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THE INDUSTRIAL BEHEMOTH:

Adaptive reuse is the lifeblood of industrial heritage

Case study of reuse industry factory and A planning proposal in Luoyang.

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Acknowledgment

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To all the professors and friends and classmates I've met in my life over the years. I'd like to express my gratitude to everyone for all your kindness.

To my family and friends in China who have always been there in my life to give me encouragement , They made me believe that love is the one thing that transcends time and space.

To make each day count. Nothing can help us endure dark times better than our faith.

To Politecnic, Miracles happen every day.

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Abstract

China is entering a stage of urban development dominated by renewal and redevelopment, and the renewal of old industrial buildings has become a focus of social attention. Due to the rapid economic development, a large amount of industrial heritage is facing idleness and abandonment. Under such circumstances, the subject of how we should properly deal with industrial heritage, so that the abandoned industrial heritage since the recent times can be effectively protected and its reuse value can be developed, and the renewal and replacement of urban industrial land can be successfully realized, has important historical and cultural significance. It is also a realistic issue in the context of urban renewal and has important practical significance for the sustainable development of cities.

This Paper identifies the problems in the reuse of industrial heritage in the context of urban renewal by examining China's national conditions. From the government's planning, the existing situation is analyzed and the potential of industrial heritage is explored. It also puts forward suggestions to optimize the solutions in the context of the current situation of industrial heritage in Luoyang.

Keyword : Industrial heritage; adaptive reuse ; urban renewal.

1 Introduction

1.1 Research Background

1.cultural and historical background

Industrial buildings have existed since ancient times. At the end of the 18th century, the European Industrial Revolution emerged, which was a turning point for industries and industrial buildings around the world. Before the Industrial Revolution, industrial development was still in a relatively primitive stage, mostly handicrafts, agriculture, and animal husbandry, and most industrial buildings appeared in the form of workshops with a small scale. The industrial revolution led to the development of the machine industry, and the industrial development extended from the initial light industry to the heavy industry. The output of this type of industrial iron increased sharply, and also brought new functions and new forms to industrial buildings, and new technologies provided necessary conditions for it. Based on the development of China's national conditions, with the help of the industrial revolution, many industrial buildings are built to adapt to the creation of economic benefits. The site selection problem that pays attention to immediate interests and ignores long-term interests, lack of deliberation in architectural forms, etc., time flies, cities are With the development, these industrial buildings are facing many problems, but they are still developing by leaps and bounds, which strongly promotes the emergence of industrial buildings. Instead of being in the center of the city, it needs to be relocated and rebuilt, or the production is backward and it faces bankruptcy. There are more and more old industrial buildings in the city, and they are more and more extensive. How to deal with these old industrial buildings has become an urgent issue for social development and urban construction. [1]

1.A Study on Ten Principles of Urban Renewal [J]. Wang Yunpeng. Housing and Real Estate. 2021

China's reform and opening up led to a period of rapid economic development, the times have changed, and it has entered a period of rapid urbanization. During this period, the Chinese government also issued a series of policy documents to guide this work, but due to the lack of corresponding legal guarantees, the protection of industrial heritage in China is still in the exploratory stage. After the renewal of urban industrial land, along with great changes in the urban spatial structure and use functions, the old industrial areas in the city were gradually abandoned and gradually surrounded by new urban areas. However, the original factory is located in the center of the city, the industrial area has serious environmental pollution, inconvenient transportation, living facilities and other impacts are becoming more and more obvious. As a result, the status of the city center no longer exists, and new economic impetus must be injected. Urban renewal is urgent. A large number of cities have relocated industrial enterprises to the edge of the city and remote mountainous areas. However, a large number of factories have been left behind after the changes. Facilities, related buildings and streets have gradually become forgotten parts of the city.

image 01 : china culture describe
source : https://jiu.ifeng.com/c/7uT-qkryoMN6

image 01

2.Economic and Policy

Driven by economic globalization and urban renewal, the city's industrial structure is constantly being adjusted. A large number of industrial industries in the city center have been relocated, outdated industries have gone bankrupt, and old industrial buildings have gradually increased in the city. All these have become the social and economic background for the subject research. China is the most populous country in the world and the second largest industrial country in the world. It has rich industrial heritage resources, including factory ruins, factory buildings and other related facilities. For nearly half a century, these industrial heritages in the early days of the founding of the People's Republic of China have been the main material carriers of the era of industrial civilization, because they not only witnessed a glorious page in the history of new China's industrial development, but also witnessed the evolution of human civilization and the task of inheriting culture. [2]
At present, many old industrial buildings that have not been put into operation are regarded as abandoned buildings with no function, but these buildings still have a good material life and are still valuable for reuse, and there are many such buildings. The method of demolition or re-demolition needs to be improved from the perspective of economic value and culture. On the other hand, China's economic development is developing in the

2. Progress and Prospects of Research on the Spatial and Temporal Evolution Paths and Driving Mechanisms of Sustainable Urban Renewal[J]. Cao, Kexin, Deng, Yu. Advances in Geographical Sciences. 2021(11)

direction of low-carbon economy. Rational use of old industrial buildings will avoid economic waste and create economic benefits and cultural aspects of the city [3]

The core theme explored in this paper is “industrial architecture”, which plays an important role in the development and restoration of urban human settlements in the process of urbanization in China.

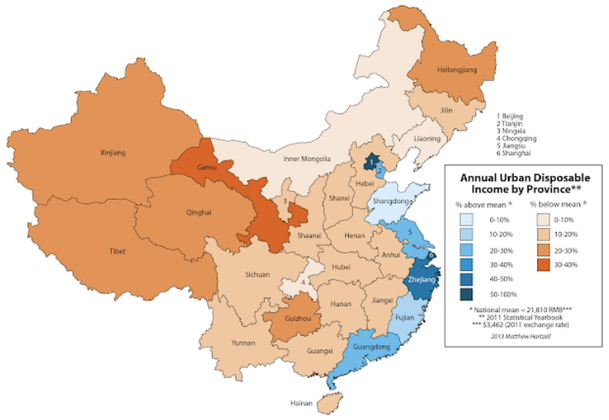

image 02

3. Analysis of the current operation mechanism of urban renewal in China[D]. Song Litao. Shandong University 2013.

image 02: disposable income of the urban population in each province
saource: http://matthartzell.blogspot.com/2013/09/chinas-economic-disparityin-maps.html

1.2. Aims and objectives

China is in a period of accelerating urbanization, and some unappreciated industrial buildings and related remains are rapidly disappearing from cities. Due to the lack of renovation experience at the urban management level, there are many limitations in the renovation of industrial heritage in small and medium-sized cities, coupled with the lack of awareness of social protection and imperfect policies, there are great difficulties and obstacles in the renovation and reuse of cotton. Therefore, this paper takes the Luoyang area with a relatively low degree of industrial transformation and complete industrial areas as the research object, to explore a relatively reasonable strategy for industrial heritage transformation, and to explore a model that promotes urban renewal and industrial development. And create a vision of industrial transformation in the form of industrial heritage.

To this end, this paper proposes the following research objectives.

- To explore the definition of industrial heritage, stages of development. To study the characteristics, current situation and causes of abandoned industries in China, and to understand the relationship between urban renewal and industrial heritage
- Analyze the current situation of industrial heritage, understand the dilemma of development dynamics, and analyze the relevant stakeholders.
- Discuss the theory and evolution of adaptive reuse of industrial heritage. To study the situation of industrial reuse in China.
- Analyze the current situation and countermeasures of industrial heritage reuse in different countries
- Through the case of industrial heritage reuse, by exploring the strategies of reuse
- Understand the heritage conservation system and policies of the Chinese government
- Propose measures to promote the reuse of industrial heritage

1.3 Research hypothesis

Old industrial buildings in urban regeneration play a prominent role in the culture and economy of the city as a whole. By studying the relationship between the two to find strategies for improvement, the city can develop for the better.

1.4 Research methodology

In order to achieve the aims and objectives of the study and to try to test the hypotheses developed, the study is divided into two parts, as shown in the figure: a theoretical part and an illustrative part. In the first part, I will examine the relevant academic literature and findings, survey and analyse the theoretical knowledge in the literature related to industrial heritage and adaptive reuse, and study the concepts and their intrinsic links.

The second step of the research is to build on the above practical approach by combing through industrial conservation policies and identifying some of the problems currently encountered in industrial reuse, by conducting case studies. The study summarises the design principles and strategies for industrial transformation adapted to small and medium-sized cities. A series of suggestions for optimisation strategies for China's industrial heritage based on the context of urban regeneration.

1. Methodology of the study

Literature Research Methodology
After the selection of the topic, a large amount of literature was collected and studied in depth through the literature research method. As the renovation and reuse of old industrial buildings has a crucial impact on urban development, different people have different interpretations of this industry heritage and adaptive reuse topic. Through the different cases mentioned in the study, the definition, scope of application and characteristics of industrial adaptive reuse are summarised to provide a theoretical basis for future research.

2. Survey Method
Through extensive research, we summarised the definition, characteristics, dynamic mechanisms and development trends of industrial and reuse, and presented general issues of industrial heritage renovation in China in the context of urban regeneration. Finally, we selected some representative cases for further study to explore the problems and countermeasures involved and to illustrate the possibilities of reusing industrial heritage in Luoyang.

3.Comparative Research Approachx
Different ways of reusing industrial heritage can also produce different results. By analysing and studying industrial heritage that has been successfully developed and utilised, this paper draws out guiding experiences that can be applied to the conservation and utilisation of similar types of industrial buildings, in order to form a suitable development and utilisation model for oneself. Throughout this paper, a comparative approach is adopted to identify and solve problems in the process of comparison.

