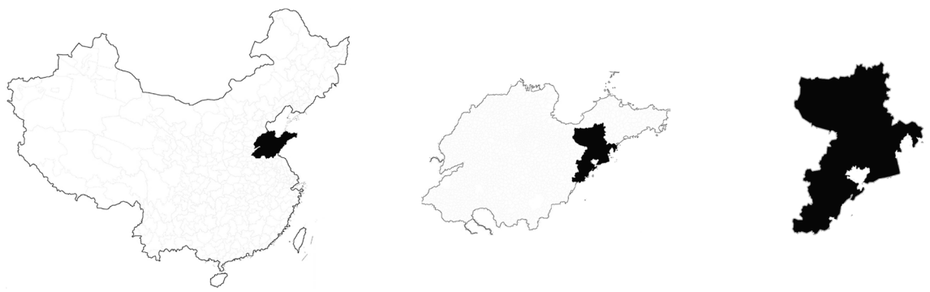


Fig.43 Location Map of Qingdao (Drawn by author)

Item	Location	Administrative Divisions (7 Districts & 3 County-level Cities)	Resident Population	Total Area
Details	Situated on the southern coast of the Shandong Peninsula. It is bordered by the Yellow Sea to the east and south, neighbors Yantai City to the northeast, Weifang City to the west, and Rizhao City to the southwest.	Districts: Shinan District, Shibei District, Huangdao District, Laoshan District, Licang District, Chengyang District, Jimo District. County-level Cities (administered by Qingdao): Jiaozhou City, Pingdu City, Laixi City.	10.44 million (as of the end of 2024).	11,293 km² (land area).

Chart.5 Basic Geographic Profile of Qingdao (Data as per the latest official information)

4.1 The urban development history of Qingdao

Qingdao was originally a natural fishing village. Later, due to the needs of the Qing government's coastal defense construction, it developed into a "city"(Li & Li, 2005). The introduction of urban planning by German colonists accelerated its transformation from a "village" to a "city".From 1897 to 1914, Germany leased an area of 551 square kilometers around Jiaozhou Bay and named it "Qingdao." This marked the first appearance of the term "Qingdao" as an administrative district name on the historical stage. The German leased area spread outward from Jiaozhou Bay, with Qingdao Bay chosen as the starting point for urban development, and development expanded around the bay. During this period, Qingdao Port and the Jiaoji Railway were established.

From 1897 to 1914, Germany leased an area of 551 square kilometers around Jiaozhou Bay and named it "Qingdao." This marked the first appearance of the term "Qingdao" as an administrative district name on the historical stage. The GermanBay chosen as the starting point for urban development, and development expanded around the bay. During this period, Qingdao Port and the Jiaoji Railway were established.

From 1914, Qingdao became a Japanese concession. Due to the existing transportation infrastructure, Qingdao was able to develop, and the urban area began to expand to the right.

In 1922, Qingdao was returned to China, and during this period, Qingdao developed steadily. Some further development occurred in the northern part of the city. However, development stagnated for a period after the start of the war in 1937.

Until the 1960s, after the founding of the People's Republic of China, due to the increase in the labor force, the Qingdao government proposed the "work in the south and live in the north" policy. The urban area of Qingdao began to extend northward along the Jiaoji Railway, with residential areas added along the industrial zone.

In 1978, during the period of reform and opening up, Qingdao experienced an important turning point. Huangdao District was established and assigned to Qingdao, along with Jiaozhou County, Jiaonan County, and Jimo County. At this time, the urban area of Qingdao finally expanded.

In 1983, Pingdu County and Laixi County were assigned to Qingdao. This marked the completion of Qingdao's overall expansion. Subsequent adjustments were made to internal divisions, but there was no further expansion in area.Although the jurisdictional area expanded significantly, for a long time, the built-up area of Qingdao was still composed of "Shinan District, Shibei District, Taidong District, Sifang District, and Cangkou District."

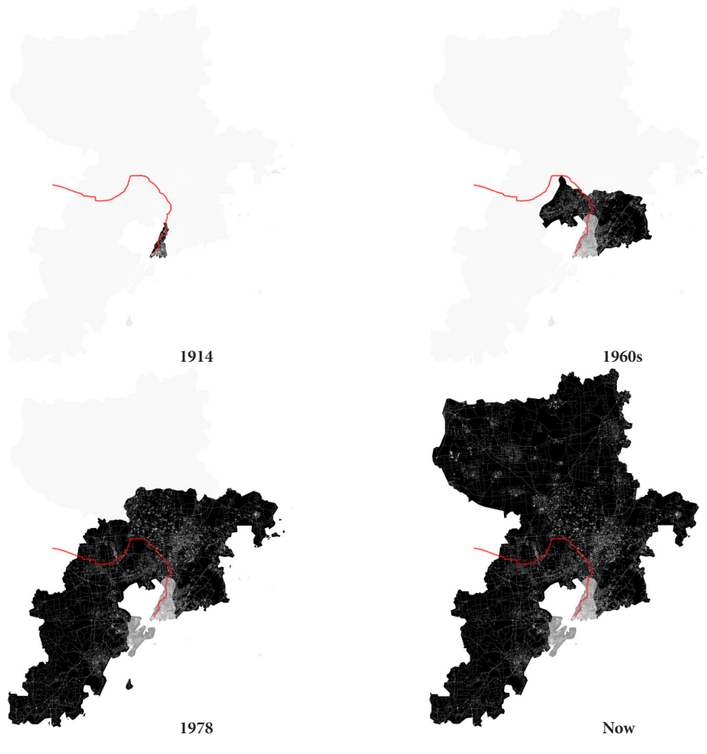


Fig .44 *The urban development history of Qingdao (Drawn by author)*

4.2 Qingdao industry development

Since Qingdao's opening in 1891, over 130 years ago, it has transformed from a small fishing village into an international port city. Initially built around its port and developed along the axis of the Jiaozhou-Jinan Railway, Qingdao gradually expanded eastward and eventually formed a pattern of expansion centered around Jiaozhou Bay, radiating outward in all directions.
Since 1891, Qingdao's industrial development can be roughly divided into the following seven stages:

Pre-industrialization era: Construction of Qingdao

Qingdao has a long history, formerly belonging to Jimo County. According to the "Jiao'ao Zhi" (Record of Jiaozhou and Qingdao), "Jimo was once part of the domain of Qingzhou in the Yu's tribute, an ancient land of Dongyi, initially a Yi state in the Zhou dynasty, later assimilated into the Qi state as Jimo."(Zhao, 1928) The Qingdao area was once an important port in northern China. However, after the Tang and Song dynasties, due to the southward shift of China's economic center and the gradual decline of maritime trade, the port of Qingdao fell into silence. By the end of the Qing Dynasty, Qingdao had already declined, becoming a gathering place for fishing boats with around three to four hundred households, mainly engaged in fishing(Fan & Liu, 2011). At the end of the 19th century, due to various international reasons and the gradual strengthening of international defense awareness, Qingdao, as an excellent military port, began to be valued. In 1891, the Qing government stationed troops here, and Qingdao began to develop from a fishing village into a town.

Industrial germination

In 1897, Germany occupied Qingdao and invested heavily in the city's construction, including the port, railway, and municipal industry. Transportation was prioritized, with a focus on integrating the layout of the port, railway, and urban construction. Urban development was promoted through port construction, and by 1908, significant progress had been made in building ports and roads. During this period, Qingdao established its first shipyard and locomotive factory - the Qingdao Shipyard and Sifang Locomotive Factory. The Jiaozhou-Jinan Railway began operation in 1904, connecting Qingdao to other regions and laying a solid foundation for industrial development. Germany also constructed basic industrial facilities such as power plants, waterworks, and slaughterhouses, making Qingdao one of the most industrially advanced cities in China at the time. With the formation of basic industrial infrastructure, industrial products manufactured in Qingdao could be exported to other ports or overseas via the port and railway. Consequently, Germany further established a number of profit-oriented factories. For example, the earliest textile enterprise in Qingdao, the Dehua Silk Mill(later renamed as Qingdao Huaxin Silk Mill), was founded in 1902. It "had the ability to supply a kind of wild silk with unparalleled fineness and uniformity in texture, which was smoother and easier to dye than products from other factories, providing a new variety for some silk weaving and printing and dyeing factories."(Zhang, 2016) Additionally, there were many small-scale enterprises such as soda factories, refined salt factories, egg product factories, and cooperages. During this period, Germany's contribution to the industrial development of Qingdao cannot be underestimated, as they were the pioneers of modern industrialization in Qingdao.

Formation of Qingdao's industrial structure

In 1914, Japan replaced Germany in occupying Qingdao. During this period, Japan introduced numerous immigrants and attracted investments to consolidate its rule. Japanese capital dominated Qingdao's industrial landscape and established a textile-centered structure to serve its interests. By 1922, the Japanese

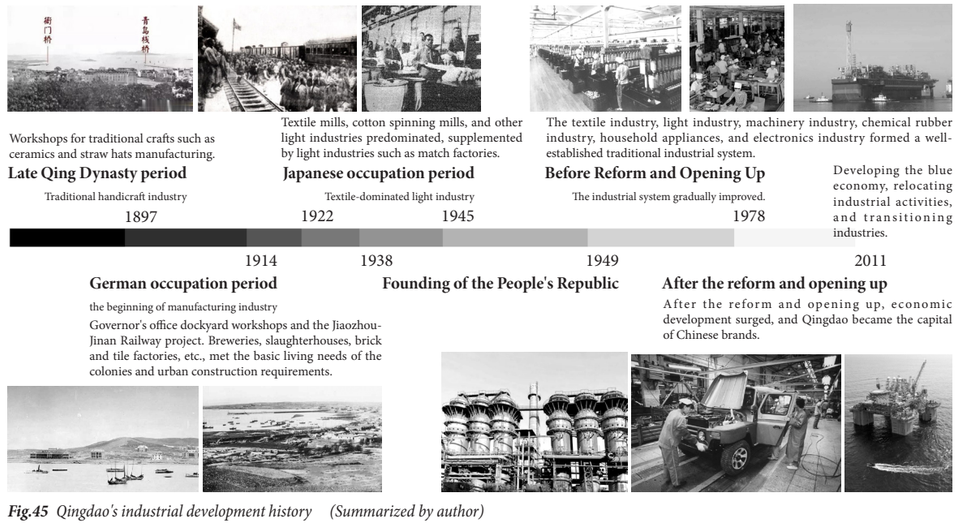


Fig.45 *Qingdao's industrial development history (Summarized by author)*

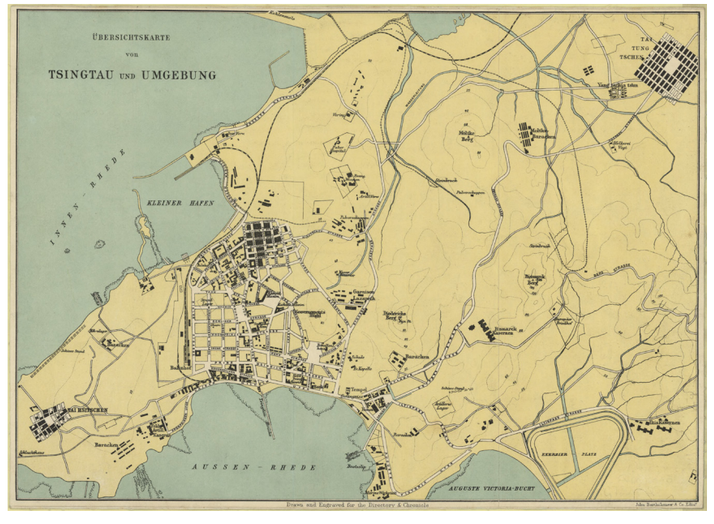


Fig.46 *1910s Qingdao and surrounding area map (Source: http://www.txlzp.com ditu/5790.html)*

population in Qingdao reached its peak, with "6,491 households and 23,566 individuals."(Zhao, 1928) Japan continued to control various enterprises along the railway, focusing on the textile industry due to advantages such as cheap labor and raw materials, proximity to consumer markets, and a suitable climate. Major yarn mills like Dakang, Fuji, Zhongyuan, Longxing, and Baolai were established between 1921 and 1923. These six yarn mills had a total capital of over 80 million yuan and employed over 16,000 workers(Gu, 2014). During this period, Chinese-owned enterprises struggled to establish themselves. Despite these struggles, enterprises like the Huaxin Silk Mill, acquired by Chinese industrialist Zhou Xuexi in 1913, faced challenges under Japanese dominance. By the time Japan returned administration to China, Japanese capital exceeded 5 million yuan, with over 80 Japanese companies and extensive land leases. Although Qingdao, under Japanese control, did not manage to form an independent industrial system, it objectively established Qingdao's position as a major silk weaving center in northern China.

Development under the Nanjing Nationalist Government

During the period from 1929 to 1937, although the dominant position of Japanese capital in Qingdao's industry remained largely unchanged, there was significant progress in the development of Qingdao's domestic capital industry, maintaining a positive momentum. The continued dominance of Japanese capital was mainly reflected in the continuous development of its cotton textileindustry. In the years 1935 and 1936, Japanese capital continued to build three new yarn mills in Qingdao, namely Shanghai Yarn Mill, Toyota Yarn Mill, and Tongxing Yarn Mill, bringing the total number of Japanese-owned yarn mills in Qingdao to nine(Fan & Liu, 2011). At the same time, the status of Qingdao's textile industry

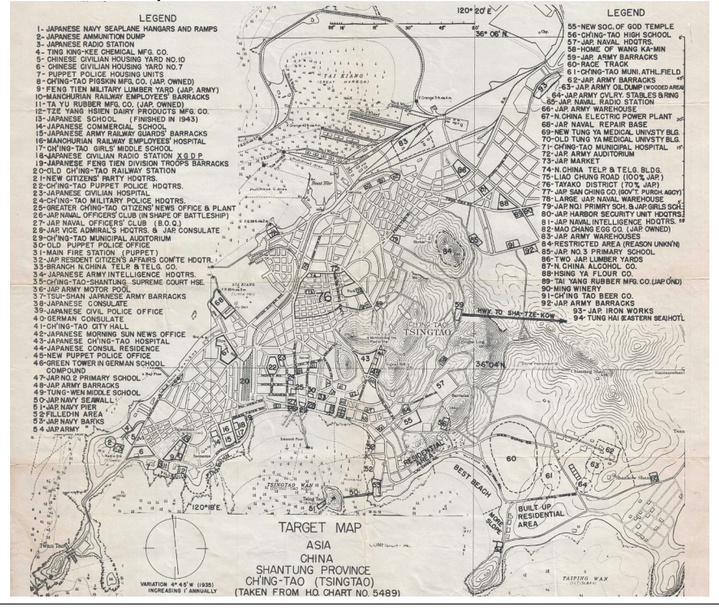


Fig.47 *1910s Qingdao and surrounding area map (Source: http://www.txlzp.com/ditu/5790.html)*

in the national industry continued to rise. Nationally, "Qingdao's textile industry, mainly dominated by Japanese capital, had 568,400 spinning spindles, accounting for 10% of the national total, and 9,286 looms, accounting for 15% of the national total, second only to Shanghai." Despite the continued dominance of foreign capital, Qingdao's domestic capital industry made significant progress in terms of the number of factories, total capital, and industries involved, continuously narrowing the gap with foreign capital. Due to government policy support and regional stability, the period from 1929 to 1937 can be considered the golden age of modern industrial development in Qingdao. Both foreign-owned and domestic industries made significant progress during this period, with the development of domestic industries being particularly remarkable.

Before the establishment of the People's Republic of China

This stable development situation lasted only for 8 years. After the outbreak of the full-scale Anti-Japanese War in 1937, the mayor of Qingdao received an order from the Nationalist Party leader Chiang Kai-shek to implement a scorched-earth policy. All Japanese factories, including the nine major yarn mills, were bombed. From then until the establishment of the People's Republic of China, Qingdao's industrial development came to a standstill. When the People's Republic of China was established in 1949, the total industrial output value of Qingdao was only 200 million yuan, and its fixed assets were only 430 million yuan.

Before the Reform and Opening Up

After the People's Republic of China was founded, the industries that were already there in Qingdao changed completely, and new ones grew quickly. The layout of the industries made more sense, and businesses grew in size and production capacity over time.

After the Reform and Opening Up

Since the start of the Reform and Opening Up, Qingdao's industrial economy has grown quickly, making its economic power stronger than ever before. The structure of industry has changed a lot, and the level of industrialisation has also gone up a lot. This time was a historic jump from the beginning of industrialisation to the middle of it. Qingdao has gone from having a weak industrial base, old technology, and only a few types of industries to having a much stronger industrial base, steadily improving technology, and adding more types of industries. The industrial sector has played a big role in the overall growth of Qingdao's national economy and the building of a moderately prosperous society.