Chart 1: Mind Map

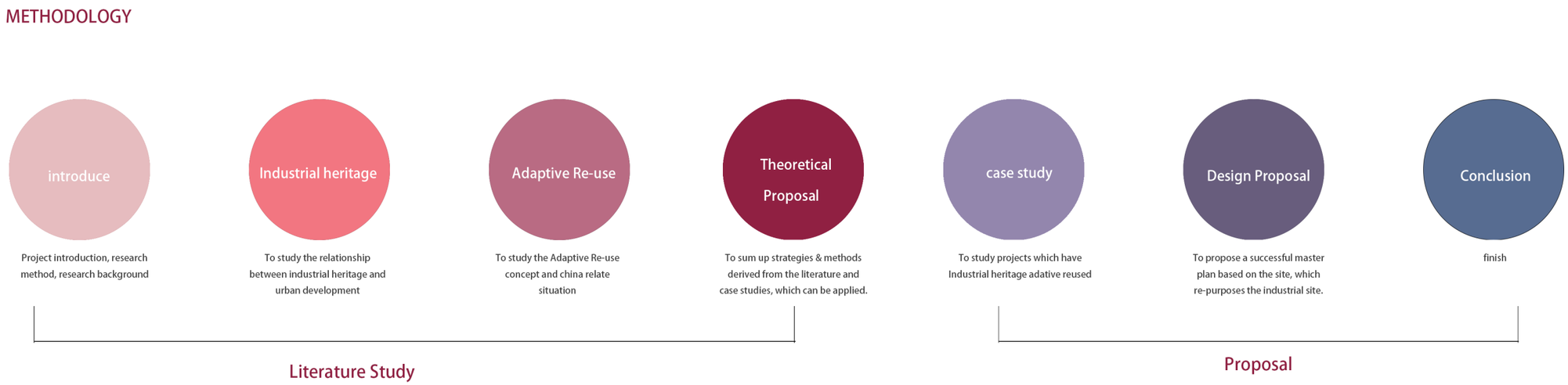

Chart 1

2 Industrial heritage

"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."[1]

2.1 Industrial heritage definition

Industrial heritage is of vital importance for the buildings and structures created by industrial activity, the processes and tools contained in such buildings and structures, the towns and landscapes in which they are located, and all their other tangible and intangible manifestations. [2]

The Charter of Nizhny Tagil states: "Industrial heritage includes monuments of industrial culture of historical, technical, social, architectural or scientific value, including buildings and machinery, plants, production workshops and factory mines and processing sites, warehouses, places of production, transformation and use, transport and its infrastructure, as well as places of residence, religious worship or education and social activities related to industry. industrial-related social activities." The 2006 Wuxi Conference noted that industrial heritage includes not only the tangible but also the intangible cultural heritage derived from the process of industrial development.

Industrial heritage represent history, architecture and technology indifferent time and area, which needs to keep in good condition for next generations. [3]

From a comprehensive perspective, industrial heritage generally refers to the tangible and intangible cultural heritage that remains after the industrial optimisation and land redistribution of traditional industrial areas in cities, reflecting the industrial civilisation, industrial history and culture of a specific period. [4]

1.Michael Falser ." Industrial Heritage Analysis World Heritage List and Tentative List" 8.Aug.2001< https://whc.unesco.org/archive/ind-study01.pdf >.

2.Sun Shengxiong, Zhang Ziyi, Yuan Jiahui. Protection and Redevelopment of Industrial Heritage from the Perspective of creative Industry Development: A case study of Changying Studio [J]. Jilin, Journal of Art College,2016

3. Bateman, H., Harris, E., McAdam, K. (eds.): Dictionary of Leisure, Travel and Tourism (Third Edition), A & C Publishing, London, 2005.

4.Yu Hu, Wang Kaiyong, Xu Linlin, "Research on the Utilization of Industrial Heritage Resources and its Enlightenment", World Geographic Research, 10th, 2019 .

2.2 Industrial heritage development stage

The three phases of human social development (pre-industrial, industrial and post-industrial societies) were first proposed in 1973 by the American economist Daniel Bell in his book The Coming of Post-Industrial Society. In his book The Coming of Post-Industrial Society, the American economist Daniel Bell referred to this theory. As industrial societies develop, the characteristics of cities vary, and the main features, in general, are the objective laws of productivity progress that have contributed to the construction of cities themselves, which is the reason for the industrial heritage. [5]

5. Xie Wen-Hui, Deng Wei. Urban Economics, 2nd Ed. Beijing: Tsinghua University Press, 2008.

chart 2 :The main characteristics of urban development in each period

Historical period	The main characteristics
Pre-industrial society	The structure and layout of the city centered on the cottage industry had no fundamental change from the cities in the previous feudal society.
Industrial society	Unprecedented large areas of industrial areas, transportation areas, warehouse docklands and workers' residential areas have emerged in the city. Cities are getting bigger and messier. The original urban environment and appearance of the city have been destroyed, urban greening and public, public facilities are abnormal insufficient, the city is in a state of panic.
Post industrial society	With diversified functions and the tertiary industry as the center, the city is relatively stable in scale and quantity, forming Dadu and continuous city area. The municipal facilities in the city are modern, and the living conditions are relatively superior. The city has changed from an industrial production center to a tertiary industry center.

Chart 2

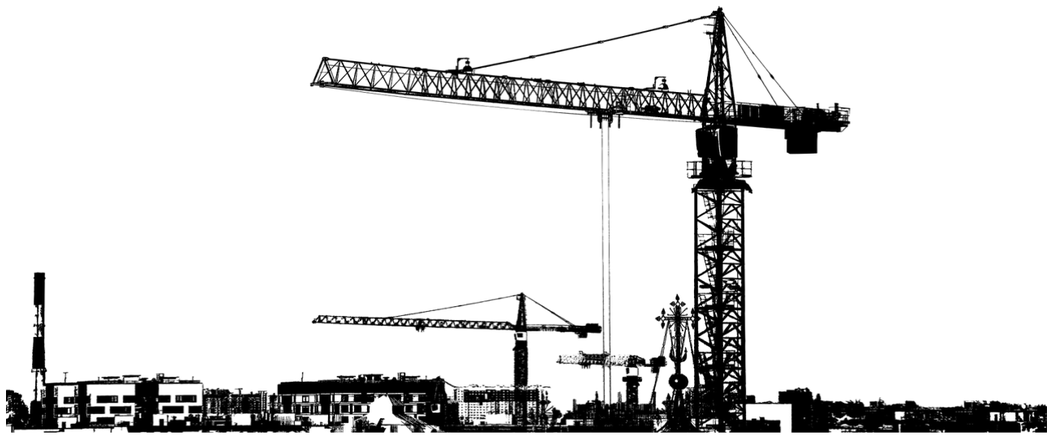

image 01: industry building
source:https://pixabay.com/vectors/cranes-cityscape-silhouette-city-4074519/

Image 03

2.3 Industrial heritage in China

China's development model is distorted and fast. It is transformed from the era of a planned economy in the early days of the founding of the People's Republic of China to the market economy, and also from the era of the industrial economy to the era of the service economy. The specific performance is: industrial land is not included in the production cost, so industrial enterprises generally have supporting staff housing near the production area, resulting in the concentration of a large number of industrial buildings in the center of most cities in China. This period is the era of the industrial economy After the founding of the People's Republic of China, thousands of industrial construction projects were planned and arranged, which had an extremely far-reaching positive impact on the structure and layout of the national economy in the future. With the advancement of science and technology and the change in social needs, the mid-1980s began to adjust the urban industrial structure, causing a large number of traditional industrial depressions and bankruptcy, resulting in a fundamental change in the functional layout of the city. The industrial heritage produced by economic development has become a worldwide phenomenon. [6]

6. Xie Wen-Hui, Deng Wei. Urban Economics, 2nd Ed. Beijing: Tsinghua University Press, 2008.

The existing types of China's modern industrial heritage are divided into the following stages according to the time stage:

chart 3 : Development stages of modern and contemporary industries in China
source : Jiang Difei. Urban form vitality theory. The first edition. Nanjing: Southeast University Press, 2007,13.55
(sum up by author)

Historical period	The time span	The main characteristics
Modern industrial	From 1840 to 1894	In the stage of the emergence of modern Chinese industry, many industrial categories began to break through from none to some.
	From 1895 to 1911	At the initial stage of industrial development in modern China, the Treaty of Shimonoseki allowed foreign capitalists to set up factories in various places. The invasion of foreign capitalist powers produced new industrial buildings, and China lost its exclusive right to industrial manufacturing
	From 1912 to 1936	During the rapid development of private industrial capital, important military and political officials and overseas Chinese became important industrial investors, and the Chinese national bourgeoisie developed and strengthened, and modern industry gradually moved toward the development road of self-reliance.
	From 1937 to 1948	During the war of Resistance Against Japan, industrial development was difficult, and a large number of industrial and mining enterprises relocated, and the post-war industry began to recover briefly.
contemporary industries	From 1949 to 1965	New China's early industrial development, after rational development and the Great leap forward wave lake.
	From 1966 to 1976	The exploration of industrial development experienced a tortuous period of progress, industrial production stagnation or even regression.
	From 1978 to the presentds	During the great development of modern industry, the industrial pattern retreated, advanced and adjusted, resulting in the reorientation of some industrial areas

Chart 3

2.4 Protection of industrial buildings

Industrial heritage reuse practice has gone through many shifts since the late 1970s. From a heretic and scarce form of conservation during the 1980s, industrial heritage reuse became common practice in most western European countries during the 1990s and flourished in the first years of the 21st century, when Europe was enjoying a good economic situation. Nevertheless, this prosperous period did not meant to last. In 2008, financial crisis hit Europe, causing financial and social upheavals in all countries which in turn resulted once more in major shifts influencing the heritage sector. [7]

While safeguarding industrial buildings is frequently regarded as a positive step in heritage conservation, the growing emphasis on industrial structures is unremarkable in light of the recent increased admiration for architectural styles linked with unique historical periods. Individual landmark buildings that are notable in some way, such as being symbolic of an important architect, are frequently the focus of conservationists' attention. This is especially true when they approach the half-century mark and are threatened by material failure, maintenance neglect, or physical or functional obsolescence. [8]
The last 30 years have brought increased awareness of the importance of industrial history in understanding heritage. [9]

7.https://reindustrialheritage. eu/industrial-heritage-reuse .

8. PRUDON, T. H. M. (2008) Preservation of Modern Architecture, Wiley, Hoboken, NJ .the international Committee for the Conservation of the Industrial Heritage (TICCIH) ,2003 .