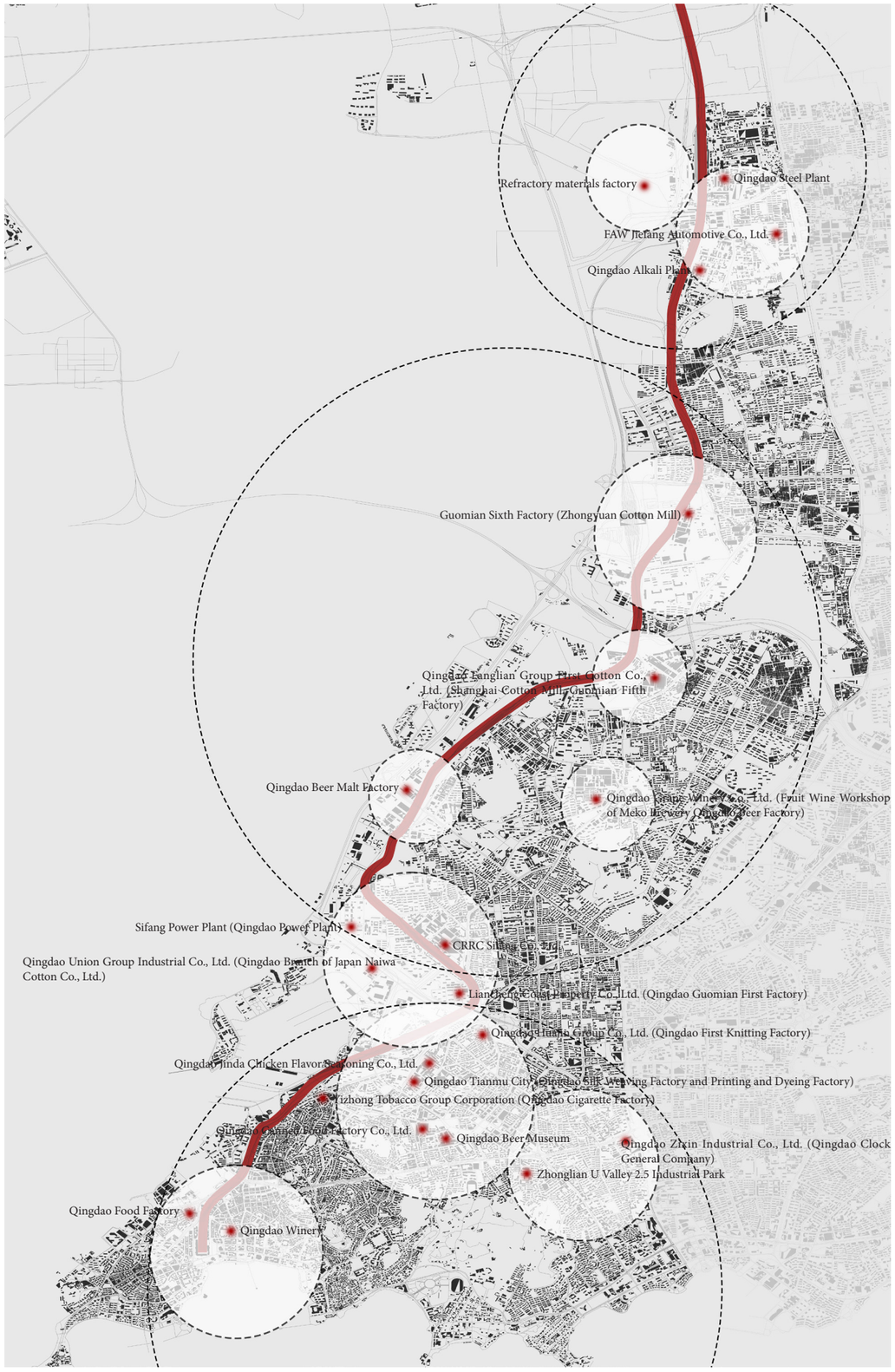


Fig.48 *Distribution of Major Industrial Heritage Sites in Qingdao (Drawn by author)*

4.3 Characteristics of Qingdao's industrial heritage

The characteristics of Qingdao's industrial heritage can be summarized in three aspects: first, the interdependent relationship between industrial heritage and urban space; second, the types of usage of industrial heritage; and third, the current status of protection and reuse of Qingdao's existing industrial heritage.

The Interdependent Relationship Between Industrial Heritage And Urban Space

i: Spatial distribution characteristics
Qingdao's modern industrial (architectural) heritage has distinct characteristics in terms of spatial distribution, composition, and form. These are primarily reflected in its dependency on the port and railway, the mountain-sea features of its spatial layout, and the clustering and dispersion of heritage sites.

ii: Dependency on the port and railway

The port and railway in Qingdao made it a well-known city. The Jiaozhou-Jinan Railway and Qingdao Port have been very important to the city's growth in the modern era. The port and railway were the main parts of the city from the very beginning of the German planning of Qingdao. The Germans made good use of the Jiaozhou Bay coastline by skilfully figuring out how to connect the port, railway, and city. This made these structures even more important to Qingdao's urban landscape.

During different times in history, Qingdao's leaders always made sure to build and keep up the port and railway, which made them even more important to the city.

Modern industry in Qingdao has worked hand in hand with the port and railway to help the city grow. Modern industry is different from traditional handicrafts because it involves large-scale production and operation, which means that raw materials and products need to be moved quickly. This need is way too much for traditional transport to handle, so modern ports and railways are very important for industrial growth. As a result, the port and railway have become very important to the growth and decline of Qingdao's modern industry.

The Types Of Usage Of Industrial Heritage

Qingdao's industrial heritage can be broadly categorized into five types based on usage: textile production, port transportation, food processing, heavy machinery, and other categories.

i: Textile Production

Qingdao's textile industry was once renowned as "reaching to the sky". During the 1950s and 1960s, nearly every household had members engaged in textile production, earning it the nickname "Qingdao's mother industry"(Zhang, 2019).

ii: Port Transportation
Qingdao, as an important port city in China, plays a crucial role in the urban expansion and industrial development driven by port transportation (Jia et al., 2019). The port transportation industrial heritage mainly includes Qingdao Port and Jiaoji Railway.

iii: Food Processing
Qingdao has given birth to many well-known Chinese food brands, such as Qingdao Beer, Qing Shi Biscuits, Laoshan Mineral Water, and others. These brands equally represent the industrial prowess of Qingdao.

iv: Heavy Machinery
Qingdao is at the forefront of domestic industries including train, ship, and automobile manufacturing. It has given birth to renowned brands such as the Type 81 steam locomotive, Dongfanghong diesel locomotive, and Qingdao 69 branded automobiles, all of significant historical importance domestically and internationally. Heavy industry is also one of the industrial pillars of Qingdao.

v: Other Categories
Apart from several main industrial types, Qingdao has also preserved numerous industrial heritages with distinctive characteristics of their times and regions. These include military defense, hydroelectric supply, petrochemicals, and commodity processing, among others, all of which have made significant contributions to the urban development and social progress of Qingdao.

Industrial Development Trend In Qingdao

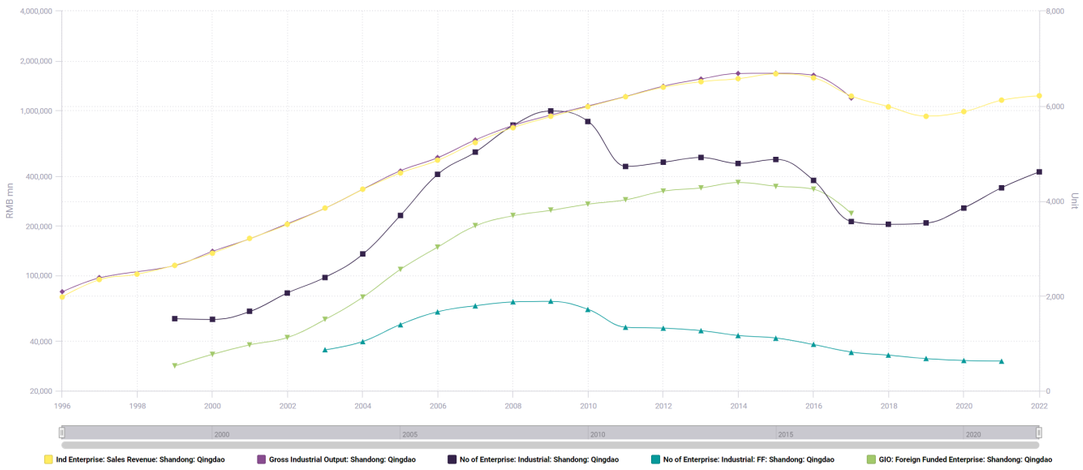


Chart.5 Industrial Development Trend In Qingdao (Date Source: Ceicdata.com)

The Current Status of Qingdao's Industrial Heritage

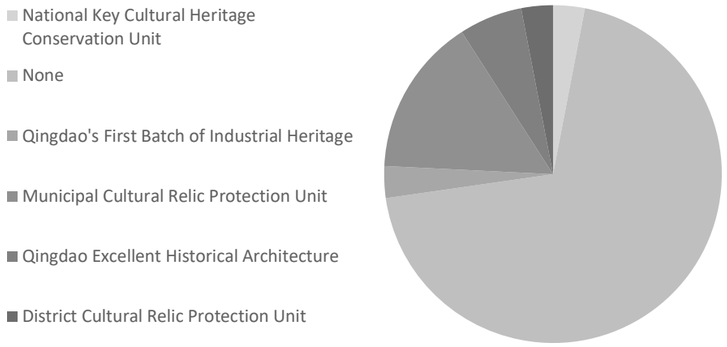
Between 2000 and 2020, Qingdao's industrial development stagnated and even declined (see chart 5). This decline was primarily attributed to urban transformation, which rendered traditional industries like textiles and automobile manufacturing less competitive. In response, the Qingdao municipal government launched the "14th Five-Year Plan for High-Quality Manufacturing Development in Qingdao" in 2021. The plan aims to bolster industrial clusters' capacity and competitiveness, develop modern marine industry clusters, accelerate next-generation information technology clusters, establish advanced manufacturing clusters for intelligent home appliances and rail transit equipment, and enhance new energy vehicle clusters, ultimately aiming to establish leading advanced manufacturing clusters in China.

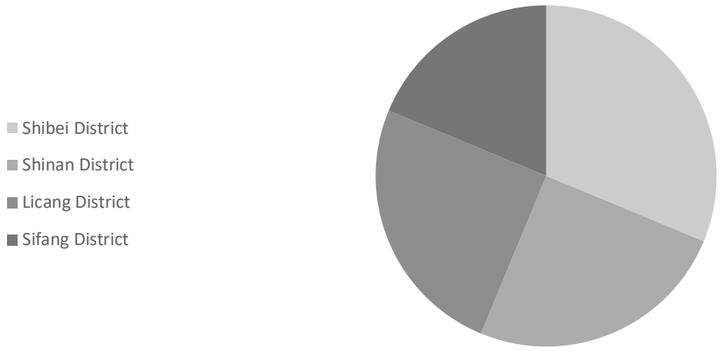
During this period, many industrial sites were inevitably abandoned, subsequently becoming sources of Qingdao's industrial heritage. Based on statistics, Qingdao boasts nearly 100 industrial heritage sites, though detailed information is scarce for most. Following rigorous screening, a list of 33 major sites was compiled, detailing addresses, construction dates, industrial types, protection levels, land areas, and current statuses (see chart 6). Detailed introductions were provided for three selected sites. Subsequent analysis (see chart 7) revealed that Qingdao's industrial heritage mainly dates back to periods of Japanese and German occupation and post-liberation. Most sites are concentrated in Shinan, Shibei, and Licang districts, predominantly linked to secondary industries. Approximately one-quarter of these sites are underutilized, and three-quarters lack any formal protection status.

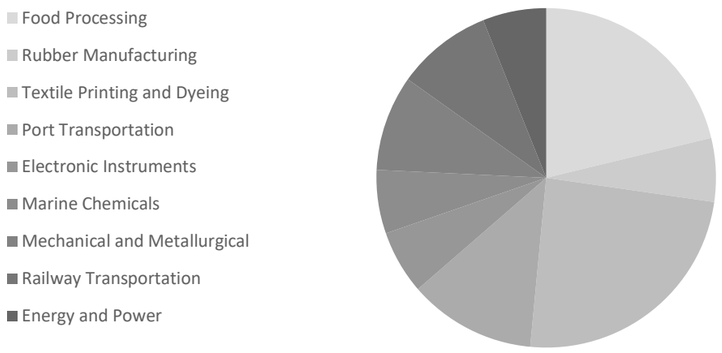
There are three main ways to redevelop Qingdao's industrial heritage: as a creative industry park, a museum, or a heritage park. This framework follows the usual ways that Chinese industrial heritage is redeveloped, which were talked about in section 2.6. For example, the renovation of Guomian No. 6 Factory used the creative industry park model to combine business and landscape design to make cultural landscape districts. The Qingdao Brewery is part of the museum mode. It uses the "restoration to the original state" principle to show how it has changed over time and how it works. It also has shopping centres and tasting areas, which makes it a good example of how to redevelop industrial heritage museums in China. The Qingdao Olympic Sailing Centre is a great example of a heritage park. That's where the first Beihai Shipyard was moved to. It then added Olympic features and fun things to do, which is appropriate for a tourist city like Qingdao.

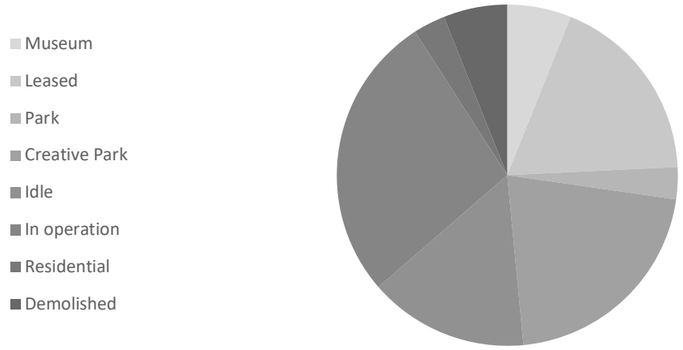
Industrial Heritage Name	Address	Year	Industry Type	Protection Level	Land Area	Number of Floors	Current Use
Tsingtao Brewery	No. 56 Dengzhou Road, Shibei District	1903	Food Processing	National Key Cultural Heritage Conservation Unit	90000	Mostly multi-storey	Museum
Qingdao Rubber Factory No. 6	No. 36 Huayang Road, Shibei District	1952	Rubber Manufacturing	None	60000	Mostly multi-storey	Idle
Qingdao Embroidery Factory	No. 100 Nanjing Road, Shinan District	1954	Textile Printing and Dyeing	None	9999	Mostly multi-storey	Leased
Tongtai Rubber Factory	No. 18 Ninghai Road, Shibei District	1934	Rubber Manufacturing	None	10000	Mostly single-storey	Leased
Qingdao Beihai Shipyard	No. 121 Yanmen Road, Shinan District	1898	Port Transportation	None	73600	Not specified	Park
Qingdao Silk Mill and Dyeing Factory	No. 12 and No. 16A Shangqing Road, Shibei District	1917	Textile Printing and Dyeing	None	Not specified	Mostly single-storey	Creative Park
Qingdao Cathode Ray Tube Factory and Yuantong Electronic Components Factory	No. 122 Nanjing Road, Shinan District	1960	Electronic Instruments	None	33300	Mostly multi-storey	Idle
Qingdao Electronic Medical Equipment Factory	No. 20 Huayang Road, Shibei District	1980	Electronic Instruments	None	30000	Mostly multi-storey	Creative Park
Qingdao Cigarette Factory	No. 20 Huayang Road, Shibei District	1919	Food Processing	None	86580	Mostly multi-storey	Creative Park
Qingdao National Cotton Mill No. 1	No. 2 Coast Road, Xifang District	1919	Textile Printing and Dyeing	Qingdao's First Batch of Industrial Heritage	237000	Mostly single-storey	Creative Park
Qingdao Red Star Chemical Plant	No. 43 Siliu North Road, Licang District	1956	Marine Chemicals	None	160000	Mostly multi-storey	Leased
Qingdao Knitting Factory No. 7	No. 5 Jiading Road, Sifang District	Not specified	Textile Printing and Dyeing	None	100000	Mostly multi-storey	Leased
Qingdao Sifang Locomotive Factory	No. 16 Hangzhou Road, Sifang District	1900	Mechanical and Metallurgical	None	430000	Mostly single-storey	In operation
Qingdao National Cotton Mill No. 5	No. 70 Siliu South Road, Licang District	1934	Textile Printing and Dyeing	None	139860	Mostly single-storey	Creative Park
Qingdao National Cotton Mill No. 6	No. 46 Siliu Middle Road, Licang District	1921	Textile Printing and Dyeing	None	130000	Mostly single-storey	Creative Park
Qingdao Port	No. 6 Xinjiang Road, Shibei District	1892	Port Transportation	None	Not specified	Not specified	In operation
Youneishan Lighthouse	Tuandao Corner, Shinan District	1900	Port Transportation	Municipal Cultural Relic Protection Unit	Not specified	Multi-storey	In operation
Xiaoqingdao Lighthouse	Xiaoqingdao, Shinan District	1898	Port Transportation	Municipal Cultural Relic Protection Unit	Not specified	Multi-storey	In operation
Shandong Road Mining Company Site	No. 14 Guangxi Road, Shinan District	1902	Railway Transportation	Qingdao Excellent Historical Architecture	Not specified	Multi-storey	Residential
Qingdao Dagang Railway Station	No. 2A Shanghe Road, Shibei District	1899	Railway Transportation	Qingdao Excellent Historical Architecture	Not specified	Multi-storey	In operation
Jiaozhi Railway Qingdao Section	Not specified	1899	Railway Transportation	District Cultural Relic Protection Unit	Not specified	Not specified	In operation
Qingdao Governor's Slaughterhouse	No. 65 Xiancheng Road, Shinan District	1903	Food Processing	Municipal Cultural Relic Protection Unit	Not specified	Multi-storey	Leased
Qingdao Soda Water Factory Office Building Site	No. 25 Xianggang West Road, Shinan District	1905	Food Processing	Municipal Cultural Relic Protection Unit	Not specified	Multi-storey	Leased
Qingdao Winery Site	No. 13 Siliu South Road, Licang District	1956	Food Processing	None	11999	Not specified	Museum
Qingdao Brewery No. 4 (formerly Qingdao Alcohol Factory)	No. 6 Yongping Road, Licang District	1928	Food Processing	None	59178	Not specified	In operation
Qingdao Brewery Malt Factory	No. 19 Banghai Middle Road, Sifang District	1993	Food Processing	None	Not specified	Not specified	Demolished
Qingdao Tap Water Factory Site	Shibei District	1901	Energy and Power	Municipal Cultural Relic Protection Unit	Not specified	Not specified	Idle
Qingdao National Cotton Mill No. 2 (formerly Neiwai Cotton Yarn Factory Site)	No. 9 Xingyuan Road, Shibei District	1916	Textile Printing and Dyeing	None	Not specified	Mostly single-storey	Creative Park
Qingdao Textile Machinery Factory	No. 22 Siliu South Road, Licang District	1920	Mechanical and Metallurgical	None	400000	Mostly single-storey	In operation
Qingdao Iron and Steel Plant	No. 5 Zunyi Road, Licang District	1958	Mechanical and Metallurgical	None	1300000	Mostly single-storey	Idle
Huadian Qingdao Power Plant (formerly Sifang Power Plant)	No. 6 Xinglong Road, Sifang District	1936	Energy and Power	None	777000	Mostly single-storey	In operation
Qingdao Haichang Chemical Plant (formerly Qingdao Chemical Plant)	No. 65 Siliu South Road, Licang District	1947	Marine Chemicals	None	400000	Mostly single-storey	Idle
Qingdao National Cotton Mill No. 3	No. 149 Xinglong Road, Xifang District	1921	Textile Printing and Dyeing	None	19600	Mostly single-storey	Demolished