9. Andrei Eugen Lakatos, Recovering the Memory: Conversion within the Context, Acta Technica Napocensis: Civil Engineering & Architecture Vol. 58, No. 4 ,2015 .

chart 4 : Industrial heritage stage source :https://reindustrialheritage.eu/industrial-heritage-reuse

chart 3 : Industrial heritage stage

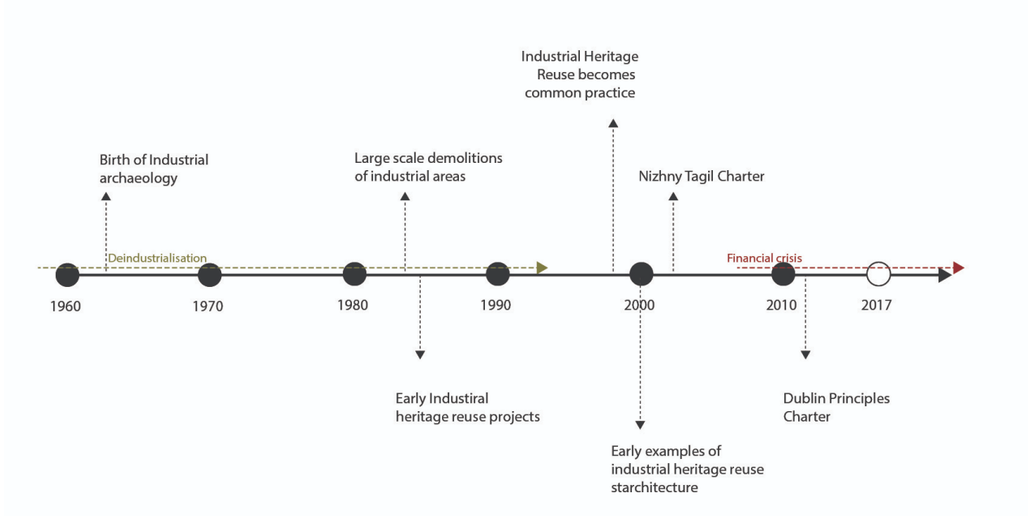

Chart 4

2.5 Reasons for the abandonment of industrial buildings

1. the transformation of the economic system to eliminate outdated traditional industries

The industrial zones were slowly incorporated into the growing cities and industrial production being gently moved out of the new city limits or they abandoned inside the city. [10]
For China, the transition from agriculture to industry led to rapid economic development, but the elimination of traditional industrial enterprises over time was also a symptom of the shift in the economic system. After the reform and opening up policy, China introduced a system of compensatory use of urban land in the form of a tax, which included industrial land in the cost of production and allowed companies to compete freely. This has resulted in some increased costs and fewer sales customers

2. The accelerated urban renewal process has led to the shrinking of traditional industries.
The restructuring of urban industries that began in the mid-1980s, in response to advances in science and technology and changes in social needs, led to the decline and closure of a large number of traditional industries, resulting in a fundamental change in the functional layout of cities. The industrial heritage generated by economic development became a worldwide phenomenon

3.The Chinese state system has led to an increase in industrial inactivity. To improve the efficiency of land use and urban functions, China has adopted a "policy of industrial restructuring and urban development", which involves replacing industrial land in urban centers, especially those in commercial centers, with land for tertiary industries in order to obtain the best economic results. In this process, the formerly prosperous industrial areas are being converted or relocated and gradually replaced by new technological industries. In this process, a large number of traditional industrial technologies were eliminated and a large number of industrial facilities, including factories, warehouses, municipal utilities and their ancillary facilities, docks, etc., were left idle. [11]

10. Hu Xinxue. Protection and Reuse of Shanxi Industrial Heritage -- Taking Shanxi Jinhua Textile Factory as an example: [Master's Thesis, Taiyuan University of Technology]. Shanxi: Taiyuan University of Technology, 2012 .

11. Dengwen, Social stability risk assessment and countermeasures of urban renewal projects [D]. Nanchang University,2020.

2.6 The relationship between industry and China urban evolution

Industrial heritage reuse practice has gone through many shifts Western urban regeneration has reached a relatively mature and vigorous stage. China's long-standing semi-feudal and semi-colonial society has resulted in the dominance of a natural economy and the backward growth of the commodities economy for complicated socio-historical reasons. [12]

12.Li Jianfeng,Research on Model Selection and Comprehensive Benefit Evaluation of Urban Renewal[D]. South China University of Technology ,2019 .

1) In the 1970s, China's overall economy was in serious decline due to the effects of prolonged war, and urban infrastructure was in decline.
The focus of urban construction was on productive construction. The state was fully committed to the development of heavy industry, and most of the production projects were concentrated in new urban areas. Although there were many urban problems left over from the old China, due to the limited economic situation of the government and the shortage of resources, the main focus was on the renovation of shanty towns and dilapidated buildings, as well as adding some basic municipal facilities to solve the most basic problems of the residents.

At this stage, the level of construction was low, the facilities were incomplete, the management tools were not perfect, the supervision was insufficient, and the destruction of cultural relics and monuments was serious. The urban form is characterised by newer, better quality and higher-storey buildings on the periphery, while the buildings in the centre are generally older and of poorer quality, which is contrary to the general rule of urban development. This is contrary to the general rule of urban development. To a certain extent, it also aggravates the further deterioration of the environment and leaves a hidden danger for the future development of the city.

image 4 : Chinese Industrial Design from the Late 1970s to the Late 1990
source :https://www.ugainian.com/news/n-3631.html

Image 04

2. After the introduction of the reform and opening-up policy in 1978, China's economy developed rapidly and the speed of urban construction was greatly accelerated.

At the same time, with the establishment and perfection of the socialist market economy system, the use of land for compensation, the flourishing of commercial housing, the rise of the tertiary industry, and the diminishing availability of land for development in new urban areas, the old urban areas have gained new impetus and opportunities for transformation. This led to a new historical period of urban renewal. [13]

13.Wang Yunpeng,A Study on Ten Principles of Urban Renewal [J]. Housing and Real Estate, 2021 .

3. After the 1990s, urban renewal began at an unprecedented pace and scale. At the same time, with the growth of the city's overall economic power and the real estate market, the investment approach to urban regeneration was also changing - from 'input-based' to 'industry-based'.

In this process, the chaotic layout of China's old urban areas, congestion, traffic congestion, poorly constructed municipal facilities and serious environmental pollution have been addressed to some extent in the post-reform urban regeneration process. However, the process of urban renewal has also revealed some new problems. The old conflicts and problems that have accumulated over the course of history continue to reappear in different forms. [14]

14.Li Guohao et al. Chinese Encyclopedia of Civil Architecture: Architecture. China Construction Industry Press, 1999.

image 5 : Chinese Industrial Design in Late 1990
source : https://interactive.wbez.org

Image 05

2.7 The value of industrial buildings

Industrial buildings are “buildings and structures intended for productive use. [15] In addition to its architectural value, a building has the following three values

15: source: https://baike.baidu.com/item/%E5%BB%BA%E7%AD%91%E7%89%A9/673834

1) Economic benefits
By reusing the old industrial buildings in good structural condition, whether they are demolished or left idle, it is a waste of resources. By reusing them in a comprehensive way, the original spatial environment can be improved .It will also improve the environment of the area, optimise the quality of life in the area and provide conditions for the re-employment of factory workers and the re-prosperity of the surrounding area.

2) Cultural value
The old industrial buildings are a combination of force and beauty, a product of the industrial era and a symbol of industrialisation, and condense the architectural culture of a specific period, and their specific image features satisfy the psychological sense of belonging of a specific group of people living in the city. It perpetuates the memory of the city, is an important part of the process of urban civilisation, and is an important trace.

16: Fuying Liu;Qi Zhao;Yulan Yang , An approach to assess the value of industrial heritage based on Dempster–Shafer theory, Journal of Cultural Heritage,2018

3) Ecological environment
The built environment is a way of improving the quality of the original space and adapting it to the needs of modern life. The deterioration of old buildings is often accompanied by the deterioration of the surrounding environment. By reusing buildings, improving the environment, rationalising traffic conditions, renewing infrastructure and exploring and enhancing the aesthetic characteristics of the area, the aim is to improve and enhance the quality of the environment. [16]

chart 5: Industrial heritage comprehensive value evaluation system structure model.
source :https://www.scirp.org/journal/paperinformation.aspx?paperid=109286

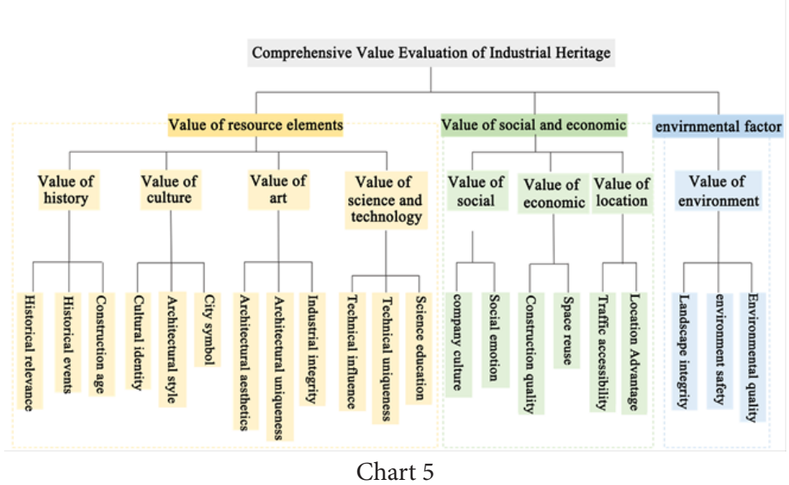

Chart 5

2.8 Stakeholders of industrial heritage

For industrial heritage-type historical and cultural blocks, different stakeholders have different interest demands, and according to their own interest demands, they affect the generation and implementation of the final decision-making of protection and utilization. Therefore, in the practice of protection and reuse, it is necessary to accurately grasp the According to the appeals of different stakeholders, the forces of all parties are gathered in the most effective way to give full play to their influence.

1. Representative of the public interest—local government
The importance of industrial heritage has been recognized by most city managers. At present, China's heritage management and supervision system has become more and more complete. Cities with many historical and cultural heritage resources have begun to actively explore the protection and utilization of cultural heritage. For the historical and cultural blocks that still bear some social functions, reasonable development and utilization principles As it should be the preferred mode. Governments at all levels have incorporated the protection and development of historical and cultural blocks into local development plans, and have continuously issued relevant laws and policies to escort the protection and development of historical and cultural blocks. [17]

17: Ting guo , Research on the management practice and sustainable development strategy of industrial heritage resources in Bisezhai Railway Station from the perspective of stakeholder theory, Università di Economia e Finanza dello Yunnan,2022

2. Representatives of the elite class—experts and scholars
As an urban public area, historical and cultural blocks are the focus of attention of multiple stakeholders. In the field of urban cultural heritage protection, relevant experts and scholars have professional knowledge of cultural heritage protection, and their opinions are authoritative, which can often directly affect the final decision-making of cultural heritage management departments, and protect urban historical culture with practical actions. Realization of legacy goals. In the protection of urban cultural heritage, experts and scholars are active participants in the protection and reuse of urban cultural heritage, and every link of the protection and development of cultural heritage cannot be separated from their participation.

3. Representing the interests of the masses—the public
The public's active participation in the protection and development of industrial heritage-type historical and cultural blocks can not only ensure that the interests of the group can be valued by the competent authorities, but also promote the scientific advancement of the development and planning of the competent authorities, so as to realize the industrial heritage-type historical and cultural development. The protection and development goals of the block.

4. The representative of the market entity is an enterprise
The production area in the historical and cultural blocks of industrial heritage often becomes the idle space of the city due to the relocation and bankruptcy of industrial enterprises, so the enterprises themselves have an inescapable responsibility for the protection of the historical and cultural blocks.

chart 6 : Stakeholders dealing with heritage
source :https://www.researchgate.net/figure/Stakeholders-dealing-with-heritage-examples-of-heritage-they-hold-and-of-their-aims_fig2_321756240

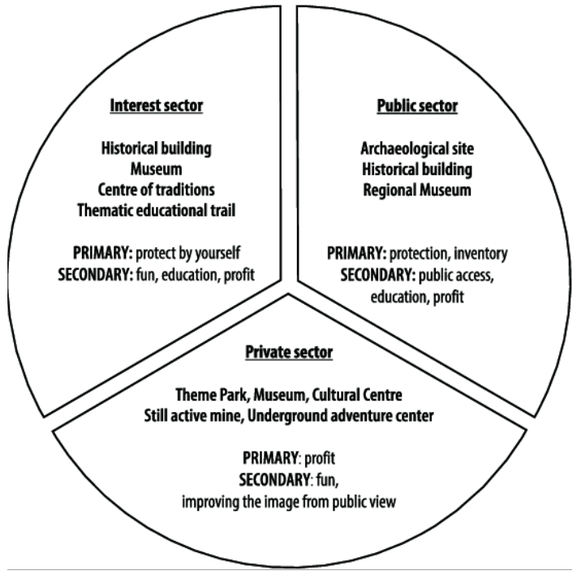

Chart 6

2.9 Drivers of Industrial Heritage Development

The industrial heritage architectural group shows the historical and cultural development of the city where it is located. It is a living "fossil" of a city's industrial development, a "recorder" of the city's industrial cultural tradition, and a real place for modern people to understand the historical development of the city's industry. Specifically, the driving forces for the protection and utilization of industrial heritage areas mainly include the following aspects [18] :

18. Gao Xiangguan; Changjiang ,Uno studio sui fattori di sviluppo del patrimonio industriale, Edifici industriali,2013

1. The needs of urban development
Usually the city presents a mixed state of diversity, and these neighborhoods determine the character and personality of the city, concretizing and perpetuating meaningful places.
With the deepening and strengthening of the public's understanding of the integrity of industrial protection, in addition to protecting the building itself to maintain the integrity of its historical information, the additional functional features of historical buildings must also be protected. Putting the industrial heritage area into the overall development of the city, there are two renewal needs. On the one hand, there is the need for material renewal of the industrial heritage itself, so as to protect the individuality and regional characteristics of the historical buildings; Bringing lasting vitality, industrial historical buildings can play new functions while being reasonably protected.

2. Protection needs of cultural heritage
After the western countries experienced the large-scale urban renewal movement after the Second World War, faced with the rising high-rise buildings, the surviving cultural heritage has become the "bright spot" in the urban environment. These countries realize that urban cultural heritage is of great significance to ensure the continuation of urban history and the preservation of collective memory, so the protection and activation of cultural heritage has become an important issue in urban development. The premise of protecting urban cultural heritage is to ensure that the integrity of the heritage is not damaged. An important feature of industrial heritage is that it occupies a large area. Whether it is a production area or a living area, there are a large number of buildings and a large area, which brings great challenges to the preservation of the integrity of such historical and cultural blocks. In addition, the intangible intangible cultural heritage is also difficult to preserve intact. The overall demolition of the factory area is an effective way for urban management, but it hinders cultural preservation, and

the information of the times, the spirit of the place, and the value of science and technology contained in the idle space of the industry are forgotten.
In order to effectively protect industrial heritage-type historical and cultural blocks, it must be included in policies consistent with urban economic and social development, and the protection of cities and historical and cultural blocks must be considered in many aspects in planning programs and urban programs. The streets are recognized in the network and harmoniously combined.

3. The concept of sustainable development
In 1980, the International Union for the Conservation of Natural Resources, the United Nations Environment Program and the World Wildlife Fund jointly issued the "World Conservation Outline". [19]
The concept of sustainable development has set off an upsurge all over the world since it was put forward. With the continuous advancement of the urbanization process, the sustainable development theory proposed for the natural environment has gradually begun to be used in urban development.
As a "micro-society" in the modern city, the factory has buildings with a long history. These buildings have strong characteristics of the times, provide urban residents with a place of collective memory, and are part of the urban social fabric. The concept of sustainable development requires modern cities to fully activate and utilize urban historical resources, rationally plan idle geographical space, reduce the waste of urban space, and improve the living environment of urban residents. The principle of sustainable development requires other areas to be completely preserved.

4. Development of cultural industry
Today's society has moved from the industrial age to the information age, and from the industrial society to the post-industrial society. In the post-industrial age, driven by economic development, the adjustment of industrial structure is carried out on a global scale, which can improve the living standards of residents and improve the urban environment. The industry is vigorously supported. The development of cultural industry has become the new trend of world economic development and the strategic choice of many cities.

19.
Ou Hao;Zhan Yu Xie;Jing Ha , Research Sustainable Protection and Development of Industrial Heritage - For Example Laolongkou Distillery, Applied Mechanics and Materials, 2012

Foreign developed countries and domestic first-tier cities have already set off an upsurge of utilizing urban idle space such as industrial factories to develop cultural industries. Industrial idle space has become the first choice for cultural and creative industry practitioners. The low rent and wide space environment are very popular. The Soho Art District in New York and the 798 Art District in Beijing were formed by the spontaneous gathering of artists. As more and more creative workers come, a large number of industrial architectural heritages are fully utilized. Art workshops, galleries, art Studios have been established one after another, and the originally obscure industrial idle space has become an influential creative industry cluster due to the development of creative industries. The creative industry provides a reference template for the development and utilization of idle space in historical and cultural blocks.

5. Requirements for the inheritance of industrial culture
The inheritance of history and culture is an important driving force for the progress of the whole society.
In the process of the development of industrial heritage, industrial culture is also constantly bred and developed, which is an effective way to inherit industrial culture. Industrial culture is defined as the sum of material culture, system culture and spiritual culture in the process of industrialization formed along with the process of industrialization. The physical elements such as industrial buildings, production equipment and tools in historical and cultural blocks can show the rich connotation of industrial culture, including the level of productivity development, scientific and technological level, and aesthetic preferences of the era. In particular, industrial buildings can contribute to the inheritance of industrial culture Provide enough space and continuation as a display carrier for industrial production equipment and industrial archives with preservation value. In addition, the complete preservation of industrial heritage-type historical and cultural blocks is conducive to the continuation of industrial culture. [20]

20: Bole David , 'What is industrial culture anyway?' Theoretical framing of the concept in economic geography , Geography Compass , 2021.

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20. Bole David , 'What is industrial culture anyway?' Theoretical framing of the concept in economic geography , Geography Compass , 2021.

Image 6 : Steam engines
source : https://th.bing.com/th/id/OIP.-QAzbM9nP6_3DpfvRiUlyQHaJ4?pid=ImgDet&rs=1

3 Adaptive reuse

"The greenest buildings are those that have already been built"[1]

3.1 Defining Adaptive Reuse

The term of "adaptive reuse" could be superficially understood by anyone, the word give a clear idea of what it means: "The process of reusing and old site or building for a purpose other than which it was built for" [2]

Adaptive reuse usually refers to the reuse of sites or buildings for purpose other than they were originally built or designed for. These new uses can offer economic, social and cultural benefits to their environments. As well, reuse is one approach to sustainability since it conserves original durable building materials. Adaptive reuse deals with issues of conservation and preservation of built heritage as well as strategies and policies. Once old structures become unsuitable for their functiona and programmatic requirements, adaptive reuse becomes a sustainable option for reclamation ofsites. [3]

"To develop a new user function in the field of architecture, or to reorganize moving buildings or structures and continue their original functions in a new way to fulfill new needs," according to the definition. Architectural adaptation is another term for reuse. The best method for most unconventional industrial relics to exist is to discover the underlying spatial value, artistic value, educational value, and other economic values to suit the needs of contemporary urban development. To give inhabitants with high-quality production and living space, use current green, environmental protection, health, intelligence, and other cutting-edge construction technologies. [4]

1. Carl Elefante , https://carlelefante.com/

2. Wikipedia, «Adaptivereuse» 13 August 2018. [Online].Available: https://en.wikipedia.org/w/index.php?title=Adaptive_reuse&oldid=854726958v

3. The Royal Australian Institute of Architects (RAIA) New Uses for Heritage Places . (2011).John Whiey&sons. Encyclopedia of Architecture.Design Engineering&Construction,New york. 199.

4 .Peng Li-lei ,Research on problems and Countermeasures in the process of Old industrial building Reuse Taking the reuse of commercial space as an example,2008.M. .

3.2 Evolution of Adaptive Reuse

The world's industrial heritage can be traced back to the industrial revolution in the 18th century, while most of China's industrial heritage is after the Opium War. The Westernization Movement from the 1860s to the 1890s was the beginning of my country's industrialization. National industry and commerce and foreign capital industries sprung up in my country, and they are the main body of China's industrial heritage. Due to social development and changes in urban structure, a large number of industrial sites were produced. In the 1970s, my country began to have a sense of protection and reuse of historical industrial buildings.

Internationally, the world's first international organization for the protection of industrial heritage was established in 1978, named the International Committee for the Protection of Industrial Heritage (TICCIH). The organization passed the "Nizhny Tagil Charter" in 2003. It is a consensus document on the protection of permanent industrial heritage, and is regarded as a milestone event in the protection of industrial heritage. The charter elaborates on the content, social value and scientific and technological value of industrial heritage, and makes a prospect on how to protect industrial heritage. In 2011, the "Dublin Declaration" was passed at the 17th General Assembly of the International Council on Ancient Sites. Compared with the "Lower Tagil Charter", the composition of industrial heritage has expanded, and the value interpretation has also increased the value of regional landscapes. In terms of protection, comprehensive Complete enough to emphasize the protection of regional structures, indicating that the integrity of industrial heritage protection has improved. In 2012, the "Taipei Declaration" was passed at the 15th meeting of the International Industrial Heritage Conservation Committee. This declaration pays more attention to the protection of Asian industrial products, adds aesthetic value and scientific value in value interpretation, and focuses on holistic protection in terms of protection concept. [5]

Through the analysis of the three documents, it can be concluded that the composition of industrial production includes both material and non-material, and it is becoming more and more comprehensive from the perspective of value interpretation. Pay attention to the overall and holistic protection of the site, and both advocate the reuse of industrial heritage. From a domestic point of view, around 2000, the concept of protection and reuse of industrial heritage in my country was gradually in its infancy. A general survey of industrial heritage in cities was carried out and a protection list was proposed. In 2005, the "Xi'an Declaration" was published at the 15th International Conference on Heritage, and determined the theme of the International Day of Monuments and Sites on "4.18" in 2006 - attaching importance to industrial heritage. The 2006 "Wuxi Conference" is the first constitutional document on the protection of industrial heritage in China, emphasizing the importance of industrial heritage protection and reuse. In 2018, the first batch of China's industrial heritage protection list was released, covering shipbuilding, military industry, railways and other categories. In April 2019, the "Second Batch of China's Industrial Heritage Protection List" was released. The list is all representative industries with outstanding value heritage.