Chart.6 Qingdao's List of 33 Industrial Heritage Sites (summarized by author)









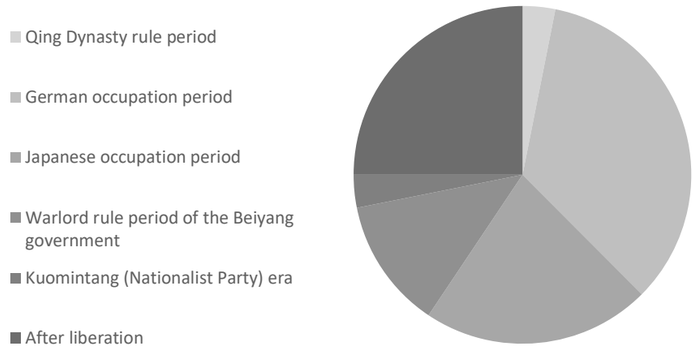


Chart.7 Categorization Summary of Qingdao's 33 Industrial Heritage Sites (summarized by author)

Qingdao National Cotton Mill No.1			
Location	No. 2 Haian Road, Sifang District, Qingdao City, Shandong Province	**Historical Evolution**	·1919: The Daikang Yarn Factory was established in Qingdao by the Japanese company Dai-Nippon Spinning Co., Ltd. ·October 1921: Operations commenced in the factory's first workshop, equipped with 20,000 spindles and employing about 1,000 workers. ·September 1922: A second spinning workshop was added, increasing the factory's spinning capacity by an additional 22,000 spindles. Autumn 1924: Construction began on a third workshop dedicated to weaving, solidifying the factory's position as a major yarn producer in Qingdao. ·January 1946: The factory came under Chinese management and was renamed the Qingdao No. 1 Cotton Textile Factory. ·June 2, 1949: Following Qingdao's liberation, the factory resumed operations under local government control. ·2007: The entire factory relocated, with some buildings preserved as industrial heritage sites. ·June 2009: Preserved buildings were renovated into an art workshop, providing a new cultural space while honoring the factory's history.
Completion Date	1-Sep-19		
Industrial Era	Early 20th century		
Architectural Structure	None		
Industry Type	Light industry		
Current Use	Commercial services		
Building Category	Industrial Building		
Equipment Status	1919 Art Space, Community Commercial District		
Architectural Scale	Plant Area, 229,490 m²		
Protection Level	Some buildings listed as Qingdao's initial industrial heritage		
Founding Entity	Dai-Nippon Spinning Co., Ltd. Qingdao Daikang Yarn Factory		
Architectural Style	Modern Architecture		

Chart.8 Information about Qingdao National Cotton Mill No.1 (summarized by author)

In June 2009, media reported that some of the old factory buildings preserved from the former National Cotton Mill No. 1 would be renovated and integrated with fashionable elements to create the "Red Jinfang 19 One 9 Art Workshop." The five preserved buildings include the auditorium, cafeteria, fine yarn workshop, warehouse, and office building located at the northeast corner of the factory area. In 2010, out of the five factory buildings preserved from demolition, except for the office building and one old factory building, the other three old buildings were demolished. The remaining two sites became the only surviving historical witnesses of the former National Cotton Mill No. 1(QingDaoChengShiDangAn, 2024).

Three decades ago, this place buzzed with the daily flow of thousands of bicycles ridden by textile workers along Haian Road, with tens of thousands of square meters of factory space, 80,000 spinning machines, and thousands of looms operating around the clock. The bustling scenes of the past have now become history(QingDaoChengShiDangAn, 2021).

Fig 49 *National Cotton Mill No.1 (https://www.163.com/dy/article/GS79LVC80543B6OX.html)*

Qingdao Iron and Steel Plant			
Location	No. 5 Zunyi Road, Licang District, Qingdao City, Shandong Province	**Historical Evolution**	·December 1, 1958: Qingdao Third Iron and Steel Plant was officially established. In 1961, the other 6 iron and steel plants in Qingdao were all abolished, leaving only the Qingdao Third Iron and Steel Plant. ·July 1, 1962: Qingdao Third Iron and Steel Plant merged with Qingdao Rolling Mill and Qingdao Wire Rope Plant to form Qingdao Iron and Steel Plant. ·May 18, 1988: Qingdao Iron and Steel Plant merged with Lunan Iron Alloy Plant and was renamed as Qingdao Iron and Steel General Plant. ·Renamed as Qingdao Iron and Steel Corporation in 1992. ·Restructured as Qingdao Iron and Steel Group in 1994. ·In 2011, environmental relocation was officially launched, moving from Licang District to Dongjiakou. ·Groundbreaking took place in February 2013 with a total investment of 16.4 billion yuan and a construction period of 3 years. The main construction included a 7-meter coke oven, 265 square meter sintering machine, 250 cubic meter blast furnace, 120-ton converter, refining continuous casting, and specialized high-quality wire rod production line. The planned annual output is 4 million tons of steel, which has now been put into operation. ·In 2015, Qingdao Iron and Steel's crude steel production was 1.55 million tons.
Completion Date	1-Dec-58		
Industrial Era	Early 20th century		
Architectural Structure	None		
Industry Type	Heavy Industry		
Current Use	Idle		
Building Category	Industrial Building		
Equipment Status	Partially Preserved		
Architectural Scale	Plant Area		
Protection Level	None		
Founding Entity	Qingdao Iron and Steel Holding Group Co., Ltd.		
Architectural Style	Modern Architecture		

Chart.9 Information about Qingdao Iron and Steel Plant (summarized by author)

Qingdao Iron and Steel Plant serves as a collective memory for a generation, leaving indelible marks on the people of Qingdao during that era. On October 13, 1959, the first batch of molten iron was produced at Qingdao Iron and Steel Plant. Mr. Dong Lichu, now nearly eighty years old, witnessed this moment. At that time, he was just over twenty years old. Describing the scene, he said, "As layers of mud were peeled off the furnace mouth, splashes of red-hot molten steel sprayed out, stirring extreme excitement within us." During those years, Qingdao Iron and Steel Plant had only two cars, and all internal transportation relied mainly on manpower. "Back then, we had to produce forty furnaces of steel per day, each furnace producing two tons, all of which had to be completed manually. During the busiest times, every worker worked day and night without rest. When too exhausted, they would take a short break in the dormitory. However, at that time, the so-called 'dormitory' was actually very rudimentary shacks."(Wang, 2015)

Fig 50 *Qingdao Iron and Steel Plant (Source: https://www.sohu.com/a/305827141_281892)*

Qingdao Brewery			
Location	Dengzhou Road 56, Shibei District, Qingdao, Shandong Province	**Historical Evolution**	·On August 15, 1903, German and British businessmen from the Anglo-German Brewery Company established "Germania Brewery Company, Tsingtao Co., Ltd." near the He Bo Camp in Qingdao to meet the beer demand of German troops and expatriates. This brewery eventually became the predecessor of Tsingtao Brewery Co., Ltd. ·After World War I broke out, Qingdao was occupied by Japan. The brewery was acquired by Tokyo's "Dainippon Beer Company" and renamed "Dainippon Beer Company, Qingdao Plant." They marketed their products across China under brands like "Tsingtao," "Asahi," and "Kirin." Following Japan's defeat in August 1945, the Nanjing National Government took control and renamed it "Tsingtao Brewery Company." Later, it was simplified to "Tsingtao Brewery," focusing solely on the "Tsingtao" brand. ·Since Qingdao's liberation, Tsingtao Brewery has grown with support from the Communist Party and government, expanding production and enhancing technology and quality. ·Today, Tsingtao beer is exported to over 40 countries and territories, representing more than 50% of China's beer exports. In 2003, Tsingtao Brewery entered the top ten global beer brands. By 2004, it was valued at RMB 16.873 billion, ranking among China's top 500 most valuable brands.
Completion Date	1903		
Industrial Era	Early 20th century		
Architectural Structure	None		
Industry Type	Food Industry		
Current Use	Commercial Development		
Building Category	Industrial Building		
Equipment Status	Qingdao Beer Museum		
Architectural Scale	Factory Area, 182,320 m²		
Protection Level	National Cultural Heritage Protection Level		
Founding Entity	German and British merchants		
Architectural Style	German-style architecture		

Chart.10 Information about Qingdao Brewery (summarized by author)

"The museum features over 30,000 artifacts across three main exhibition areas: 'Centennial Cultural History', 'Brewing Technology Development', and 'Experiencing the Charm of Beer'," explained Jiang Wei, Honorary Curator of the Qingdao Beer Museum(Wang, 2023). Housed in a nationally protected industrial building, the museum is a leading figure domestically. Due to Qingdao locals' deep affection for Qingdao Beer, it remains immensely popular after its transformation from the Qingdao Beer Factory. The museum successfully utilizes collective memory to preserve the legacy associated with Qingdao Beer for future generations.

Coming to the Qingdao Beer Museum is like browsing through a condensed history of China's beer industry and the development of Qingdao Beer. For this museum, hailed as the "flagship of China's industrial tourism," breaking the boundaries of industrial tourism and achieving better integration of culture and tourism has always been a challenge it strives to address(Jiemian Shandong, 2023).

Fig 51 *Comparison of Qingdao Beer Factory Then and Now*

4.4 Problems and Strategies

Despite Qingdao's ongoing efforts in recent years to renovate its industrial heritage and some practical examples of redevelopment where new functions have been assigned to old industrial sites, preserving some old buildings, aside from the renovation outcomes, represents significant progress. However, it is undeniable that there are challenges in the process of reusing industrial heritage, impacting the future fate of these sites.

First of all, there is a strong push towards commercialisation. The main idea behind the renewal of industrial heritage is "renovation-utilization-protection." However, commercial interests have gotten in the way, making the change to industrial heritage less clear. The heritage buildings have been changed in a brutal way under the pretence of renovation, which has caused them to lose their original look and industrial traces. Qingdao Tianmu City is an example of this because it is too commercialised.

Fig 52 *The Tianmu City, built in 2007, is now facing demolition (Source: https://baijiahao.baidu.com/s?id=1761617676358750943&wfr=spider&for=pc)*

Second, there are a lot of creative industry parks close to each other. Many cities have started to copy Beijing 798, Beijing 751, and Shanghai M50 because they were so successful. Qingdao has set up the Animation Creative Industry Park, the Zhonglian U-Valley 2.5 Creative Industry Park, the Qingdao 1919 Creative Park, the Nanjing Road Creative 100, and the Zhonglian Creative Plaza as entrepreneurial industry parks. But the results haven't been great because they didn't take local conditions into account, and the renovated creative parks aren't very appealing.

Fig 53
The Cotton No. 5 Factory Textile Valley Creative Park, now empty and deserted. (Source: https://www.sohu.com/a/662092342_120646855)

Finally, there is a lack of archives. During the research and statistics process, many industrial heritage archives were not available on government websites, and information had to be gathered from snippets on the internet. People cannot obtain good public education on industrial heritage through official channels.

Based on the existing problems, some can be proposed.

Firstly, there is a need to promote public awareness of industrial heritage. Despite recent efforts in surveying Qingdao's industrial heritage, which have roughly identified the quantity of such sites, the level of protection for these heritage sites remains inadequate. Relevant institutions have not actively disseminated knowledge about industrial heritage, leading to a lack of public awareness. Therefore, it is crucial to enhance public education and awareness programs, building upon the establishment of comprehensive industrial heritage archives.

Secondly, it is imperative to strengthen existing laws and regulations pertaining to industrial heritage. Effective protection of industrial heritage requires robust legal frameworks in every country and city. This legal framework is essential to prevent developers from overly commercializing industrial heritage sites for profit or engaging in activities that could potentially damage these historically significant assets. By implementing stringent legal controls, it becomes possible to safeguard industrial heritage comprehensively.

Thirdly, the establishment of an industrial heritage assessment system is essential. According to the importance of industrial building heritage, the heritage can be categorized into three main levels: "Outstanding," "Relatively Important," and "General." These categories will dictate the treatment of the sites as follows: permanent preservation for the outstanding ones, preservation of distinctive features and adaptive reuse for the relatively important ones, and selective demolition and reconstruction for the general ones(Guo et al., 2019).

Finally, developing long-term development plans is critical. Qingdao's industrial heritage represents the collective wealth and memory of generations past. It is essential to conduct thorough research and analysis to formulate sustainable redevelopment strategies. This approach aims to prevent tragedies such as the demolition and reconstruction of historically significant sites like the Qingdao Tianmu City, which was completed in 2007. By planning for sustainable development, Qingdao can preserve its industrial heritage while accommodating modern needs and ensuring cultural continuity.

Renovation of Qingdao Port

5.1 Introduction to Qingdao Port

5.1.1 Development History

In 1877, Ferdinand von Richthofen first proposed in his published work that Jiaozhou Bay was the ideal port in northern China. Since then, Qingdao has developed over more than a hundred years. Due to its unique social background and geographical environment, it has gradually evolved from a small fishing village into a modern city with a diverse and developed industrial base (Liu, 2020).

The development phases of Qingdao Port correspond with the historical periods of Qingdao's development. These phases can be roughly divided into the German occupation period, the first Japanese occupation period, the Nanjing Nationalist Government period, the second Japanese occupation period, and the period following the founding of the People's Republic of China(see fig.54). Over 120 years, Qingdao Port has evolved from a fishing port into an international port with eight terminals. Since the founding of the People's Republic of China in 1949, Qingdao Port was nationalized. The Qingdao Port Authority was established and managed by both the Qingdao Municipal People's Government and the Ministry of Transport, with the Qingdao Municipal People's Government being the primary governing body. In 1974, the construction of the Huangdao Oil Port began, serving as the main port area for handling liquid bulk cargo.

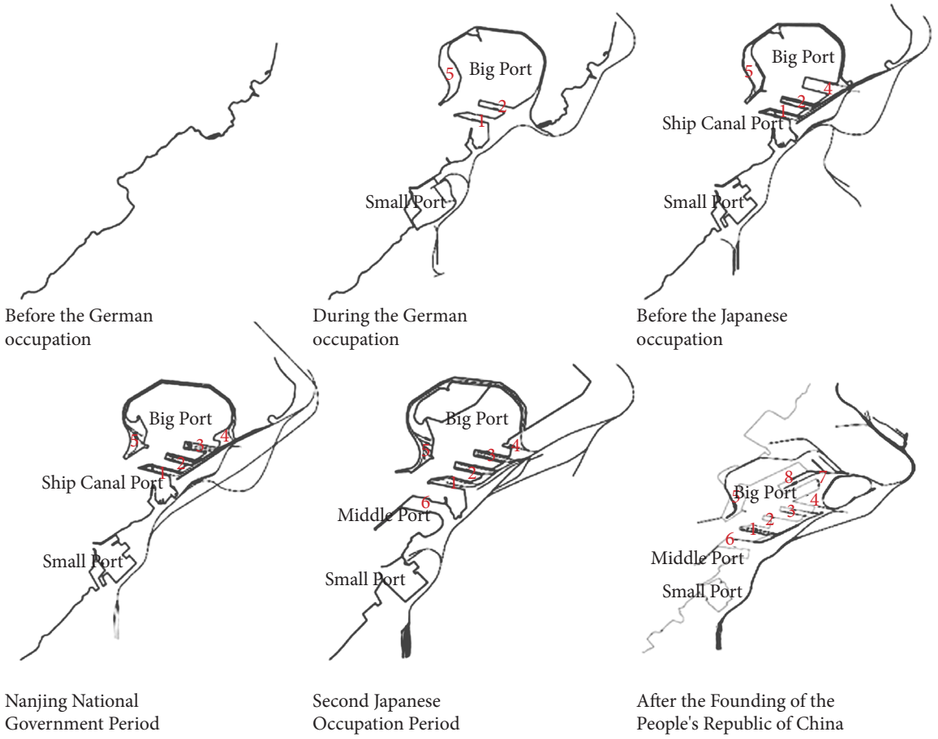


Fig 54 *The History of Qingdao Port Establishment (Drawn by author)*

The process of nationalisation turned the Port of Qingdao from a colonial port into an important part of the country's economy (Qingdao Municipal Archives, n.d.). During the planned economy period from 1949 to 1978, the development of the Port of Qingdao was part of the national "Five-Year Plan." Its main goal was to strengthen the heavy industrial sector in northern China and make it a key hub for important resources like coal, oil, and wood (Zhang, 2006). After the reform and opening-up in 1978, the Port of Qingdao was one of the first coastal ports to connect with the rest of the world. It attracted foreign investment and adopted modern logistics technologies like containerisation, marking the beginning of its internationalisation process (Qingdao Port International Co., Ltd., n.d.). As the 21st century commenced, the transformation of the global economic environment and China's entry into the WTO further enhanced the status of the Port of Qingdao. In the 2010s, propelled by the "Belt and Road" Initiative and the "Maritime Power" plan, the transformation of the Port of Qingdao acquired new modern relevance (Qingdao News, 2024). The transfer of operations from the Dagang Port region and the subsequent urban revitalisation were driven not only by the port's expansion but also marked a pivotal transition in Qingdao's evolution from "turning its back to the sea" to "facing the sea," as it aspires to establish itself as a global marine hub (Qingdao News, 2024). This trajectory illustrates the transformation of an industrial infrastructure asset from a marginal production unit to a central strategic asset, catalysing a thorough enhancement of the city's overall capabilities.