5. Zhang Xue ,A Study of Industrial Heritage Conservation Policies in Old Urban Areas - Against the Background of Industrial Upgrading,2011 .

3.3 Adaptive Reuse architecture

In fact, adaptive reuse is a practice carried out on pre-existing buildings, meaning that a building or site has its own aesthetic character and architectural style, which of course must be maintained. This might lead one to think that architectural design contributes little to this practice. But on the contrary, architectural design is in charge of operating within established aesthetics in order to insert and organize new uses in these "hard objects", preserving their memory as completely as possible while conveying the necessary freshness, in keeping with their It doesn't seem like an unfamiliar and distant element to new users making connections. As "hybridize the new with the old" says. [6]
It can be roughly divided into the following six categories

1. Cultural and creative parks (art museums, studios, auditorium theaters, educational institutions, etc.) such as Beijing 798 Art District,

2. Landscape parks (combined with local traditional culture,

image 7

6.M. Robiglio, RE-USA: 20 American stories of adaptive reuse : a toolkit for post-industrial cities,Berlin: Jovis, 2017.

image 07: 798 Art Factory / Space source: https://www.chinadiscovery.com/beijing/798-art-district.html

artisan culture, and modern science and technology culture) such as Duisburg Landscape Park in Germany, La Villette Park in Paris, France, and Qijiang Park in Zhongshan.

image 8: Duisburg Landscape Park in Germany
source: http://www.lanyuwenhua.com/news_detail_2427.html

3. Experience leisure functions (dining, coffee, bars, etc.) such

image 8

as New York High Line Park, Chengdu Eastern Suburb Memory, Xi'an Dahua 1935.

4. Shopping functions (creative bazaars, home furnishing, bookstores, supermarkets, etc.) such as Oberhausen Shopping Center in Germany and Yangshupu Industrial Zone in Shanghai.

5. Residential functions (youth apartments, boutique hotels, etc.) such as the "Gas Tank City" in Vienna, Austria.

image 9: New York High Line Park
source: https://loving-newyork.com/the-high-line-park-in-new-york-city/

image 9

3.4 China's Industrial Heritage Adaptive Reuse Mechanism

3.4.1 China's Industrial Heritage Protection Policy

Industrial heritage protection policy refers to a set of policy systems formulated by the government to better select, plan and reuse industrial heritage that has lost its original function according to the requirements of cultural inheritance and economic and social development. [7] Its elements include:

7. Xuewei Jiang ,A Study on the Revitalization and Utilization of Typical Spaces of Urban Industrial Heritage - Taking Shougang Old Industrial Area as an Example,2015 .

(1) The subject of industrial heritage protection, that is, the institution responsible for implementing industrial heritage protection policies. At present, the subject of industrial heritage protection in China is relatively complex, and the departments involved include: the cultural relics department, the construction department, and the State-owned Assets Supervision and Administration Commission. The implementation of a dual management system requires not only the comprehensive management of the local government, but also the business guidance of the superior competent department. [8]

8. Cha Man Yu ,Research on Comprehensive Assessment and Conservation and Utilization Strategies of Urban Industrial Heritage in the Context of Inventory Planning,2019.

(2) The object of industrial heritage protection, that is, the object of industrial heritage protection policies, only those typical and symbolic industrial heritage can be called industrial heritage and become the object of protection.

(3) Industrial heritage protection policy means, that is, the ways and measures for the protection policy subject to implement the protection policy. Usually, policy means include: economic means, legal means and necessary administrative means. Specific to the protection of industrial heritage, due to the special nature of its public goods, more legal and administrative means are used. [9]

9. Zhang Rui Wang Ying , A Study of Strategies for the Protection and Renewal of Wuxi's Industrial Heritage, 2022 .

In terms of the content of industrial heritage protection policies, central policies are more strategic and instructive, while local policies are more operational.

3.4.2 Contents of Industrial Heritage Protection Policy

1. Central industrial heritage protection policy content

The "Wuxi Proposal" was formed and promulgated on the basis of the unanimous consent of representatives of relevant cities and cultural relics departments, experts and scholars at the China Industrial Heritage Protection Forum on "4.18" International Ancient Site Day in 2006. [10] Its main contents can be summarized as follows:
Definition of industrial heritage - industrial heritage is industrial cultural relics with historical, sociological, architectural and technological aesthetic value;

The "Notice on Strengthening the Protection of Industrial Heritage" was promulgated by the State Administration of Cultural Heritage on May 12, 2006. Its content can be summarized into two aspects:
(1) Point out the problems existing in the protection of industrial heritage. Insufficient attention, unclear family background, insufficient understanding, and ineffective measures;
(2) Putting forward requirements for the protection of industrial heritage. Correctly understand the value and significance of industrial heritage, incorporate industrial heritage protection into local economic and social development planning, and urban and rural construction planning, formulate special industrial heritage protection plans, and carry out investigation, evaluation, identification, protection and utilization of industrial heritage step by step Various tasks, form a complete industrial heritage protection theory, and strengthen the publicity and education of industrial heritage. [11]

2. Local industrial heritage protection policies

There are mainly two types of local industrial heritage protection policies, one is typified by Luoyang City, which has promulgated special industrial heritage protection regulations; It is not easy to carry out a targeted analysis of its content, so the relevant policies of Luoyang City are taken as examples for local industrial heritage protection policies. [12]

10. Li Bing ,Policy Study on the Protection of Industrial Heritage in Tiexi District, Shenyang,2020.

11. Lu Ning; Liu Min; Wang Rensheng ,Reproducing the discourse on industrial heritage in China: reflections on the evolution of values, policies and practices,2020.

12. Northern Architecture , Industrial Heritage Preservation and Reuse,2021.

3.4.3 Protection agencies

Regulations on the subject of industrial heritage protection——The municipal competent cultural relics department, together with the municipal planning competent department, is responsible for the protection, supervision and management of the city's industrial heritage; the people's government of the county (city, district) where the industrial heritage is located is specifically responsible for the protection and management of the industrial heritage in its jurisdiction ; Construction, land and resources, real estate, state-owned assets, land, and cultural departments should jointly do a good job in the management of industrial heritage protection in accordance with their respective responsibilities. [13]

13. Yang Ling ,Research on the conservation and rational use ,2018.

3.5 Analysing the problem in re-use of the industrial building

Threats to the protection of industrial heritage are:
1. Changes in the urban spatial structure and functional requirements have resulted in the gradual abandonment of the old industrial areas in the city;
2. The development of new technologies has brought traditional industries into a situation of "shutdown, suspension, merger, and transfer";
3. The rapid development of urban construction has caused some neglected industrial buildings and related remains to disappear rapidly from the city;

The specific issues are the following aspects:

1. Weak awareness of social protection
At the social level, the public's "cultural awareness" of industrial heritage protection is very lacking, and the awareness of industrial heritage protection at the entire social level is not strong. Some people believe that the industrial heritage is just dilapidated factory buildings or mechanical equipment, etc., which have almost no value of preservation, and will hinder the pace of urban modernization. [14]

2. The legal system is not perfect
China's laws and regulations have no clear regulations to regulate and limit people's destruction of industrial heritage, let alo-

14. Li Guoqing. Promoting green community construction and building a platform for public participation[J]. Environmental Protection. 2013.

ne establish a strict legal system to protect industrial heritage. At present, China's relevant laws and regulations related to the protection of industrial heritage are only the "Law on the Protection of Cultural Relics" and "Notice on Strengthening the Protection of Cultural Heritage". Responsibilities are not clearly defined. Therefore, there are many limitations in the specific implementation of industrial heritage protection. [15]
Only by establishing relevant laws on the protection of industrial heritage as soon as possible can the protection of industrial heritage be justified and legally based.

3. Lack of multi-party participation mechanism leads to poor enthusiasm
In China, the lack of funds for the protection of industrial heritage by local governments is a common phenomenon. Exploring a multi-party cooperation model suitable for China's national conditions, using social forces, and raising funds through multiple channels is the key to the specific implementation of industrial heritage protection. Establishing and improving the multi-party participation mechanism has great feasibility significance for the protection of industrial heritage. [16]

4. The ownership of industrial architectural heritage is complicated
In the process of protection and reuse of industrial architectural heritage, the primary problem is the unclear ownership of industrial architectural heritage. The property rights, management rights, and protection rights of these buildings belong to different units or individuals, and the relationship is intricate. Further conservation and reuse pose obstacles. Only when property rights are clear can resources be allocated optimally.

5. Lack of connection to urban development
In the process of urbanization, the problem of tight urban development space is a problem that plagues many cities, especially for old-school industrial cities, where huge industrial land occupies the land in the city center, and Luoyang is no exception. Some cities seem to be eager for quick success when facing this problem, and have not fully realized the value of these industrial architectural heritages. In the process of urban renewal, large-scale demolition and construction have accelerated the disappearance of industrial heritage to some extent. [17] It has brought certain difficulties to the protection of industrial heritage.

15. Peng Haifang , A Study on the Current Situation and Countermeasures of Multi-Party Participation in Community Environmental Management - A Case Study of Hudong Community in Suzhou Industrial Park,2016.

16. Song Ying,Zheng Bohong. Research and reflection on the conservation and reuse of urban industrial heritage[J]. Famous Cities of China. 2009.