Fig 55 *Qingdao Port No. 1 Wharf, 1980s (manual handling) compared to the 21st century (modern mechanized transportation) (https://www.163.com/dy/article/J15SJBHF0543B6OX.html?f=post2020_dy_recommends)*

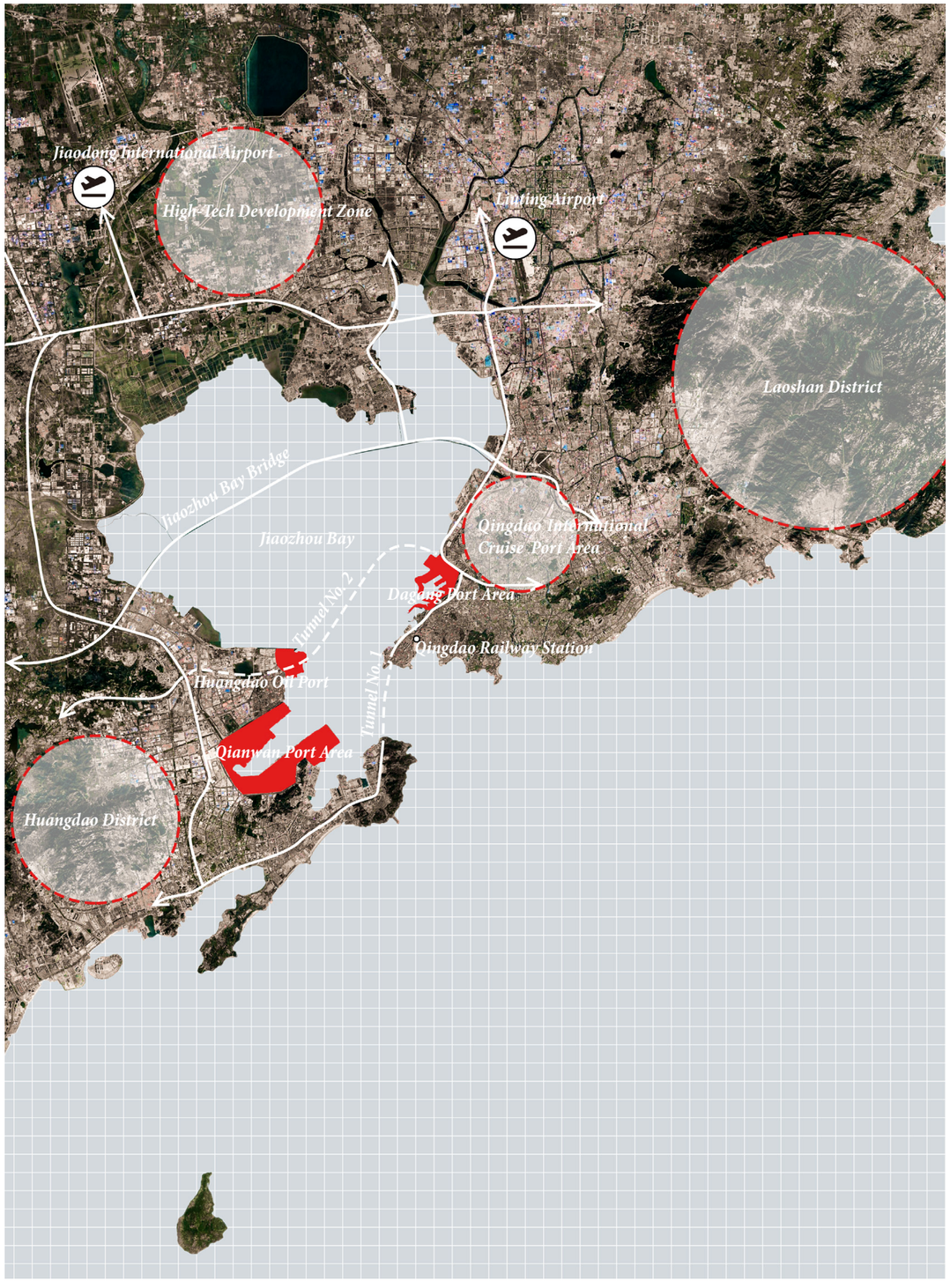


Fig 56 *The Relationship between Jiaozhou Bay's Three Ports and Urban Layout (Drawn by author)*

The Qianwan Port area was built in 1987 and became the main port area for moving containers and general cargo. The Qingdao Port Authority was turned into the Qingdao Port Group in January 2003. This new company is a limited liability company owned entirely by the state and is overseen by the Qingdao State-owned Assets Supervision and Administration Commission. In 2008, work started on the Qingdao New Port (Dongjiakou Port area), which is now one of the main ports for moving metal ores, coal, and liquid bulk cargo (Xunzhao Mengtian, 2022). Weihai Port was also bought; it mainly handles containers, dry bulk, and general cargo. As a result, Qingdao Port became an international group with five port areas. People in Qingdao still call the original Qingdao Port "Qingdao Port," but now it is called the Dagang Port area.

The Qingdao Dagang Port Area, the Huangdao Oil Port Area, and the Qianwan Port Area now surround Jiaozhou Bay. The new port area has gradually moved the functions of the old Dagang Port Area westward, which has helped the city grow to the west. This change has made it possible to change the original Dagang Port Area, which has given the old city a chance to come back to life and improve its urban vitality.

5.1.2 The Framework of the Institution

The mission of Dagang Port has been completed with the building of Huangdao Oil Port and Qianwan Port. Dagang Port stopped handling bulk cargo on October 25, 2014. The old port area at Qingdao Port needs to find a way to fill the industrial gap. There is also the question of how to connect the port's long-standing spatial and industrial divisions with the city's development strategy and the areas around the port.

Fig 57 *In 2012, Pier 6 prior to the construction of the cruise port. (Source: http://www.qingdao.gov.cn/ywdt/tpxw/202010/t20201012_309450.shtml)*

Fig 58 *The completed cruise port terminal on Pier 6 (Source: https://www.jintangjiang.cn/v_detail-302.html)*

In the 2009 government document "Opinions on Accelerating the Construction of the Blue Economic Zone," the Qingdao municipal government clearly stated the need to fully leverage Qingdao's marine resources, scientifically develop and reasonably protect the marine environment, and cultivate advantageous marine industries. Consequently, for the Qingdao Port area, the document proposed the construction of a blue economic zone, utilizing port resources to actively plan and build the Fushan Bay International Cruise Port. This includes gradually transforming the old port area into a dedicated terminal for international roll-on/roll-off ships and cruise ships, establishing a number of yacht clubs, and developing international cruise tourism and yacht economy to break into the high-end tourism market(Qingdao Municipal Government, 2009).

In 2011, Article 17 of the "Implementation Plan for the Reform and Development Pilot Work of Qingdao Blue Economic Zone" proposed a coordinated plan to start the construction of coastal port cruise terminals(Qingdao Municipal Government, 2011). It mandated that the Dagu Cruise Port be completed between 2014 and 2015. According to the plan, Qingdao Cruise Terminal will emphasize its commercial and business functions in the hinterland, strengthen the connection between the cruise city and the urban area, and develop yacht berths and yacht clubs. It aims to create a high-end urban complex integrating functions such as business offices, star-rated hotels, commercial dining, exhibitions, leisure, and entertainment. The goal is to transform the Old Port Area into a "crown jewel" of Qingdao's old city (Qingdao State-owned Assets Supervision and Administration Commission, 2013).

The idea of the "Blue Economic Zone" was constantly improved and put into action in the next policy framework. This led to a complicated network of institutions that changed the Port of Qingdao (Qingdao Port International Co., Ltd., n.d.). The national policies were just as important as the strategic plans made by the city government. The 2014 National New Urbanisation Plan stressed "advancing urban renewal and redevelopment" and "preserving industrial heritage". This gave the "port relocation and city restoration" of Qingdao's historic port districts a stronger legal and policy base (Qingdao News, 2024). In 2017, the former China National Tourism Administration named the Qingdao International Cruise Home Port as part of the "China Cruise Tourism Development Experimental Zone". This gave it the resources and policy benefits of a national-level platform (Qingdao News, 2024).

The rebuilding of the Port of Qingdao went beyond the usual divide between government and business. It created a "networked governance" framework in which many different groups worked together (Zhang, 2013). The Qingdao Port Group was responsible for certain growth and operations because it owned the assets and was the main market player (Qingdao Port International Co., Ltd., n.d.). The Shibei District Government was responsible for making sure that public services were available, managing land acquisition and destruction, and guiding social interactions (Qingdao News, 2024). The Qingdao Municipal Bureau of Natural Resources and Planning was responsible for reviewing plans and giving out licences. Professional institutions like the Tongji University Architectural Design and Research Institute gave very useful intellectual help. This collaborative approach successfully tackled common challenges faced during the redevelopment of large industrial areas, including complex property rights, conflicting interests, and incompatible planning (Zhang, 2013).

Fig 59 *Shandong Province Coastal Port Layout Plan*

(Source: Shandong Provincial Department of Transportation : http://jtt.shandong.gov.cn/art/2025/7/24/art_100540_10325109.html)

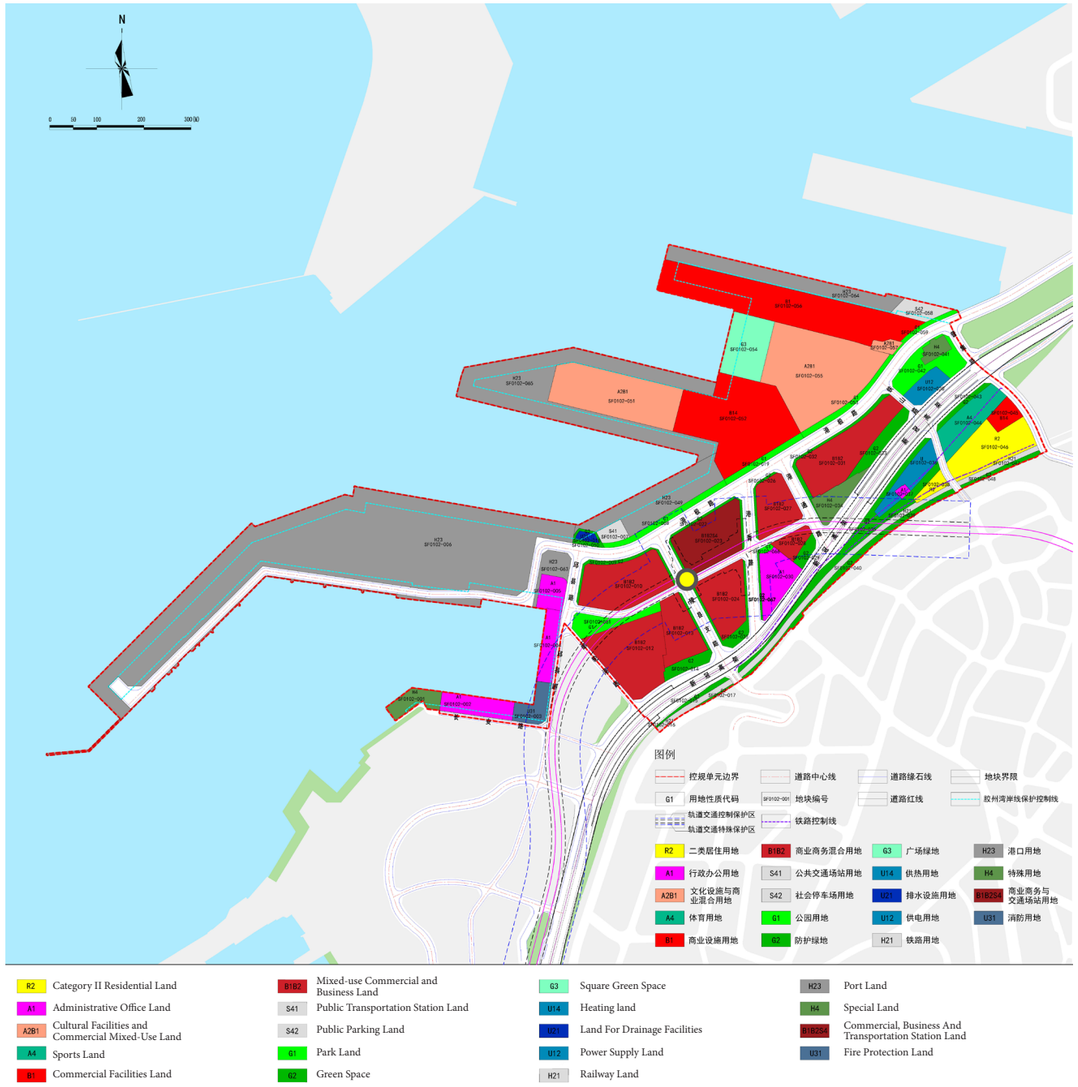


Fig 60 *Detailed control planning for the start-up area unit of the cruise port area*

(Source: http://www.qingdao.gov.cn/zwgk/xxgk/zygh/gkml/gzxx/202109/t20210929_3401324.shtml)

However, after the Qingdao Cruise Terminal officially began operations, several issues became apparent. Compared to Shanghai's Wusong and Tianjin's cruise terminals, Qingdao's cruise terminal has the form but lacks the substance. While the terminal's iconic building boasts an impressive and international appearance, its interior lacks a systematic commercial functional division. Additionally, the area around the cruise terminal suffers from relatively congested traffic, with insufficient signage along the way. Even if tourists manage to reach the terminal, their travel experience might already be significantly compromised.

To truly invigorate the cruise terminal, it is essential to optimize the surrounding infrastructure, such as improving the roads leading to the cruise terminal. Moreover, the port area should undergo comprehensive commercialization, transforming it to offer a wide range of entertainment and leisure experiences for visitors.

In 2021, the Qingdao Municipal Government's approval of the partial planning adjustments for the old port area of Qingdao Port, Sifang Port Area, Hujiashan Operation Area of Dongjiakou Port, and the bulk cargo yard of Dongjiakou Port mentioned that the freight functions of Terminals 1, 2, 4, and 7 in the old port area of Qingdao Port would be gradually phased out during the planning period. This initiative aims to return port areas to urban use, retaining only Terminals 6 and 8 to serve cruise passenger transport and clean urban material transport. The land area behind these terminals is approximately 310,000 square meters. The old port area's Zhonggang and Xiaogang operational areas will be urbanized and developed in conjunction with the cruise port city's development, with the shoreline primarily accommodating yachts, cruise ships, and other vessels (Qingdao Municipal People's Government, 2021).

Following the proposal of the "Retreat from Harbor, Return to City" strategy, led by Academician Wu Zhiqiang's team, a design team composed of Tongji Architectural Design (Group) Co., Ltd. Project Operation Department and Urban Planning Center has drafted a conceptual plan for the Qingdao Cruise Homeport Pilot Zone. Building upon this foundation, after two years of meticulous technical coordination and refinement, the pilot zone's detailed planning regulations(see fig.58) have been carefully crafted by the Shibei Sub-bureau of Qingdao City, in conjunction with the Shibei District Government and Qingdao Port Group(Qingdao Government Affairs Website, 2021).

Fig 61 *Qingdao Port Planning Renderings, drawn by Tongji Architectural Design*

(Source: http://www.qingdao.gov.cn/zwgk/xxgk/zygh/gkml/gzxx/202109/t20210929_3401324.shtml)

5.2 Preliminary analysis

5.2.1 Site analysis

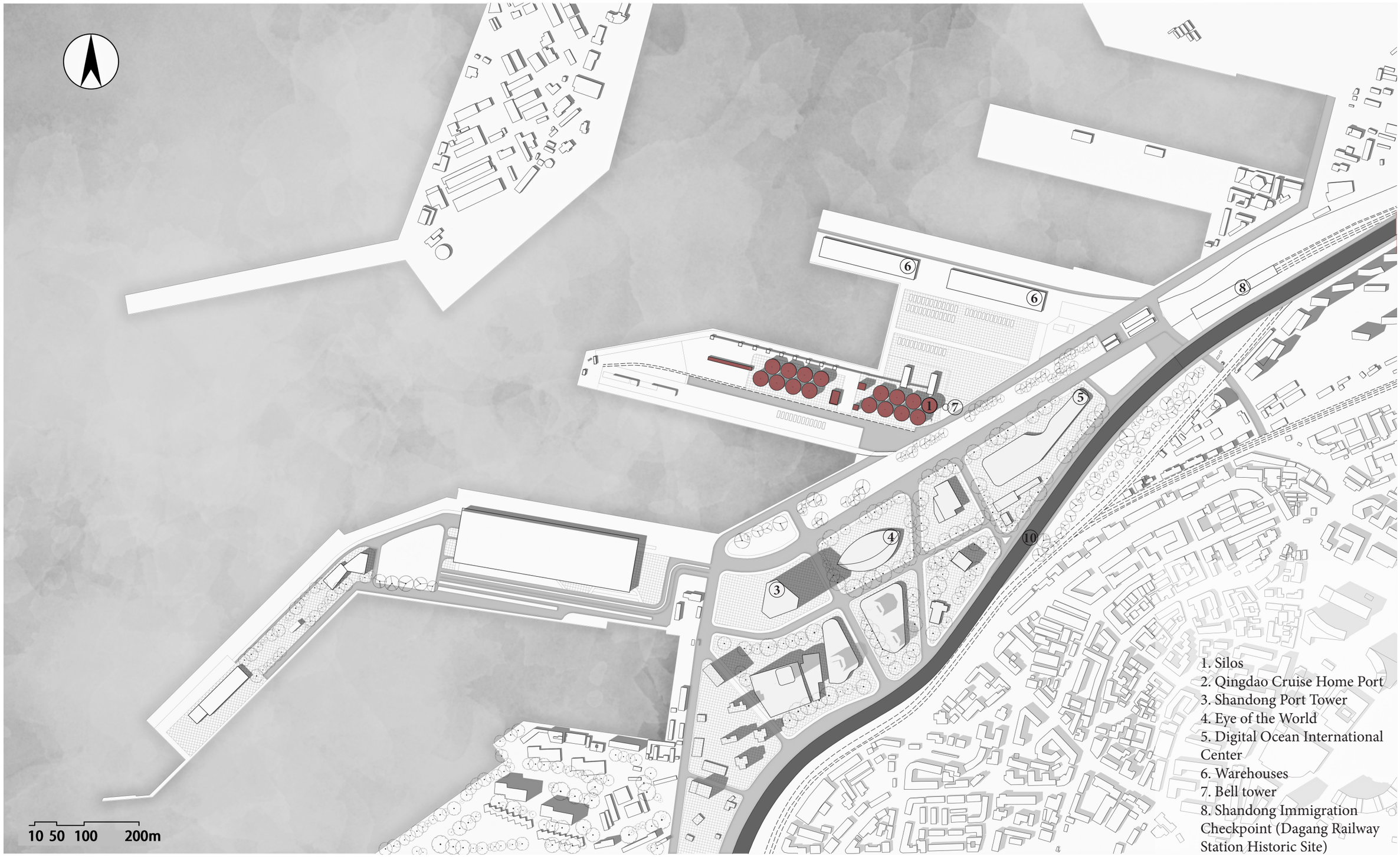


Fig 62 *Master Plan Before Renovation (Drawn by author)*

Fig 63 *Urban Mapping within the 7km × 7km Project Scope (Draw n by author)*

Within the 7km × 7km project site, the area can be divided into three concentric zones. The first zone, within a 1.5km radius, is the port area. The second zone, between 1.5km and 3km, is a mixed-use commercial and residential area, featuring a combination of buildings constructed before and after 2008. The third zone, beyond 3km, is predominantly residential, with most buildings dating from before 2008. Due to Qingdao's hilly topography and abundant green spaces, this outer zone forms a natural buffer that encircles and encloses the Qingdao Port area.

Additionally, Qingdao Port is intersected by two urban expressways. On the eastern side of the port, one of the expressways is elevated, creating a visual connection between the silo structures and the elevated roadway. This spatial relationship allows for visual interaction between industrial heritage elements and the urban infrastructure.

Fig 64 *Building, Road, and Construction Age Classification within the 7km × 7km Area (Draw n by author)*

5.2.2 Architectural elements analysis

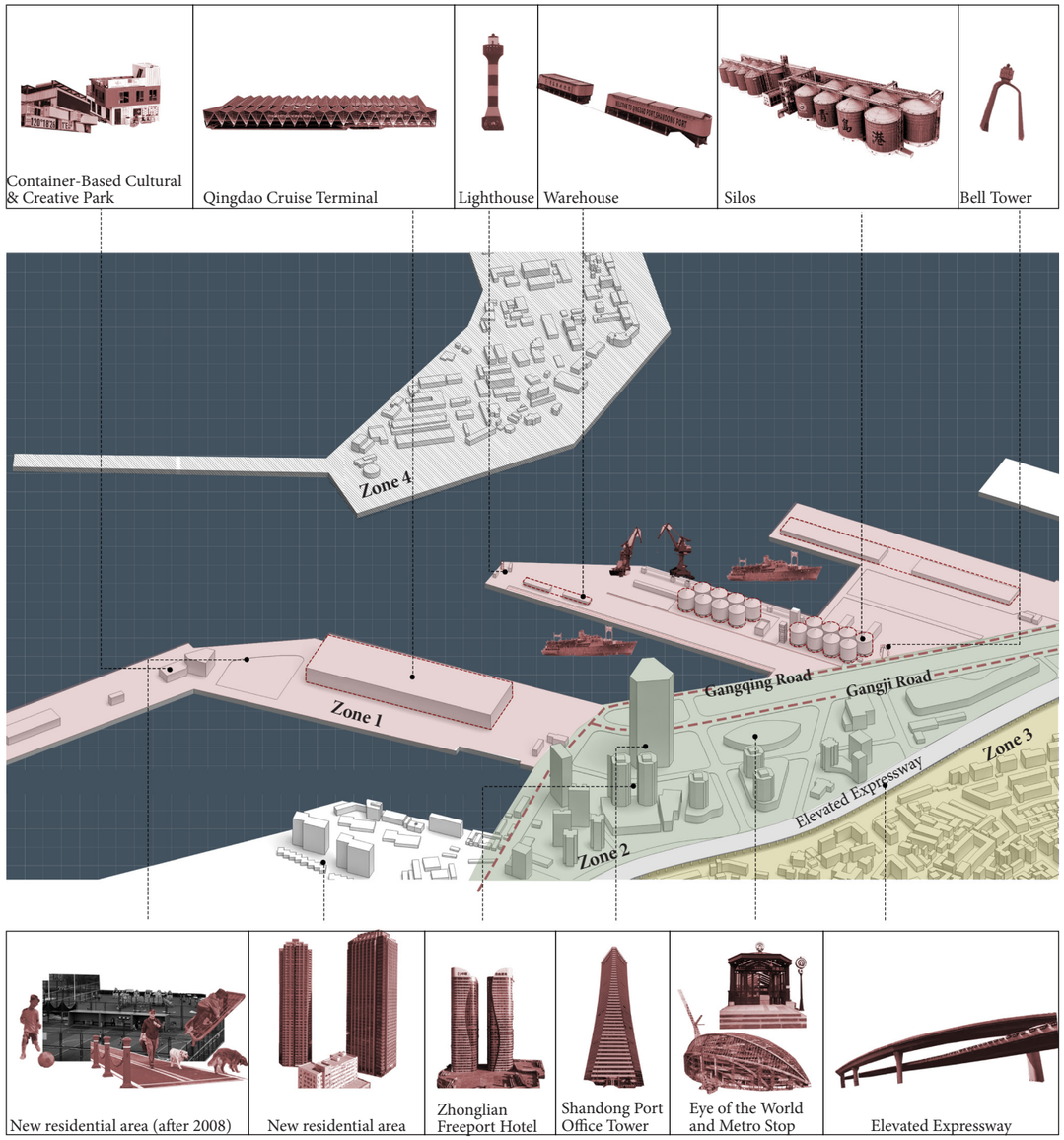


Fig 65 *On-Site Landmark Buildings (Draw n by author)*

Within the Qingdao Dagang Initiation Area, the site is divided into four distinct zones:

Zone 1 is the core project development area, containing various industrial heritage buildings as well as the port passenger terminal. This zone is characterized by low building heights and large volumes, conveying a sense of solidity and permanence.
Zone 2, defined by Gangqing Road and the Xinguang Elevated Expressway, features commercial buildings and large office towers. Most structures in this area were built after 2020, and a newly opened metro station (operational since 2024) has significantly increased pedestrian flow.

Zone 3 lies to the southeast of the Xinguang Elevated Road and consists primarily of residential neighborhoods. These buildings mostly date back to before 2005, and the area is home to many long-term residents, with a noticeably aging population.

Zone 4 is a military-controlled area and will remain largely undisturbed in the planning and development process.

The extensive array of structures and amenities constitutes a comprehensive "industrial heritage pedigree," necessitating scientific evaluation and prioritisation for preservation and adaptive reuse (Qingdao Municipal Bureau of Natural Resources and Planning, 2020). The silo clusters are without a doubt the most famous and game-changing buildings among these. They are not only quite large and have a unique shape, but their internal continuous vertical spaces, which are free of beams and columns, also give them a lot of flexibility for functional conversion (Qingdao Municipal Bureau of Natural Resources and Planning, 2020). This makes them perfect for turning into places like hotels, exhibition halls, or performance spaces that need large, open spaces inside.

The gantry cranes and rail systems, which are directly involved in loading and unloading at the port, can be kept as important parts of the landscape (Qingdao Municipal Bureau of Natural Resources and Planning, 2020). They can be used in the design of public spaces. For example, the rails can be used to guide pedestrian paths, and the gantry cranes can be used to hold up light art pieces. The square granary on the beach is a good option for turning into boutique shops or creative offices due of its unusual shape and historical importance (Qingdao Municipal Bureau of Natural Resources and Planning, 2020). The clock tower, which has been around for decades, is now a visual and emotional icon for the area. It should be strictly protected, and it could be employed again as an information centre or observation platform (Qingdao Municipal Bureau of Natural Resources and Planning, 2020).

5.2.3 Main problems to be addressed

Age Group	Population Share	Description
0–14 years	0.1521	Below national average (17.8%)
15–59 years	0.6149	Main labor force
≥60 years	0.233	Deep aging (exceeds international 10% threshold)
≥65 years	0.1682	Noticeable trend of advanced aging

Chart.11 Age Structure of Qingdao Population (Data source: Qingdao Population Change Sample Survey Bulletin (2022))

Age Group	Shinan District	Shibei District	Cause of Differences
0–14 years	<10%	12%–14%	Shinan: High cost of school district housing lowers birth rates Shibei: Educational resources attract young families
15–59 years	62%–65%	>68%	Shibei: Industrial zones bring in new migrants Shinan: High housing prices hinder youth settlement
≥60 years	>28%	23%–25%	Shinan: Retirement communities and high-end housing Shibei: Aging slower due to mixed community composition

Chart.12 Age Structure of Shinan and Shibei Districts (2023) (Estimated by author)
Note: These figures are estimates based on urban characteristics, not direct census data. Aging threshold: ≥60 years >10% = aging; >20% = deep aging.

Indicator	Shinan District	Shibei District	Citywide Average
Total Population	588800	1097100	–
≥60 Population Share	Deep aging (>28%)	Deep aging (23%–25%)	0.233
Working-age Population	Medium scale (62%–65%)	Major share (>68%)	0.6149
Child Dependency Ratio	Very low (<10%)	Moderate (12%–14%)	0.1521
Population Density	19,600 people/km²	16,900 people/km²	–

Chart.13 Core Demographic Indicators of Shinan and Shibei
(Data sources: Total population data cited from Qingdao Statistical Bulletin 2023; Age structure is the author's comprehensive inference)

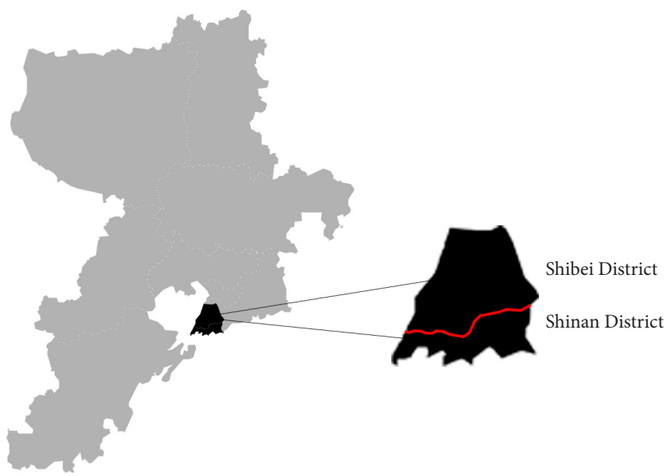


Fig.66 The location of Shinan and Shibei Districts in Qingdao (Drawn by author)

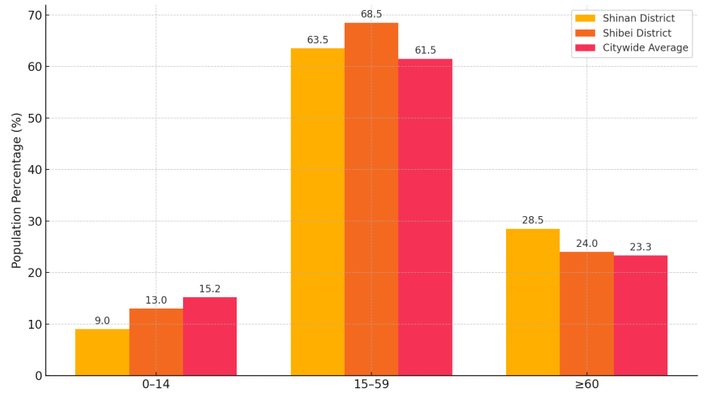


Fig.67 Age Distribution Comparison in Central Qingdao (Drawn by author)

The historic centre of the city is in the middle of the Shibei and Shinan Districts, where Qingdao Port is. It is in a very old social and demographic environment. Both districts are getting older, but Shibei District has a younger population and a job market that is more open to new people than Shinan. Because of this, restoring Qingdao Port's industrial heritage will have to deal with problems related to both space and people. Because the area is focused on tourism, the adaptive reuse of industrial sites should focus on keeping their industrial character while adding new public and cultural functions. This method not only brings industrial brownfields back to life, but it also makes cities more lively, helps people feel connected to their culture, and boosts the local economy. This means that industrial heritage is a key part of the larger process of improving cities.

It gets harder to solve a lot of problems as the population gets older and Qingdao Port changes. First of all, people lose their jobs and businesses go out of business. The port's job of moving goods has changed, and this has quickly hurt traditional supporting industries like storage, transportation, and repair. A lot of people in the area have lost their jobs because of this. People who used to work in factories have a hard time finding new jobs in the growing cultural tourism and high-end service sectors. This is a big problem for the economy and society. Second, it's hard to keep the historical setting alive and come up with new ways to use it. The change in industrial heritage shouldn't mean that it stays the same all the time. Instead, it should make people think about the past and give them new life in the city now. This means that the "essence" must stay the same while new features and designs are added. Also, the buildings and other physical structures need to be safe. There is a balance between growth that happens quickly and growth that lasts for a long time. Because the land is valuable, the project could run into problems that come with too much real estate development and commercialisation. This would make it less valuable to society and to culture. There needs to be a strong system of planning control and interest balance to make sure that the main goal of the change is to make the city more competitive and improve the lives of its residents.

5.2.4 Original site conditions and silo structure

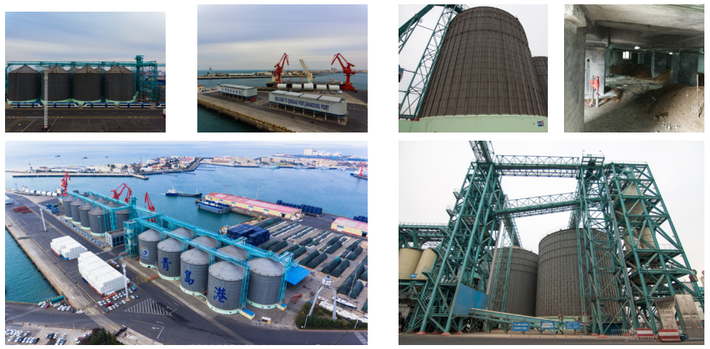
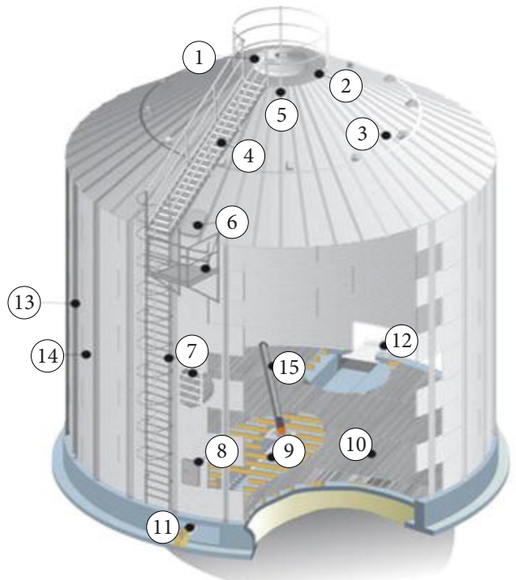


Fig.68 On-site photographs of the location (taken by author)

Within Pier No.1 of Qingdao Dagang Port, there are two main sets of silos, each consisting of eight units, along with several cranes, cargo containers, two elevated square grain warehouses by the sea, and a clock tower with several decades of history.