17. Blackaby, F.(ed.), Deindustrialization. London: Heinemann.1979.

3.6 Reuse process in different countries

1. Germany

When it comes to the protection and utilization of German industrial heritage, people first think of the famous Ruhr Industrial Area. Germany is a powerful industrial country in history, and its mechanization precision is praised by the world, as evidenced by the famous quality supervision organization in the 20th century - German Manufacturing Union. In the 1970s, Germany entered a period of "anti-industrialization". [18]
In terms of protection and reuse of industrial heritage, a series of successful industrial heritage protection cases represented by the Ruhr area in Germany provide a model and approach for the reuse of industrial heritage—the museum model: such as:
1. Public imagination space mode: such as North Duisburg Landscape Park, which takes the Thyssen Iron and Steel Plant in downtown Duisburghi as the transformation object; a comprehensive development mode combined with shopping;
2. For example, Centro, the Oberhausen central shopping area transformed from the Oberhausen Iron Foundry; [19]

image 10

image 11

18. Mo Leiyu , Insights from the recovery of the Ruhr region in Germany,2004.

19.Berg, Rogier van den. 2020. How Will COVID-19
Affect Urban Planning? April 10. Accessed December 11, 2020. https://thecityfix.com/blog/will-covid-19-affect-urban-planning-grogier-van-den-berg/

1.image 10: the Thyssen-Meiderich iron works
source: https://mooool.com/en/metamorphosis-of-the-thyssen-meiderich-iron-works-into-a-landscape-park-by-latzpartner.html

2. image 11: Oberhausen Iron Foundry
source: https://www.sohu.com/a/397050917_685101

Germany's industrial layout is relatively concentrated, obviously developing regionally, so urban industrial land renewal is mainly based on regional units. For the renewal practice of old industrial areas in Germany, the most representative one is the Ruhr Industry, which is the largest industrial area in Germany and the heart of the whole of Europe. The Ruhr Industrial Zone is located in the west of North Westphalia, between the Ruhr River and the Lippe River, covering an area of 4430 square kilometers. The Ruhr area is not only a production center. In the middle of the 19th century, the Ruhr industry was mainly dominated by heavy industries such as coal mines, steelmaking, chemistry, and machinery manufacturing. [20]

In the 1950s, the competition between oil and steel was fierce, the coal industry crisis broke out in the Ruhr industrial area, the structural drawbacks of heavy industry became prominent, the economy suffered a severe setback, social problems aggravated, and the economic unemployment rate rose to 12%. Mines, sprawling vacant buildings and surrounding homes were abandoned. Facing the decline of the industrial area, the Ruhr area began to renovate and renovate within the region, and develop the single regional economy in the direction of diversification and integration. [21] The current Ruhr area has realized the coexistence of new and old industries, close internal ties, and a rational layout of industrialized clusters. It uses science and technology to innovate continuously and keeps up with the general trend of economic globalization.

20. Jana Liu, Nan Li. Analysis of the public functions of industrial building heritage renovation projects and insights - the Ruhr area in Germany as an example,2022.

21. Wang Yi; Wu Yongfa; Liu Nan ,Characteristics of French Industrial Heritage and Strategies for Conservation and Utilization,2015.

image 12: Cultura Industrial Alemania De Landschaftspark
source:
https://www.archdaily.com/92321/ad-classics-parc-de-la-villette-bernard-tschumi/5037f5b228ba0d599b000691-ad-classics-parc-de-la-villette-bernard-tschumi-axon

image 12

2. France

The French economy is primarily concentrated in Paris, and urban development is uneven. The overwhelming growth of the capital, together with the halting of the decline of the surrounding cities, creates a major imbalance in regional development. This is analogous to the growth of China's major cities. During its restoration and renovation, Paris employed excellent economic policies and planning methods to alter the city's industrial structure and industrial layout, resulting in a balanced development of urban resources. [22]

In France, Parede la Villette first developed in the mid-nineteenth century. It is a park comprised of nine projects constructed by Paris to commemorate the bicentennial of the French Revolution. Among the parks. This was Paris's principal vegetable market, abattoir, and grocery store in the 1960s.The architectural elements symbolize change and unity, which are both interwoven and diametrically opposed. These red buildings are linked to the park's ten themed gardens. [23] The square grid, these red buildings, and the straight boulevards, canals, axes, and so on resemble the design elements of conventional French Baroque gardens at the time.

22. Huang Sha; Yu Yifan , A Preliminary Study on the Comparative Practice of Industrial Heritage Conservation in France and Spain ,2012.

23. Fang Zhihua , Industrialization of the British Homeland, 2021.

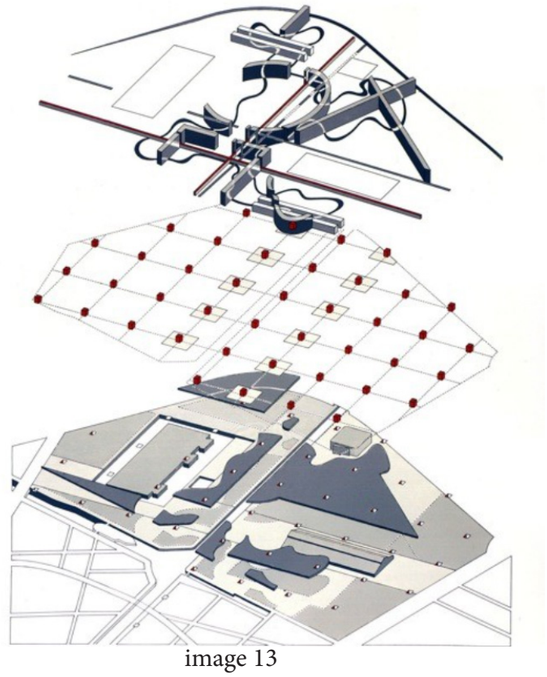

image 13

1.image 13: Parede la Villette Analysis diagram
source:
https://www.archdaily.com/92321/ad-classics-parc-de-la-villette-bernard-tschumi/5037f5b228ba0d599b000691-ad-classics-parc-de-la-villette-bernard-tschumi-axon

3.Britain

Britain was one of the world's earliest industrialised countries, as well as one of the first to face urban decline when resource-based cities depleted their resources. During the Second World War, when the British mainland was bombed by Nazi German planes and many of the industrial towns and factories of the time were left in ruins, how did the British save their industrial heritage from the Industrial Revolution, and what did they do with the damaged parts of the cities and mines - what to keep and what to demolish? What should be kept and what should be destroyed? What needs to be preserved? In response, the UK government established an agency, Town &country planning, to address the issue of redevelopment and regeneration of damaged industrial cities. [24]

24. Neil Cossons,SUSTAINING ENGLAND'S INDUSTRIALHERITAGEA Future for Preserved Industrial Sites in England,2008.

The United Kingdom likewise has extensive documentation on the designation of industrial heritage. The two systems linked to industrial heritage conservation in the UK are 'Scheduled Monuments' and 'Registered Buildings,' which are by far the most extensive records on the designation of industrial property globally.

In terms of industrial heritage conservation and reuse, the UK government and local governments have safeguarded a huge number of industrial heritage assets in the form of museums and industrial history tours. The Ironbridge Gorge and the Tate Modern are two examples.

image 14: The Tate Modern
source : https://cdn.britannica.com/39/136939-050-4EFA1B8D/Tate-Modern-London.jpg

image 14

4. United States of America

There are numerous instances of successful industrial land regeneration initiatives in the United States, including New York's South Street Port, Bethlehem Steel Corporation rehabilitation, the Baltimore Inner Harbor, and brownfield regeneration. The Lehigh Valley industrial area contains a huge number of disused industrial buildings, known as 'brownfield' sites in the United States.

25. Zhou Rongzhang , The revival of the American steel industry ,2007.

The Lehigh Valley is the country's second largest steel production center. Due to the energy crises in the 1970s, the Bethlehem Steel Corporation discontinued manufacturing in 1995, displacing a large number of people and abandoning large tracts of industrial structures and land. [25] Following that, in an effort to improve the situation, it embarked on a redevelopment project to restore the century-old steelworks to its former grandeur. The steel manufacturing lines were preserved, and the National Museum of Industrial History was established within the site, along the river, to recreate the history of steel. The mill's headquarters building has been transformed into a hotel, conference center, recreational indoor skating rink, and cinema. Former railway tracks and warehouses are now used as intermodal terminals for loading and unloading containers, and parts of the mill have been transformed into a park to improve the environment and attract visitors. [26]

26. Li Congjun ,The development of the U.S. steel industry to our inspiration,2014.

This investment of US$1.5 billion has created 10,000 jobs and has made a significant contribution to the government and local economy, restoring the steelworks to its former glory.

Image 15

image 15: night photo of Bethlehem Steel Corporation
source :
Bethlehem SteelStacks Arts + Cultural Campus by WRT « Landscape Architecture Platform | Landezine

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24. Neil Cossons,SUSTAINING ENGLAND'S INDUSTRIALHERITAGEA Future for Preserved Industrial Sites in England,2008.
25. Zhou Rongzhang , The revival of the American steel industry ,2007.

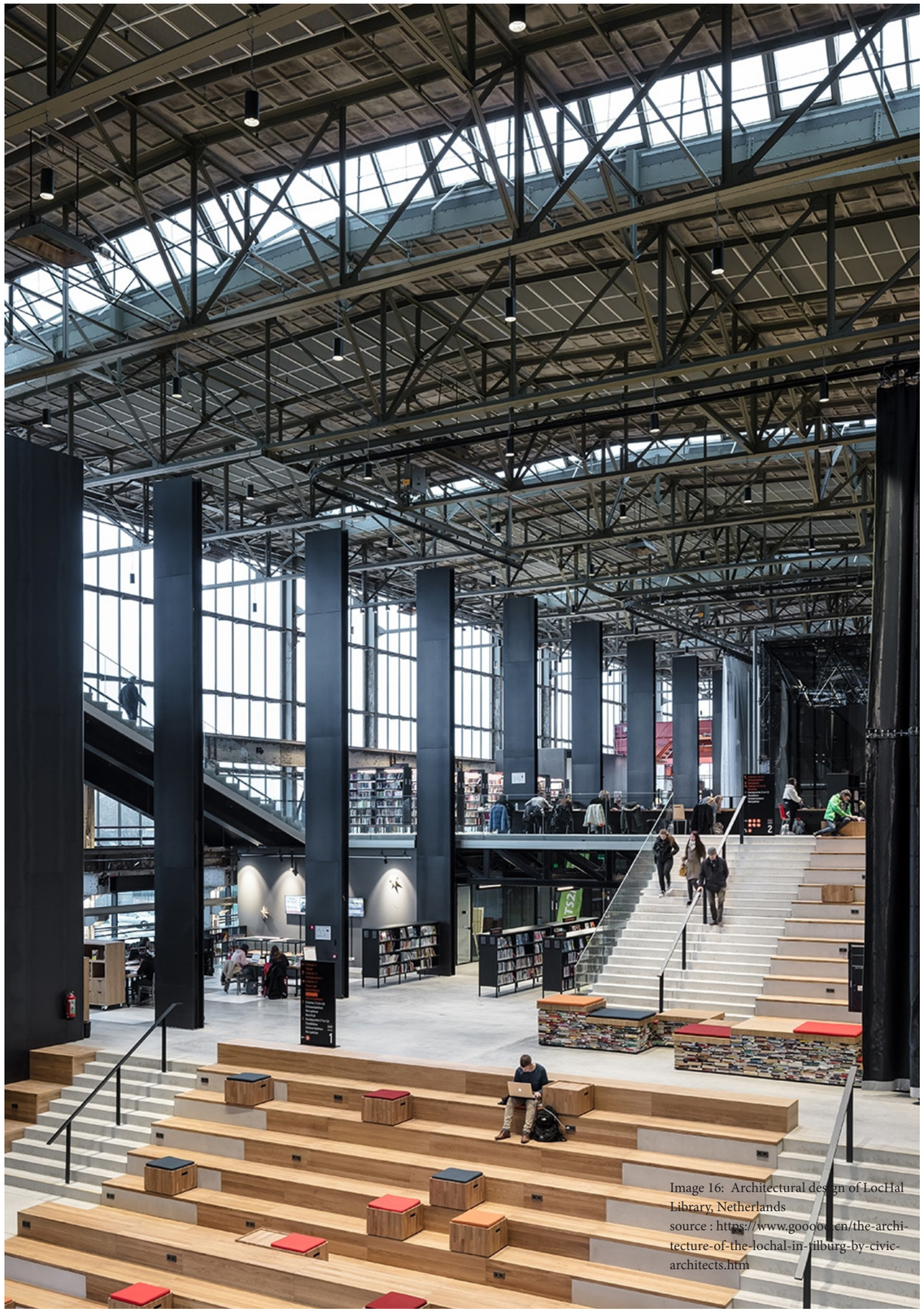

Image 16: Architectural design of LocHal Library, Netherlands
source : https://www.goooood.cn/the-architecture-of-the-lochal-in-tilburg-by-civic-architects.htm

4

Promote Strategies

4.1 Preservation of the integrity of valuable industrial historic features

In the context of urban renewal, academician Wu Liangpu proposed the theory of urban organic renewal. If renovation is to be carried out, it is necessary to reasonably protect and preserve the physical historical buildings and inherit their historical and cultural traditions, so as to ensure the integrity of the historical features of the historical and cultural blocks. He believes that from the city to the building, from the whole to the part, like living organisms, they are organically connected and coexist harmoniously. In addition, in the process of reuse, urban construction should follow the inner order and laws of the city and conform to the texture of the city. [1]

At the same time, it is necessary to clarify the value on the basis of protection. And the value of industrial heritage in the process of protection needs to be graded. There are four main values: historical value, cultural value, architectural value and emotional value.

1: Wang Xijing. Research on Protection and Reuse of Industrial Building Heritage in Xi 'an [M]. Beijing: China Architecture and Building Press,2011.

4.2 Improving the system of principles for the reuse

1. The holistic principle

Any historical and cultural treasure that is disconnected from its natural and artificial surroundings is an isolated island in the city, and it is difficult to establish a group effect. History reutilization should not be done in a cutting manner, such as splitting the original industrial heritage into independent production regions. The key premise in the regeneration process is to preserve the integrity of industrial legacy. [2]

2: Ionut Dohotariu. Andrei Purcaru , Reconstruction and reuse of heritage buildings. 2020.Wang Xinjue .Exploration on protection, renewal and reuse of industrial heritage under the background of urban double repair,2022.

2. Historic Conservation Principle

People's demand of historicity is becoming more rational, and the authenticity of historical materials is gradually being seen as the core of assessing the value of old buildings. Industrial heritage is a type of heritage that can be modified and regenerated. As a result, industrial structures, mechanical equipment, and industrial appendages can be demolished and replaced depending on the type of transformation. [3] It is vital to safeguard the authenticity of industrial heritage historical information while still continuing to use high-value manufacturing processes and functions. If structures or equipment are added to satisfy the function's requirements, they must be identified from the industrial heritage.

3. Zhang Xiaoshuang. A Study on the Conservation and Reuse Strategy of Industrial Architectural Heritage from an Ecological Perspective[D]. Qingdao University of Technology 2016 .

4: Lin Yi. Research on the conservation and utilization of industrial architectural heritage in Guangzhou[D]. Guangzhou University 2010.

5: Lv Tu. Conservation and adaptive reuse of industrial building heritage [D]. Zhejiang University of Technology 2011.

6: Zhang Jing. Research on the reuse of industrial building heritage in Dalian [D]. Dalian University of Technology 2010 .

3. Flexibility and diversity principles
There are numerous types of industrial heritage transformation, as well as methodologies that are adaptable and have a wide range of applications. There are numerous successful examples both at home and abroad to draw from. For the factory's industrial heritage protection, we should begin with the actual demands of the industrial heritage, effectively select the type of transformation, and then apply a variety of design techniques and methodologies to update, renovate, and introduce new life forms based on the transformation's practicability. [4]

4.Sustainable principles

The three most fundamental principles of sustainable use are to reduce negative consequences, reuse, and recycle. Reducing adverse effects means limiting harmful effects on the human body and the environment; reusing means reusing as many resources and materials as possible; and recycling means fully utilizing resources and materials that can be recycled after treatment. [5] Nowadays, with large-scale demolition and building of urban structures, disposing of construction solid waste has become a particularly tough challenge. To reduce building waste pollution, the most important issue is to extend the lifespan of structures. Industrial heritage has barely been around for about 50 years.

5. Economic Principle
The renewal of industrial heritage is carried out in accordance with a strategy for managing the city and increasing revenues for the city. Economic prosperity is essential for a city's development. Reusing manufacturing and purchasing allows for the reuse of limited resources andonly allows for the reuse of limited resources but also minimizes investment in urban construction. Furthermore, the transformation of industrial heritage is intended to increase crowd consumption and deliver more benefits to the city. The goal is economic development. Factory reuse should also be founded on economic revitalization and contribute to cities and communities' economic building and development notion of economic revitalization and contribute to the economic building and development of cities and communities. [6]

6. Feasibility principle
Reusing industrial heritage necessitates a number of efficient approaches to achieve it where viable. When physical heritage such as buildings, industrial landscapes, and industrial facilities can be repurposed through transformation, it is only by developing appropriate reused methods for different types of industrial heritage that real regeneration and protection of industrial heritage can be achieved.

4.3 Multi-actor participation for industrial reuse

The preservation and utilization of industrial heritage is a large and complex enterprise. The makeup of stakeholders is primarily made up of five sections. The local administration, industrial heritage firms, development investors, the general public, and other topics and their interests are all involved. Multiple contradictions emerge from their various interest appeals, opposing and compromising the focus of interests. Furthermore, unique groups such as planners, researchers, and social organizations have "links" throughout, influencing the manifestation of certain individual or group interests. [7]

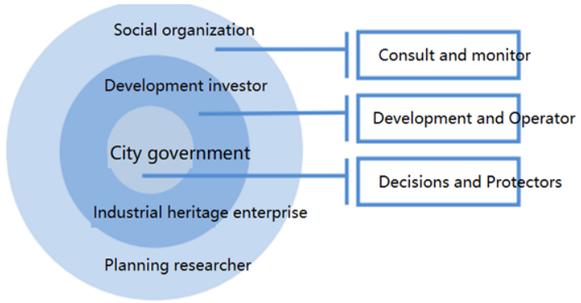

chart 7

As a result, I investigated and analyzed the subject of industrial heritage protection and reuse, and positioned their different roles based on the interest demands of each subject and their own benefits.

How to actualize the participation of numerous subjects in the reuse protection process primarily begins with motivating the enthusiasm of all parties to participate. The protection and reuse of industrial heritage is dependent on the division of labor and cooperation of diverse disciplines in order for the overall link to be effective. In the end , summarizing the experience of industrial heritage protection and reuse at home and abroad, I divide industrial heritage protection and reuse into four links: decision-making, protection, reuse, and supervision, and require all types of subjects to play their own roles in the four links. [8]

7: Chen Qingbei. Research on the Protection and Renewal of Industrial Architectural Heritage under the Threshold of Industrial Culture Inheritance[D]. Shaanxi Normal University 2021 .

chart 7 :Relevant players in the plurality of subjects

8: Xu Zheng. Research on the Conservation and Reuse of Industrial Architectural Heritage in Hefei [D]. Anhui University 2016 .

1. decision-making links

Decision-making especially refers to the identification of industrial heritage, including the determination of core and non-core value heritage and whether it is protected. This is the foundation of safeguarding and reusing industrial heritage, which necessitates a high level of authority, solid science, and particular rules and regulations. The identification of this element of industrial heritage is currently overseen by the culture department under China's current decision-making process.

Currently, the identification of intangible cultural heritage in industrial heritage needs to be enhanced. Most firms do not have much ability to invest in the maintenance and reuse of industrial heritage when they face relocation due to economic and policy issues, therefore industrial culture is easily lost in the setting of urban renewal. [9]

To avoid these phenomena, relevant examination and approval links must be strengthened by legislative or administrative measures, and major industrial businesses must be prohibited from disposing of potential industrial heritage in the factory area. Simultaneously, increase the visibility and education of such industrial heritage firms, as well as their own understanding of industrial heritage protection and utilization. It can also serve as a resource for development investors, planning academics, and social groups, allowing for proposals and suggestions as a point of reference for decision-making.

9: Liu Yegui. Research on the architectural space of creative industrial park based on the reuse of industrial building heritage in Shanghai[D]. Shanghai Jiaotong University 2013 .

image 17: decision-making links
source : https://www.com-etic.fr/lagence-cometic/

Image 17

2. Protection link

Once the industrial heritage has been discovered and valued, its basic value must be protected. Determining the exact protection techniques, the source of special money, and the person accountable for the specific implementation of protection actions are all part of the process. [10] This is the fundamental component and primary connection in the preservation and application of industrial heritage.

There are currently two issues. One is that the prior step's decision-making and identification process is insufficiently comprehensive, which will directly lead to an ineffective protective mechanism. The other issue is that China handles industrial heritage using the cultural heritage protection approach, therefore protection is not comprehensive. Because cultural heritage protects the cultural value of cultural artifacts, industrial heritage should protect both its technical and cultural value.

The following suggestions are for the specific improvement: First, professional departments should take the lead in forming a professional organization for the protection of industrial heritage, and design industrial heritage protection systems and methods, including financial operations and organizational systems, in accordance with the industrial heritage value system. The government must also take the lead in ensuring the preservation of industrial heritage. [11]
Second, for industrial heritage organizations that lack protection awareness, public awareness, and education, together with government policy subsidies, can help. Finally, social organizations reflecting societal interests should be formed into a "supplementary force" for industrial heritage protection. The lessee has the indirect ability to defend among them, and their right to speak and their interests should be preserved.