Generally, there are three types of silos, the first type is made of wood, the second type is made of concrete, and the third type is made of metal (steel and galvanized). Wheat is as barley, oat, rye, and so on, used to store suitably both in concrete and metal silos (Moustafa et al., 2018)



1 Sides of stairs
2 A circular gate
3 Above sighs
4 A higher scale
5 Directional backward
6 Platform upper
7 holderExternal concrete scales
8 A bottom gate
9 Apoios supported by concreteFully
10 Fully perforate
11 Tubular extractor thread
12 A centrifugal fan
13 Galvanized external mounts
14 Corrugated laterais sheets in aco ZAR-34515)
15 Milling thread

Fig.69 Schematic Diagram of a Typical Silo (Source: https://www.intechopen.com/chapters/60300)

Fig.70 Diagram showing staff access to the silo

The Phase I Bulk Grain Silo Project at Qingdao Port was constructed on the foundation of an existing old wharf. Due to the load-bearing limitations of the old wharf, the newly built bulk grain silos were designed with low self-weight and minimal foundation requirements. The project required a short construction period, convenient on-site assembly, and low cost. Given that bulk grain at ports is typically not stored for extended periods, and in order to maximize the use of port land, large-diameter flat-bottomed prefabricated steel silos were selected as the storage solution for this project.

These prefabricated steel silos are assembled from individual galvanized steel plates. Each silo is equipped with internal ladders, roof walkways, roof manholes, and other auxiliary facilities. Additionally, each silo features a large access door, allowing loaders to enter for cleaning purposes. Beyond the silo structures themselves, each unit is fitted with ventilation, temperature monitoring, and material level systems.

Each silo has a diameter of 27.43 meters and a height of 24.41 meters, with a single storage capacity of approximately 15,500 cubic meters. The total storage capacity of the eight silos combined is 124,000 cubic meters.

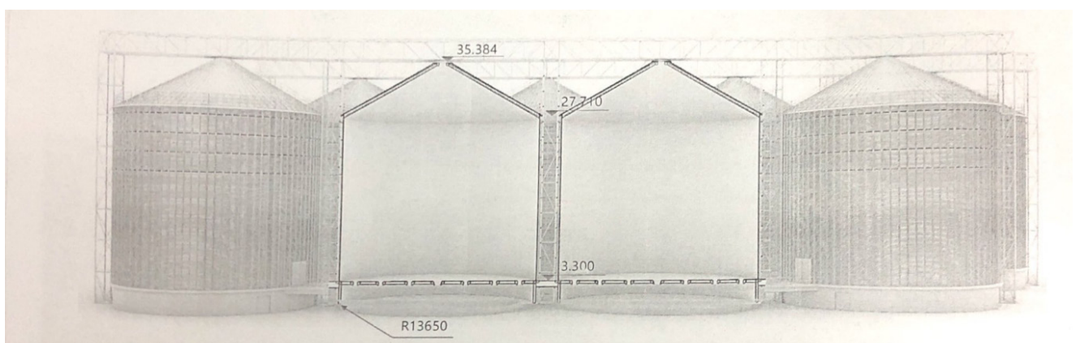


Fig.71 Basic data of the silo (Source: Qingdao Urban Planning Archive)

The transformation of these two sets of silos at Qingdao Port's Pier No. 1 represents one of the most critical and complex tasks within the port's comprehensive redevelopment plan. These iconic structures, with their distinctive industrial character and historic presence along the waterfront, offer a unique opportunity to bridge the port's industrial past with its future as a vibrant urban destination. The adaptive reuse of these silos goes beyond mere preservation; it involves creatively reimagining their function while respecting their structural legacy and the load-bearing constraints of the historic wharf upon which they stand. The challenge—and the opportunity—lies in integrating new cultural, commercial, or public functions into these monumental forms, potentially transforming them into landmarks for art, leisure, or education. This silo regeneration is therefore not an isolated project but a pivotal component in the broader strategy to physically and symbolically connect the port's operational heritage with the new mixed-use layers and public spaces, ultimately strengthening the bidirectional flow between the urban core and the waterfront.

5.3 Project positioning and conceptual developmen

According to the overall planning of the Dagang Start-up Area and its future development trends, the silo zone is primarily designated for mixed-use architecture combining cultural facilities and commercial functions. With the recent opening of metro stations in the Dagang area and the launch of the Qingdao Cruise Homeport Terminal, tourism—already a major driver of Qingdao's urban development—is expected to expand into this area. As a result, a portion of tourist activity will likely shift from the Shinan District to the Dagang Port area.

To meet this demand, the zone requires the introduction of a cultural facility—a museum—as well as a commercial-residential building that reflects the port's unique character—a silo hotel. Therefore, I have transformed the western group of silos into a museum combined with commercial spaces, and the eastern group into a hotel integrated with commercial functions.

This functional positioning is based on a comprehensive assessment of the site conditions, market demand and urban development strategy. The western silo cluster is transformed into a museum, aiming to create a regional cultural highland. Its theme can not only display the century-old history of Qingdao Port but also expand to marine culture, shipping technology or contemporary art, making it a public platform that continues to generate cultural influence. The supporting commercial space (such as cultural and creative shops, cafes, and restaurants) can enhance the vitality and self-haematopoietic ability of the museum. The eastern silo cluster has been transformed into a hotel, which makes full use of its unique spatial experience and waterfront landscape resources, aiming to create an unreplicable accommodation experience, attract high-end tourism and business customers, and improve the service level of the region.

The commercial functions integrated into the hotel (such as boutiques and bars) mainly serve hotel guests and tourists.

More importantly, the two functional areas are not isolated but closely linked through public landscape and streamlined design, forming a complete value chain of "cultural experience - leisure consumption - characteristic accommodation". This mixed-function model can effectively extend the stay of tourists, improve the level of consumption, and ensure that the area can remain active at different times (day and night, weekdays and weekends) to avoid becoming an "empty city". This mixed-use model can effectively extend the length of stay of tourists, increase the level of consumption, and ensure that the area remains active at different times (day and night, weekdays and weekends), avoiding becoming a "ghost town".

5.4 Design proposal

5.4.1 Overall planning

The core guiding ideology of the overall planning is "stitching and linking". The aim is to heal the "scars" between the port area and the city through a series of careful spatial interventions, and to re-establish the organic connection between the two in terms of function, transportation and vision. First, a public space system with rich levels is constructed. A north-south "cultural main axis" is planned to connect the city's hinterland, the core area of the silo and the waterfront shoreline. A series of squares, parks and green spaces are set along the main axis as containers for citizens' activities. Secondly, it is to open up key traffic links. Some of the walls were removed and several new urban branch roads perpendicular to the coast were added to attract urban traffic to the port area. At the same time, an independent slow-moving traffic system (bicycle lanes, pedestrian walkways) will be established and seamlessly connected to subway stations and bus hubs. Finally, the continuous and dynamic waterfront interface is shaped. The original cargo terminal was transformed into a waterfront platform, stepped square and yacht marina, allowing citizens and tourists to directly contact the water surface and restore the intimate relationship between the city and the sea.

The regional planning of the Qingdao Port area utilises a three-tiered framework to enhance the integration of business entities and pedestrian movement. Layer 1, the residential area located north of the Xinguan Elevated Road, channels traffic across the bridge into Layer 2—a multifunctional transitional zone officially designated as Qingdao Port Xintiandi, which also functions. The transition from Layer 2 to Layer 3 is achieved by a sophisticated strategy: by integrating several functions such as culture, exhibition, habitation, and entertainment, a "urban living room" is created. (see fig.72)

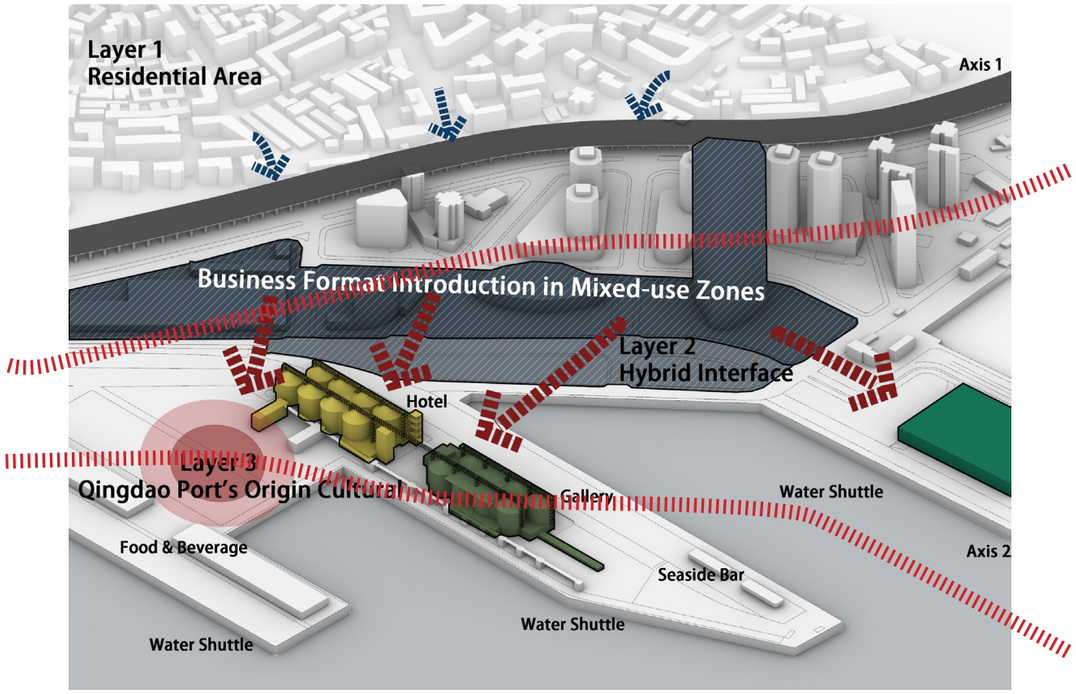


Fig.72 Upper-Tier Planning - Functional Programming (Drawn by author)

This is further enhanced by using the cruise home port to attract international tourists, fostering reciprocal engagement between the areas, and acting as the intermediary zone between the two axes.

The urban pedestrian flow commences at the carefully crafted urban interface, where the city's natural movement patterns begin their intentional northwest direction. This continuous flow of urban activity passes across key infrastructural components, initially moving beneath the elevated Xinguan Road and subsequently intersecting major urban thoroughfares that constitute vital links between the port and the city centre. The dynamic flow converges intentionally at the Qingdao Origin Cultural Centre, serving as the central spatial circulation centre and organisational core of the area. This centre node serves not only as a cultural institution but also as a sophisticated pedestrian distribution system, effectively directing human flow into distinct functional areas.

The four primary functional components - including exhibition areas that present cultural narratives, lodging facilities for visitors, various dining venues providing culinary experiences, and a cohesive mixed-use commercial complex - strategically radiate outward in four cardinal directions from this central organisational core. Each functional zone preserves its unique identity while being inherently linked to the central core via meticulously designed circulation routes. These paths develop in a stratified, sequential manner, facilitating a gradual transition from the urban periphery to the waterfront. This intricate spatial configuration facilitates the seamless incorporation of Pier 1 of Dagang into the larger urban landscape, converting a former barrier into a dynamic, accessible public space that honours the interaction between old port infrastructure and modern urban existence. The design effectively creates many layers of connectivity while maintaining the distinct identity of each functional element within the cohesive master plan.

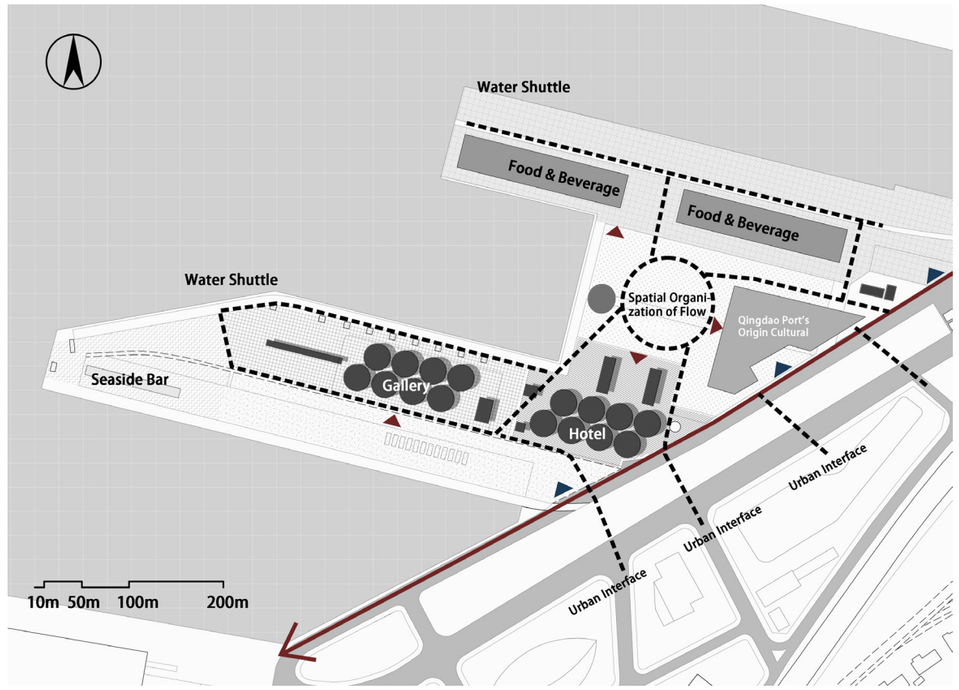


Fig.73 Organization - Flow Line Analysis (Drawn by author)

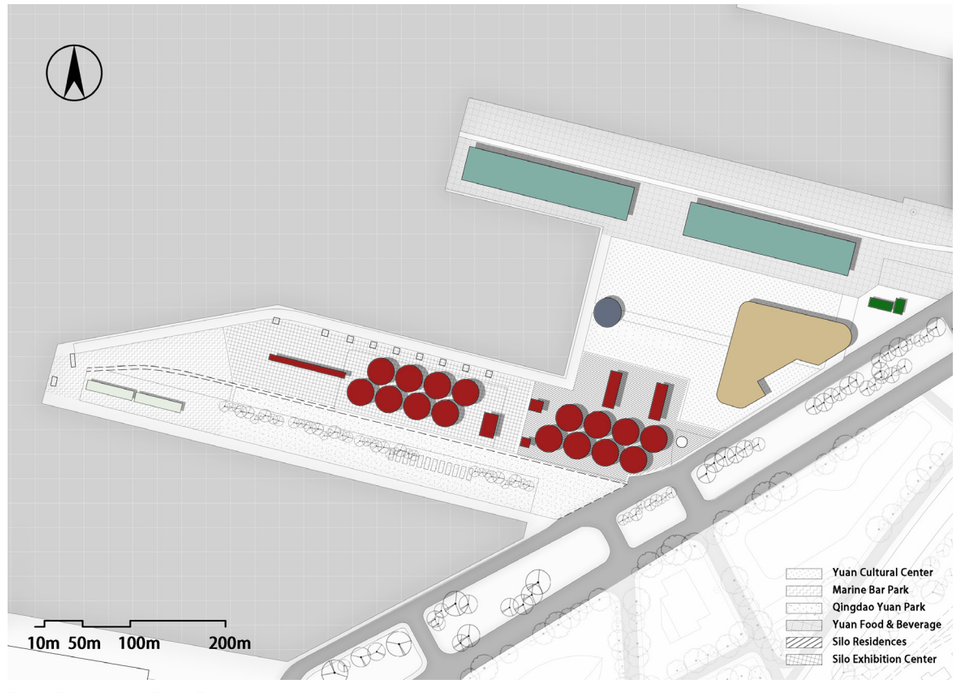


Fig.74 Development Plan (Drawn by author)

5.4.2 Architecture design: renovation of the silos

The architectural transformation of the silo structures represents the conceptual cornerstone of this regeneration proposal, guided by the overarching principle of "respecting history through innovative expression." This design philosophy seeks to navigate the delicate balance between preservation and progress, envisioning a future where these industrial monuments continue to tell their stories while serving contemporary urban needs.

For the western silo cluster, conceptually envisioned as a future museum and cultural destination, the design strategy explores "extroversion and integration" as a potential approach to revitalization. While carefully maintaining the overall industrial character and imposing presence of the silo ensemble, the proposal considers making strategic vertical and horizontal incisions at carefully selected locations. These openings would serve as sites for implanting transparent glass volumes housing the primary entrance, reception area, and a ground-level café that spills out into the public realm. This deliberate intervention aims to disrupt the original enclosed nature of the structures, creating visual connectivity and allowing dynamic urban landscapes to permeate the interior spaces throughout the day.

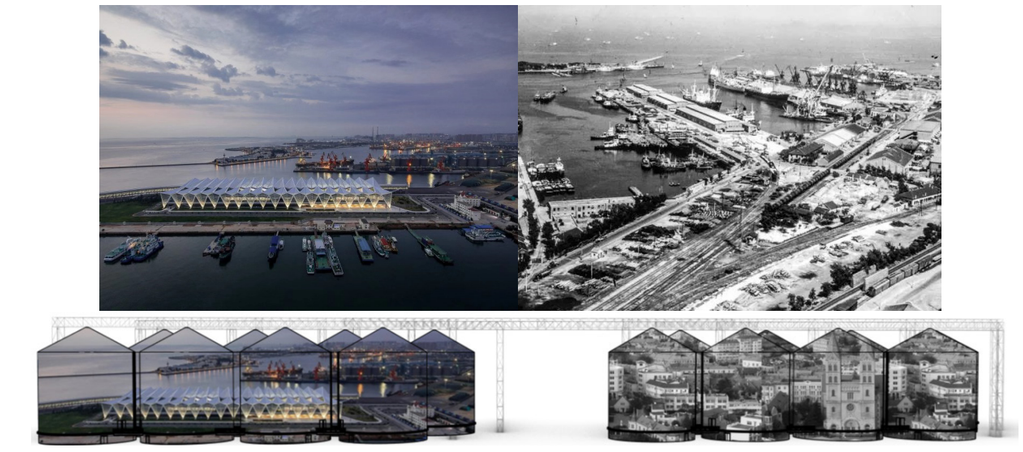
The internal spatial organization imagines adopting a "vertical village" concept that reinterprets traditional museum circulation. Through a series of interconnected staggered platforms, suspended walkways, and aerial corridors, a three-dimensional, fluid, and exploratory exhibition sequence could be created within the monumental cylindrical volumes. The existing material-conveying corridor, once the industrial lifeline of the complex, presents an opportunity to be repurposed as an elevated exhibition gallery, forming both physical and visual connections between different silos while preserving the memory of its original function.

For the eastern silos, conceived as a potential boutique hotel, the design strategy proposes cultivating an "introverted and tranquil" atmosphere that offers respite from the urban environment. Prefabricated, modular guest room units could be lightly inserted into the silo interiors like "capsules," minimizing structural impact while creating unique view corridors oriented toward either the seascape or the city skyline. The dramatic rooftop space could be transformed into an open-air bar and viewing platform, potentially becoming the project's highest vantage point and most iconic destination, offering panoramic views of the harbor and city.

The New District Engages the Old City

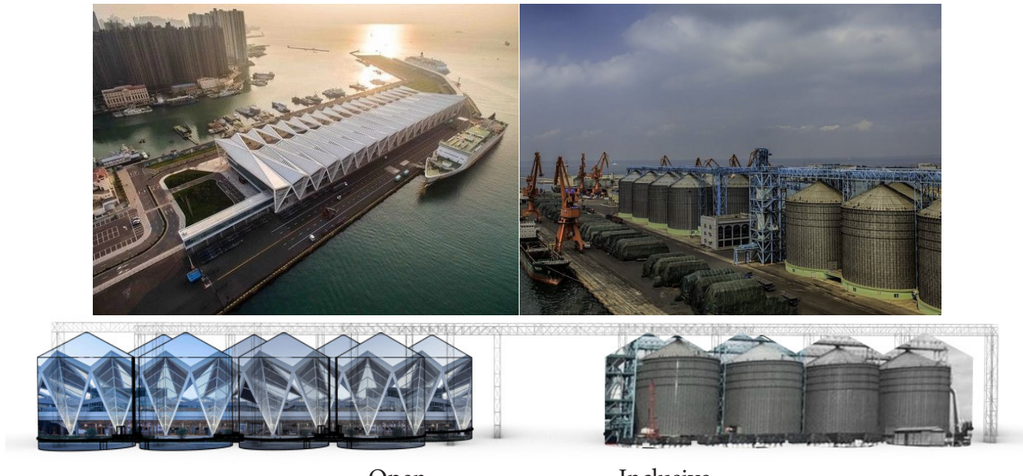
New————————Old

The Modern and the Historic Merged



Modern————————Historical

New Structures Integrated with Heritage Sites



Open————————Inclusive

Fig.75 Silo's Comprehensive Renovation Concept (Drawn by author)

The architectural approach to the silo envelopes would retain their original metallic texture and patina, with new window openings carefully composed according to a rhythm that responds to both internal spatial needs and external perspectives. These apertures would be strategically positioned to meet contemporary lighting and ventilation requirements while creating a new architectural rhythm across the weathered surfaces.

Through this comprehensive conceptual exploration—involving thoughtful volumetric expansion, strategic functional insertion, careful vertical and horizontal stratification, and innovative structural adaptation—the proposal seeks to manipulate the original forms to generate new architectural expressions, structural systems, and functional programs. By preserving select existing shapes and spaces while introducing contemporary elements, the design imagines creating a multi-layered dialogue between old and new across formal, functional, spatial, and cultural dimensions, ultimately transforming these industrial relics into vibrant contributors to the city's evolving narrative.

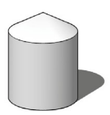
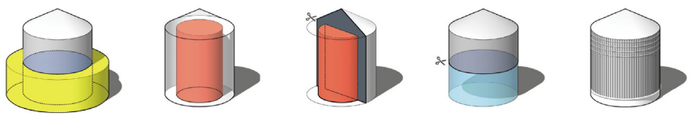


Fig.76 Feasible Silo Massing Design Approaches (Drawn by author)



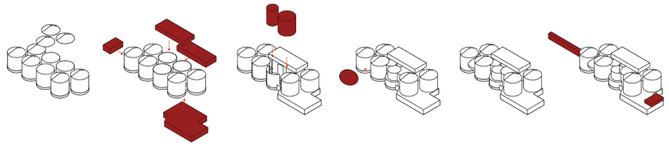


Fig.77 Massing generation of the renovated silo group on the left side (Drawn by author)

Based on the methods outlined in Chapter 3.8, a preliminary design idea for the left eight silos is suggested. This idea focusses on massing, functional zoning, and circulation to make them a major part of the area.

1. Generation of Massing (see fig. 77)

In the middle of the two silos, a vertical cut is made that creates a central atrium that acts as the main entrance and the major light well.

A horizontal cut is constructed in the top of one silo, and a clear glass volume is built out from the silo to hold a viewing platform or café.

Using the methods described in Chapter 3.8, a preliminary design idea for the left four silos is put out. This idea focusses on massing, functional zoning, and circulation to make them a vital part of the area.

1. Making Masses

A vertical cut is made between two central silos, creating an atrium in the middle that acts as the main entry and the main light well.
There is a horizontal cut at the top of one silo, and a clear glass volume sticks out from it to make room for a viewing platform or café.

2. Internal Functional Zoning (see fig. 78)

The lobby, visitor centre, and a flexible public event area are all on the ground floor.

Mid-Levels: This area is only for the main exhibition rooms inside the silo volumes.

Top Level: The multi-purpose hall and the cantilevered viewing platform have been combined to create a panoramic destination.

3. Organisation of Internal Circulation (see fig.78)

The vertical incision creates a central atrium that serves as the main organiser. All levels are connected by suspended staircases and lifts.

The galleries in separate silos are connected by aerial walkways at different heights, making a three-dimensional promenade and changing the way people used to move about in the industrial area.

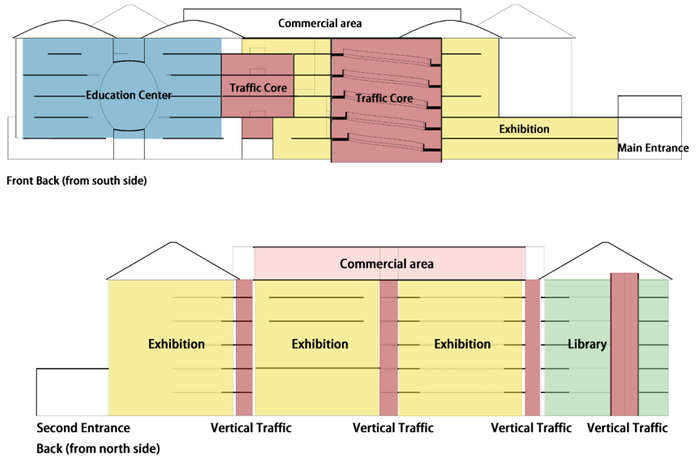


Fig.78 Internal Functional Zoning & Internal Circulation Organization(Drawn by author)

The conversion of the silos serves as a catalytic intervention in redefining the entire environment of Qingdao Port. Utilising a design technique of "stitching and linking," it dismantles the historical seclusion of the port region, re-establishing the connection between the city and the waterfront through a cultural axis and a network for slow traffic. It implements sponge city strategies and coastline restoration, transforming rigid industrial peripheries into robust, naturalised corridors. The adaptive repurposing of the silos for cultural, commercial, and public uses revitalises the region, promoting economic rejuvenation and functional diversification. The initiative maintains industrial heritage while redefining Qingdao's identity as a marine metropolis, providing a replicable model for sustainable port redevelopment globally.

5.4.3 Landscape design

The theme of the landscape design is "Industrial Wilderness and Ecological Regeneration". It does not pursue the exquisiteness of traditional gardens but is committed to retaining the industrial wild aesthetic of the site while revitalising it through the intervention of ecological technology. First, the industrial facilities are used for landscaping. Weather-resistant ornamental grass will be planted on both sides of the preserved railway tracks to form a linear "memory track"; the huge gantry crane will be preserved in place, and an outdoor exhibition hall or market square can be set up under it; the abandoned containers can be stacked into temporary commercial boxes or information kiosks.

Secondly, the application of systematic ecological restoration strategies. The sponge city concept is adopted, a large number of permeable pavements are used, and a system composed of rain gardens, ecological grass ditches and underground storage pools is established to realise the on-site digestion and utilisation of storm runoff. For contaminated soil, phytoremediation and microbial remediation and other biological technologies are used for treatment. In the treatment of the shoreline, the hard revetment was broken, and forms such as reefs, wetland plants, and gentle slopes into the water were introduced to restore the intertidal ecosystem, provide habitats for marine life, and enhance the ecological resilience and natural wildness of the waterfront space.

5.5 Summary

The Qingdao Port industrial heritage repair project is not just about repurposing a handful of ancient buildings; it is a major effort to restore the city's structure and raise its energy levels.

First, in terms of site analysis, the project is based on the Qingdao Dagang Port area's distinctive history and geography. This area has seen Qingdao change from a tiny fishing village to an international port over the course of a hundred years. The two sets of silos, gantry cranes, rail systems, and square warehouses that are still standing inside make up a complete "industrial heritage pedigree." But after the port functions moved to the west, the area was cut off from city life and had to deal with a number of major issues, such as empty industrial buildings, an ageing population, joblessness in traditional industries, and the risk of losing historical context due to too much commercialisation.

To solve these problems, the project suggests a solution based on the main idea of "stitching and linking." At the overall planning level, this is done by developing a "cultural axis" that runs north-south, adding new urban branch roads that run perpendicular to the shoreline, and making a separate slow-traffic system to reconnect the port with the urban hinterland. A creative functional insertion is suggested for the famous silo clusters: the western silos will be turned into a cultural landmark that includes a museum and shops, emphasising "extroversion and integration," while the eastern silos will be turned into a silo hotel that combines lodging and business functions, creating a "introverted and peaceful" atmosphere. This design method not only honours the structural legacy of the industrial past and the load-bearing limitations of the old wharf, but it also brings new cultural, commercial, and public uses to the building, which increases its architectural value.

In the end, the project's expected result is quite important. The "port retreat and city return" approach intends to change a once secluded and single-purpose industrial zone into a new urban neighbourhood that is open, mixed-use, and full of life. The project not only protects important industrial heritage and keeps the city's collective memory alive, but it also gives the old city a new lease on life by adding new functions and creating new spaces. Culture is the main engine, and tourism and high-end services are the two main drivers. The project's "networked governance" model, clustered renewal path, and refined design methodology are meant to make it a landmark in Qingdao's journey to becoming a "excellent global marine centre city." At the same time, they will provide a useful "Qingdao Solution" for changing other large industrial zones in China and around the world.

Conclusion

6.1. Recapitulation of the Study and Summary of Findings

This thesis has undertaken a comprehensive exploration of industrial heritage renovation within the urban environment, tracing a deliberate analytical path from the global phenomenon to a specific local manifestation. The journey began by establishing the global context of deindustrialization and the evolution of Western preservation theories, which have matured from static conservation to dynamic, adaptive reuse, as traced by scholars like (Douet, 2016) and (Bell, 2019). It then narrowed its focus to the Chinese context, where the rapid urbanization and post-industrial shift present unique challenges and opportunities, characterized by policy-driven initiatives but often hampered by over-commercialization and model homogenization (Lu et al., 2020; State Administration of Cultural Heritage, 2006). Delving deeper, the research examined the urban and industrial DNA of Qingdao, a city born from its port, whose industrial heritage is deeply intertwined with its colonial history and subsequent development as a manufacturing hub (Li & Li, 2005; Guo et al., 2019). Finally, the spotlight turned to Qingdao Port itself, using it as a central and illuminating case study to ground the theoretical discourse in a tangible, complex reality.

The findings of this research can be summarized across this multi-scalar investigation:

a. From Global Theory to Local Practice:
The study reaffirmed the multidimensional value system of industrial heritage (historical, technological, aesthetic, economic, and social) as a universal foundation (The Nizhny Tagil Charter for the Industrial Heritage, 2003; Xing et al., 2007). However, it demonstrated that the application of international models cannot be directly transplanted (Niu et al., 2018). The Chinese, and specifically the Qingdao context, demands a culturally and politically nuanced translation of these principles. The comparative analysis highlighted that while Western practice often emphasizes gradual, community-driven processes, the Chinese approach is frequently shaped by large-scale, top-down urban planning (Fox Gotham, 2001), necessitating strategies that can inject flexibility and public engagement into this framework.

b. Qingdao: A City Forged by Industry, Challenged by Transition:
The historical analysis revealed that Qingdao is not a city that merely has industrial heritage; it is a city that was built by its industry, particularly around the port and railway axis (Fan & Liu, 2011; Gu, 2014). This deep-seated industrial identity makes the transformation of its heritage not just an architectural project, but a fundamental renegotiation of the city's core identity in the post-industrial era (Loures, 2008). The decline of traditional industries like textiles and the relocation of port functions have left behind not only physical voids but also socio-economic challenges, such as an aging population in central districts, which any regeneration project must proactively address (Nefs et al., 2013).

c. Qingdao Port as a Microcosm of Systemic Urban Problems:
The thorough study of Qingdao Port was a strong confirmation and clarification of the higher-level results. The port is the best example of Qingdao's industrial past and its current problems (Jia et al., 2019; Liu, 2020). The research pinpointed a pivotal array of interconnected challenges that reflect those encountered by numerous analogous cities:

i: Spatial and Functional Disconnection: The port historically acted as a physical and economic barrier, a "city within a city." Its renovation is not just about building new functions but about surgically re-knitting this severed urban tissue, reconnecting the city to its waterfront (Wang & Lu, 2001; Ding et al., 2014).

ii: The "Form over Substance" Pitfall in Flagship Projects: The initial development of the Qingdao Cruise Terminal exemplified a common issue: an architecturally iconic project that lacked the systematic commercial functions, vibrant ground-floor activities, and seamless multi-modal connectivity required to become a truly integrated urban hub.

iii: The Technical and Programmatic Challenge of Iconic Structures: The grain silos, as monumental and inflexible structures, represented both the greatest opportunity and the most significant design challenge. Their adaptation required an innovative approach that moved beyond conventional programming to breathe new life into their unique, cylindrical forms (Liu et al., 2018; Zhang et al., 2012).

d. A Synthesized, Context-Driven Design Strategy:
In response to these layered challenges, the thesis developed a design proposal that transcends a simple architectural intervention. It embodies a strategic model for large-scale port heritage revitalization that is sensitive to its specific context. The proposal for transforming the western silo group into a cultural museum and the eastern group into a silo hotel, all within a reimagined public landscape, is a direct application of the "adaptive reuse" principle (Douet, 2016; Yao, 2014). This approach successfully negotiates the critical balance between preserving the site's powerful industrial character and injecting new, complementary functions that ensure its long-term economic viability and social relevance (Li et al., 2024; Zhu & Li, 2022). The design acts as a catalyst, aiming to transform the port area from a mono-functional cargo terminal into a vibrant, mixed-use urban district that bridges the historical and the contemporary.

6.2. Answering the Research Questions and Core Argument

This research, structured along the global-to-local continuum, provides coherent answers to its central questions:

i: How can the value of industrial heritage be realized in urban settings? It is realized not through musealization alone, but through strategic adaptation that reinterprets its intrinsic values into new urban functions (Xu, 2005; Yu & Fang, 2006). This creates a dialogue between the old and the new, allowing heritage to become a living, productive part of the city's ongoing narrative, as proposed for the Qingdao silos.

ii:What are the most important ways to connect these sites? Successful integration necessitates a multi-scalar strategy: at the macro level, via supportive policies (e.g., "Retreat from Harbour, Return to City") and infrastructural connectivity (Qingdao Municipal Government, 2009; Ministry of Industry and Information Technology, 2023); at the meso level, through master planning that fosters porous, accessible public spaces and a distinct functional mix (Bonino et al., 2021; Wang et al., 2021); and at the micro level, through architectural interventions that honour the industrial fabric while audaciously incorporating contemporary elements (Zhang et al., 2012; Feng & Wang, 2010).

iii: What is the role of specific structures like silos? Highly symbolic structures like silos should be treated as primary assets and catalytic anchors. Their adaptation requires a deep understanding of their structural logic and a creative architectural response that turns their inherent challenges (e.g., limited openings) into unique spatial experiences, thereby becoming powerful symbols of the transformation itself (Liu et al., 2018; Moccia, 2022).

The main point of this thesis is that the long-term restoration of large-scale industrial heritage sites like Qingdao Port depends on their ability to form a new, mutually beneficial relationship with the city at all levels. This isn't just a change in how things look; it's also a change in how they work, how much they cost, and what they mean. The renovated site needs to change from a secluded, production-focused area to an urban centre that is open and focused on culture and consumption (Ciaramella & Celani, 2019; Gu, 2014). The Qingdao Port case shows that this change will help keep the city's collective memory alive and make these places important for the city's future economic strength, cultural life, and social cohesion (Niu et al., 2018; Li & Wei, 2005).

6.3. A Generalized Model for Port City Transformation

While rooted in the specific context of Qingdao, the findings of this study—from the global theoretical review to the concrete design proposal—yield a transferable analytical and practical framework for the renovation of industrial port heritage in medium-sized cities globally (Loures, 2008; Zhang et al., 2023). This model can be conceptualized in four phases:

i. Comprehensive Multi-Scalar Diagnosis: Understand the site's place within global post-industrial trends, the national and local policy framework, the city's historical and economic trajectory, and the socio-economic dynamics of its immediate surroundings (Lu et al., 2020; National Bureau of Statistics of China, 2024).

ii. Vision and Positioning Grounded in Local Identity: Define a clear, integrated role for the site that resonates with the city's unique history and future aspirations, avoiding generic, mono-functional models in favor of a mixed-use, public-oriented vision that strengthens local identity (Xu, 2012; Zheng et al., 2024).

iii. Catalytic Intervention through Iconic Reuse: Identify key iconic structures as anchors for the transformation. Their innovative adaptive reuse should serve as a powerful symbol of change, create immediate landmarks of attraction, and demonstrate the project's core philosophy (Yu, 2001; Zhu & Li, 2022).

iv. Phased Integration and Stitching: Implement the transformation in stages, prioritizing public space and connectivity to ensure the area gradually becomes re-stitched into the urban fabric, both physically and in the perception of the citizens (Wang et al., 2021; Chen et al., 2023).

6.4. Limitations of the Study

Despite its comprehensive, multi-scalar scope, this research is subject to certain limitations:

i. Data Accessibility: The compilation of Qingdao's industrial heritage inventory was constrained by the limited availability of official, centralized archives, relying partially on fragmented online sources and historical texts (Zhao, 1928), which may affect comprehensiveness.

ii. Design Proposal Scope: The architectural design proposal presented remains at a conceptual and schematic design level. A full implementation would require deeper technical engineering analysis, detailed financial feasibility studies, and precise environmental impact assessments.

iii. Dynamic Policy and Urban Context: Urban development policies and market conditions in China are highly dynamic. The research captures the context up to a specific point in time, and future shifts could alter the implementation landscape for projects like Qingdao Port (Ministry of Industry and Information Technology, 2023).

6.5. Recommendations for Future Research and Practice

Building upon the findings and limitations of this study, several avenues for future research and practical recommendations emerge:

i. Community-Centric Research: Future studies should employ qualitative methods like interviews and workshops with former port workers and local residents to deeply integrate their needs, memories, and aspirations into the design process, ensuring the project's social sustainability and authenticity, a dimension noted as critical by (Loures, 2008) but which was beyond the primary scope of this study.

ii. Technological Integration in Heritage Adaptation: Research into the application of Building Information Modeling (BIM), Augmented Reality (AR), and other digital tools for the specific challenges of industrial heritage (e.g., monitoring structural health of silos, creating immersive historical narratives) holds great promise, building upon initial technical explorations like those of (Liu et al., 2018).

iii. Management and Operational Models for Large-Scale Heritage Complexes: There is a critical need to explore innovative public-private partnership (PPP) models and long-term operational business plans tailored to the unique nature of large-scale cultural-industrial complexes, ensuring their financial health beyond the initial construction phase, an area hinted at by (Li et al., 2024).

iv. Ecological Resilience and Blue-Green Infrastructure: Future designs for waterfront industrial heritage should more explicitly integrate blue-green infrastructure, climate adaptation measures, and circular economy principles, positioning these renewed sites as leaders in urban ecological resilience, extending the sustainability discourse initiated by (Niu et al., 2018).

In conclusion, the renovation of industrial heritage is a profound and necessary undertaking in the 21st-century city. It is a process of creative conservation that demands respect for the past and boldness for the future. By following the analytical path from the global to the local, this thesis has argued for a context-sensitive, multi-scalar, and design-led approach. The case of Qingdao Port demonstrates that when approached with such sensitivity and innovation, these former engines of industry can be successfully re-purposed. They can become the new beating hearts of the city—places of memory, culture, and vibrant public life, forging a sustainable and meaningful path from a productive past to a dynamic future (The Nizhny Tagil Charter for the Industrial Heritage, 2003; Bell, 2019).

References

Bibliographic

Bell, D. (2019). The coming of post-industrial society. In D. B. Grusky (Ed.), Social stratification, class, race, and gender in sociological perspective (2nd ed., pp. 805–817). Routledge. https://doi.org/10.4324/9780429306419

Bonino, M., Huaman, A., & Rosso, M. (2021). Transformative factors of post-industrial urban spaces in China and Italy. In Towards socially integrative cities (pp. 45–67). MDPI. https://doi.org/10.3390/books978-3-03936-679-8-7

Chen, C., Gong, Y., Wang, L., & Wang, H. (2023). Exploration of the renewal model for inefficiently used land of industrial heritage in the context of heritage conservation. Shanghai Urban Planning, (5), 119–125.

Cheng, Z. (2024). Industrial heritage protection and regeneration design cases [PPT]. Renren Document. https://www.renrendoc.com/paper/311774810.html

Ciaramella, A., & Celani, A. (2019). Industry 4.0 and manufacturing in the city: A possible vertical development. TECHNE-Journal of Technology for Architecture and Environment, 19, 133–142.

Ding, X., Que, W., & Sun, Y. (2014). 'Locality' and the adaptive reuse of urban industrial heritage: A case study of the UK Manchester Castlefield Urban Heritage Park. Urban Development Studies, 21(11), 67–72.

Douet, J. (Ed.). (2016). Industrial heritage re-tooled: The TICCIH guide to industrial heritage conservation. Routledge.

Falser, M., & Yang, M. (2001). Industrial heritage analysis. World Heritage List and Tentative List.

Fan, Z. S., & Liu, Z. W. (2011). Na Cheng·Na Shi·Na Ren: Qingdao 120 Nian Dangan. Shandong Pictorial Publishing House.

Feng, M., & Wang, X. (2010). Protection and reuse strategies for the industrial heritage resources of Shanxi Jinhua Textile Factory. Industrial Construction, 40(12), 118–122.

Fox Gotham, K. (2001). Redevelopment for whom and for what purpose? A research agenda for urban redevelopment in the twenty first century. In Critical perspectives on urban redevelopment (pp. 429–452). Emerald Group Publishing.

Gu, X. (2014). Cultural industries and creative clusters in Shanghai. City, Culture and Society, 5(3), 123–130.

Gu, Y. Q. (2014). A study of modern Qingdao's cotton industry (1897–1937) [Doctoral dissertation, Nanjing University].

Guo, Y. C., Wang, R. S., & Cheng, S. (2019). Protection and renewal strategies for the industrial architectural heritage of Qingdao Port. GuiHuaShi, 35(6), 6–11.

Jia, C., Wang, M. H., Yu, Y., & Wu, Y. L. (2019). Investigation on the history and current situation of Qingdao industrial heritage protection and utilization. Urban Architecture, 16(19), 86–91.

Jidipi. (2024, May 23). Kanaal: A sustainable residential project by META architectuurbureau. Retrieved November 2024, from https://architectures.jidipi.com/j00059592/en/kanaal-in-wijnegem

Jiemian Shandong. (2023, September 21). Twenty years, Qingdao Beer Museum expands steadily to explore new boundaries of beer culture. Jiemian News. https://www.jiemian.com/article/10137733.html

Law of the People's Republic of China on the State-Owned Assets of Enterprises, Chapter 1, Section 3. (2008). http://www.gov.cn/flfg/2008-10/28/content_1134207.htm

Li, A. M., Wang, J., & Zhang, H. (2024). Economic value assessment of industrial heritage in Tangshan, China. Journal of Infrastructure, Policy and Development, 8(4), 3568. https://doi.org/10.24294/jipd.v8i4.3568

Li, B. H., & Li, C. (2005). Research on the history of modern urban planning in Qingdao (1891–1949). Urban Planning Journal, (6), 81–86.

Li, J. D. (2023, April 16). Discussion on the renovation strategy of urban industrial architectural heritage. 21KS.Net. https://www.21ks.net/lunwen/gynylw/149626.html

Li, L., & Wei, W. (2005). Review of research on industrial heritage tourism at home and abroad. Journal of South China University of Technology: Social Sciences Edition, 7(4), 78–82.

Liu, F. Y., Wang, X. T., He, C. H., & Zhao, S. H. (2018). Research on strategies for protection and reuse of vertical silos. Industrial Construction, 48(2), 192–199. https://doi.org/10.13204/j.gyjz201802035

Liu, Z. Y. (2020). Research on the functional reform of development zone governments and the transformation of Qingdao Port [Master's thesis, Zhongnan University of Economics and Law]. https://doi.org/10.27660/d.cnki.gzczu.2020.003208

Loures, L. (2008). Industrial heritage: The past in the future of the city. WSEAS Transactions on Environment and Development, 4(8), 687–696.

Lu, N., Liu, M., & Wang, R. (2019). Reproducing the discourse on industrial heritage in China: reflections on the evolution of values, policies and practices. International Journal of Heritage Studies, 26(5), 498–518. https://doi.org/10.1080/13527258.2019.1666293

Ministry of Industry and Information Technology of the People's Republic of China. (2023). National industrial heritage management measures.

Moccia, M. (2022). Cities in the post-industrial turn: Promoting a new centrality through the reuse of the former Tangshan Steel and Iron Plant [Master's thesis, Politecnico di Torino].

MVRDV. (2005). Frøsilo. Retrieved November 2024, from https://www.mvrdv.com/projects/143/fr%C3%B8silo

Moustafa, S. M. N., Ali, A., & Hassan, M. (2018). Challenges to safe wheat storage. In Global wheat production (pp. 205–220). IntechOpen. https://doi.org/10.5772/intechopen.75585

National Bureau of Statistics of China. (2024). Basic statistics, national census. China Statistical Database. https://data.stats.gov.cn/english/easyquery.htm?cn=C01

Nefs, M., Alves, S., Zasada, I., & Haase, D. (2013). Shrinking cities as retirement cities? Opportunities for shrinking cities as green living environments for older individuals. Environment and Planning A: Economy and Space, 45(6), 1455–1473. https://doi.org/10.1068/a45302

Niu, S., Lau, S. S. Y., Shen, Z., & Lau, K. W. (2018). Sustainability issues in the industrial heritage adaptive reuse: Rethinking culture-led urban regeneration through Chinese case studies. Journal of Housing and the Built Environment, 33(2), 501–518. https://doi.org/10.1007/s10901-018-9614-5

Qingdao Municipal Archives. (n.d.). The urban construction archives of the German occupation period of Qingdao. Retrieved November 18, 2024, from https://www.qdda.gov.cn/

QingDaoChengShiDangAn. (2021, December 27). Qingdao National Cotton Factory No. 1, Memories of a City. 163.com. https://www.163.com/dy/article/GS79LVC80543B6OX.html

QingDaoChengShiDangAn. (2024, January 24). From Dakang Yarn Factory to National Cotton Factory No. 1, A microcosm of Qingdao's textile industry history. 163.com. https://www.163.com/dy/article/IP715N7U0543B6OX.html

Qingdao Government Affairs Website. (2021, September 29). Approval by municipal government for control detailed planning of starting area unit of cruise port area.

Qingdao Municipal Bureau of Natural Resources and Planning. (2020). Regulatory detailed planning for the core area of Qingdao international cruise port. Retrieved October 25, 2024, from http://www.qingdao.gov.cn/

Qingdao Municipal Government. (2009, September 15). Opinions on accelerating the construction of the Blue Economic Zone.

Qingdao Municipal Government. (2011, May 6). Implementation plan for the reform and development pilot work of the Blue Economic Zone in Qingdao.

Qingdao Municipal People's Government. (2021, September 6). Approval of the Qingdao Municipal People's Government on the partial planning adjustment of the old port area.

Qingdao News. (2024, August 7). 葳蕤生长，这家千亿级国企与青岛血脉相融 [Lush growth, this state-owned enterprise of hundreds of billions is integrated with Qingdao]. Retrieved November 18, 2024, from https://www.qingdaonews.com/app/content/2024-08/07/content_23594897.htm

Qingdao Port International Co., Ltd. (n.d.). Our history milestones. Retrieved November 18, 2024, from https://www.qingdao-port.com/portal/ch/14

Qingdao State-owned Assets Supervision and Administration Commission. (2013, February 27). Qingdao Home Port Cruise Project approved. Qingdao Government Website. http://www.qingdao.gov.cn/zwgk/xxgk/gzw/gkml/gzxx/202010/t20201018_439763.shtml

State Administration of Cultural Heritage. (2006). Wuxi Proposal—Focusing on the protection of industrial heritage during the period of rapid economic development. Architectural Creation, 8, i0019–i0020.

The Nizhny Tagil Charter for the Industrial Heritage. (2003). TICCIH. https://ticcih.org/about/charter/

Wang, D. W., Wang, R. S., & Zhang, M. (2021). Adaptive reuse strategy for port warehousing industrial heritage: A case study of Dagang District in Qingdao. Urban Architecture, 18(34), 5–9.

Wang, J. G., & Lu, Z. P. (2001). The historical process and experience of waterfront development in world cities. Urban Planning, 25(7), 6–12.

Wang, K. (2023, April 12). Checking in at industrial heritage: Tasting the hundred-year beer flavor in museums. Xinhua Net. https://www.xinhuanet.com/2023-04/12/c_1129516872.htm

Wang, X. M. (2015, January 15). A microcosm of the times: 57 years of Qingdao Steel. QDXin.cn. https://m.qdxin.cn/detail/13036.html

Wang, Y. (2023). Research on the regenerative design of industrial heritage spaces: A case study of the transformation of Zibo, a heavy industrial city in Shandong. Footwear Technology and Design, (21), 154–157.

Wu, C. (2021, June 7). Strengthening the protection and reuse of industrial heritage (Opinion). People's Daily Online. http://world.people.com.cn/n1/2021/0607/c1002-32123733.html

Xing, H., Ran, H., & Zhang, D. W. (2007). An initial exploration of the value and protection of industrial heritage. Journal of Northeastern University: Social Sciences, 9(1), 4–7.

Xunzhao Mengtian. (2022, February 11). The history of Qingdao Port. Xueqiu.com. https://xueqiu.com/4486330239/211234456

Xu, S. L. (2005). The third pole: On the protection of Chinese cultural and natural heritage. Science Press.

Xu, Y. Q. (2012). Reflections on industrial heritage protection in China. e-Phaïstos, 1(1), 111–119.

Yan, W., She, Y., & Chen, Y. (2025). A preliminary exploration of the construction characteristics of the Han Dynasty Minyue State ancestral temples: A case study of the Beigang ancestral temple site at the Hancheng site in Chengcun Village. Traditional Chinese Architecture and Gardens, (3), 108–113.

Yao, Y. B. (2014). Towards the methodology for the reuse of industrial heritage in China [Doctoral dissertation, Politecnico di Torino].

Ye, L., Peng, X., Aniche, L. Q., Scholten, P. H. T., & Ensenado, E. M. (2021). Urban renewal as policy innovation in China: From growth stimulation to sustainable development. Public Administration and Development, 41(1), 23–33. https://doi.org/10.1002/pad.1903

Yildiz Bicer, H. (2024). GIS-based Susa Valley industrial heritage route: Industries of the late 19th century established around the Dora River for hydropower [Master's thesis, Politecnico di Torino].

Yu, K. J. (2001). The beauty of cultural heritage underfoot—Design of Zhongshan Qijiang Park. New Architecture, (5), 17–20.

Yu, K. J., & Fang, W. L. (2006). Preliminary exploration of Chinese industrial heritage. Journal of Architecture, 8, 12–15.

Zhang, B., Dai, H., & Meng, X. (2012). Principles, models, elements, and design practice for the reuse of industrial architectural heritage. Industrial Construction, 42(6), 25–30.

Zhang, W. Y. (2019, September 24). The memory of Qingdao's "Green Sky", the China Textile Compound records the time of several generations of textile people in the Island City. Baijiahao. https://baijiahao.baidu.com/s?id=1645521996817260052

Zhang, X. J. (2013). Qingdao gang, Jiaoji tielu yu yanxian jingji bianqian (1898-1937)——xiandai jiaotong tixi shiyu xia de yanjiu [青岛港 , 胶济铁路与沿线经济变迁 (1898—1937)—— 现代交通体系视域下的研究]. Zhongguo Jingjishi Yanjiu [中国经济史研究], (3), 1.

Zhang, X. Y. (2016, April 20). Jiemi Dehua Cangkou Saosi Chang: Qingdao Zao de Qingfang Qiye. Qingdao Daily. http://www.dailyqd.com/arc/2016-04/20/content_324753.htm

Zhang, Y. X., Liu, M., Chen, H., & Wang, J. (2023). Using industrial heritage tourism to revitalize hollowed-out regions: Insights from the practice in Japan's Sorachi Industrial Area. China Ecotourism, 2, 342–355.

Zhao, Q. (1928). Jiao'ao Zhi.

Zhao, Y. C. (2021, January 26). Theoretical frontiers: Problems and suggestions for the preservation and utilization of industrial heritage in China. Weixin Official Accounts Platform.

Zheng, L., Zhang, H., & Jiang, C. (2024). Research on the holistic conservation and development strategy of Nanjing's industrial heritage group based on relevance. China Famous City, (5), 50–57.

Zhong, D., Huang, P., Xiong, G., & Li, H. (2024). Renewal strategies of industrial heritage based on placeness theory: The case of Guangzhou, China. Cities, 155, 105407. https://doi.org/10.1016/j.cities.2024.105407

Zhu, Y., & Li, A. (2022). An outstanding case of industrial heritage promoting sustainable urban renewal: Massachusetts Museum of Contemporary Art (MASS MoCA). Chinese Landscape Architecture, (7), 45–50.