10: Xiao Yi. Research on the conservation and reuse of industrial architectural heritage in Qinghai based on value evaluation[D]. Lanzhou University of Technology 2022 .

11: Chen Yu. The Practice of Renovation and Renewal Planning to Coordinate the Interests of Multiple Property Owners: An Example of Development Planning in the East Area of Hongqiao Business District, Shanghai[J]. Journal of Urban Planning. 2015.

3. Reuse links

The existing issue is that the two behaviors of reuse and protection have opposing interest demands, which can easily lead to the creation of social injustice. Owners of industrial heritage business property rights prioritize production functions and the economic benefits they generate, which contradicts the cultural values described in industrial heritage.

Therefore, industrial heritage enterprises can consider the principle of separating ownership and management rights, and hand

them over to special development investors for operation and management, so as to avoid their own blind development. At the same time, development investors should also change the concept of one-sided pursuit of economic benefits, take into account social benefits and public needs, and promptly report the actual situation to the competent government department responsible for decision-making while effectively reusing and operating management. In addition, planning researchers should focus on the research and management of industrial heritage reuse. [12]

12: Shao Fanxi. A study on the reuse model of industrial building heritage[J]. Architecture in the North. 2021.

4. the supervision link

The nature and direction of the protection and reuse of industrial heritage are intertwined, the interest demands are not consistent, there are certain risks at the same time, and the responsibility is not easy to be clarified. Therefore, there must be an external supervision link to ensure the prudence and responsibility monitoring mechanism in the process of industrial heritage protection and reuse. This link is also the most effective link to reflect public participation, promote social equity, and avoid conflicts.

But at present, China does not have a supervision system corresponding to the government or a third party. Therefore, social organizations should be established as soon as possible to play their supervisory role, and legislation should be passed to give non-governmental professional organizations the legal supervision rights. [13]

13: Yu Hongxia. Research on the transformation and reuse of old industrial buildings in Qingdao[J]. Industrial architecture. 2014 .

How to increase the enthusiasm of multiple actors to participate: the criteria for categorising participation can be clarified, i.e. seeking forms of collaboration and profit models for participation based on the interest needs of multiple participants, so that the benefits can be maximised in the context of urban reuse.

image 18 : the supervision link
source : https://www.com-etic.fr/lagence-cometic/

Image 18

4.4 Focus on sustainable development strategies

Human, social, economic, and environmental sustainability are the four pillars of sustainability.
The phrase "sustainability" refers to programs, projects, and actions that strive to conserve specific resources. However, it actually relates to four independent realms known as the four pillars of sustainability: human, social, economic, and environmental.said by Zaid Fayyaz

image23: Four Pillars for Sustainable regenergn(The CHCfE Report June 2015)
source: https://issuu.com/shravankamath/docs

Image 19

6.4 Focus on integrating sustainable development strategies under the epidemic

Culture

The inheritance strategy of industrial culture includes not only the protection of industrial relics such as industrial buildings and structures, but also the protection of industrial production processes. The inheritance of industrial culture can create an industrial heritage landscape that is suitable for living, traveling and working, so that more people can increase their sense of historical identity in the process of experien-

cing industrial culture.

First of all, the special terrain of the site and valuable and well-preserved industrial buildings and structures should be redesigned on the basis of preservation, so that they can better integrate into the urban environment and meet the diversified needs of residents' life and communication activities. This can not only arouse the employees' memories of their past work experiences, but also enable visitors to have a more intuitive understanding of the original industry Environment, the continuation of the industrial heritage of the place spirit. For example, exaggerated artistic techniques can be used to emphasize the industrial structures in the key links of production or lighting effects can be added to them, which can more intuitively show the aesthetic characteristics of industrial civilization. Secondly, the reproduction of industrial chain can help tourists to understand the industrial production process and industrial knowledge. For example, the processing, production and transportation scenes of the iron and steel industry chain can be reproduced by concrete or abstract methods, so that people can personally understand the industrial production process. Finally, retain or utilize cultural and creative industries to show major events in the industrial process, which can recall the industrial civilization process of the heritage site and sublimate the industrial cultural value of the site.

Economy

The reuse of industrial heritage is one of the most important objectives of the conservation and reuse of industrial heritage. Through the rational reuse of industrial heritage areas, not only can the local economy be revitalised, but also other areas can be stimulated and the symbiotic development of the whole urban economy can be achieved. There are many models for the reuse of industrial heritage around the world. [14]

14: Li Shuangyu. Research on the conservation and reuse of industrial heritage based on the spirit of place[D]. Zhengzhou University 2020.

New functions are injected to extend the life of the building through the injection of new uses, while preserving the industrial memory of the site and making it a unique landmark of the location. The functions to be reused include: industrial and cultural Chart ion halls, cultural and entertainment complexes, commercial/restaurant centres, sports/leisure centres, business/office, etc. The specific means ofreuse include turning the whole building into a piecemeal one, transforming it into a whole, partial additions, alterations and redevelopment.
By adopting a market-focused development strategy, industrial heritage sites can be restored to their former glory, leading to regional economic recovery, increasing employment opportunities, attracting and stimulating investment, etc. The London Docklands, for example, is a typical example of how the reuse of an industrial heritage site can contribute to the reuse of an entire region. In 1976, the London Government drew up a plan for the reuse of industrial heritage in the Docklands, focusing on the conservation andreuse of industrial heritage buildings. The original factory and residential buildings in the docklands were assessed and then converted into offices, commercial and recreational facilities and housing. The transformation led to significant economic growth and a rapid rise in land values, which led to the economic recovery of the Docklands as a whole and the reuse of the Bazinliki area not far from the Docklands.

Ecology

Ecological environment and social development are interdependent and inseparable. In the face of serious damage to the ecological environment in China, the concept of sustainable development has become the main core concept of urban construction in China. In the transformation design of traditional industrial areas, it is necessary to follow the concept of sustainable development, respect the existing ecosystem of the area, and start from restoring the natural environmental elements of the site, such as soil, water and vegetation, and fully respect the existing infrastructure of the site in the transformation design. [15]

15: Mengevenlei, Qi Chaojie. Review, reflection and inspiration on the conservation and reuse of industrial heritage in Beijing[J]. Industrial architecture. 2020 .

Mitigation of pollution and rehabilitation of industrial waste sites

The design of thereuse of traditional industrial areas respects the natural conditions of the site, while making rational use of soil, vegetation and other environmental resources. The design focuses on the recycling of materials and the use of renewable resources as much as possible to reduce the consumption of resources and maintain the ecological balance. For the traditional industrial areas that are seriously polluted, firstly, the sources of pollution should be clarified, the boundaries between the polluted and non-polluted areas should be delineated, and the polluted areas should be given priority treatment; secondly, the soil in the polluted areas should be rectified by planting plants with purification functions, so as to lay the foundation for the sustainable use of the traditional industrial areas; again, according to the functional zoning of the traditional industrial areas, the areas should be divided according to the degree of pollution of the soil in different plots. The planting of vegetation will be extended to the surrounding areas, and through the growth and spread of

vegetation, the ecosystem of the traditional industrial area will be restored.

Adaptation of public green space in the context of the epidemic How to shape the plant to both enhance the quality of the plant environment and provide space for activities in the event of an epidemic is an important objective in the landscape design of the plant. Therefore, when renewing the landscape of the factory, in situ ecological improvement and landscape reconstruction should be carried out according to the current situation of the original landscape of the site, and the industrial landscape heritage should be valued and protected and preserved by grading and zoning, and the original abandoned resources should be artistically processed and functionally integrated, so that the local industrial culture can be continued through in situ landscape transformation and echoing the history and culture of Jianxi District and the factory area, while controlling different nodes Keeping a certain distance meets the social needs of people under the epidemic. [16]

16: Tong Yun ,Strategie per la costruzione sostenibile del paesaggio nella Cina contemporanea, Università di Tianjin,2013.

4.5 Reference

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3. Zhang Xiaoshuang. A Study on the Conservation and Reuse Strategy of Industrial Architectural Heritage from an Ecological Perspective[D]. Qingdao University of Technology 2016 .
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5. Lv Tu. Conservation and adaptive reuse of industrial building heritage [D]. Zhejiang University of Technology 2011.
6. Zhang Jing. Research on the reuse of industrial building heritage in Dalian [D]. Dalian University of Technology 2010 .
7. Chen Qingbei. Research on the Protection and Renewal of Industrial Architectural Heritage under the Threshold of Industrial Culture Inheritance[D]. Shaanxi Normal University 2021 .
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10. Xiao Yi. Research on the conservation and reuse of industrial architectural heritage in Qinghai based on value evaluation[D]. Lanzhou University of Technology 2022 .
11. Chen Yu. The Practice of Renovation and Renewal Planning to Coordinate the Interests of Multiple Property Owners: An Example of Development Planning in the East Area of Hongqiao Business District, Shanghai[J]. Journal of Urban Planning. 2015.
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16. Tong Yun ,Strategie per la costruzione sostenibile del paesaggio nella Cina contemporanea, Università di Tianjin,2013.

5

Case study

1. Shanghai Oil Tank Art Center
2. Zhongshan Boda Bund Sales Center
3. Rotermann Grain Elevator
4. The Silo

1. Shanghai Oil Tank Art Center

Original use: Oil storage tank
Ownership: Pubic
Completion time: 2019
Current use: Art Center
Location: 2380 Longteng Avenue, Xuhui District, Shanghai
Architect: Open studio
Total area: 60,000 square meters
Functions: restaurants, cafes and art galleries

Design Concept:
Break the boundaries of the building and maximize the protection while enriching the function. Keep the original beauty of the oil tank.

Manipulation of reset:
Industrial heritage is connected and integrated with art, nature and city.

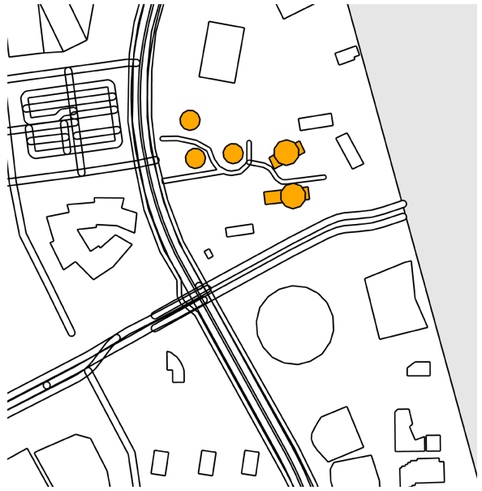

Image 20

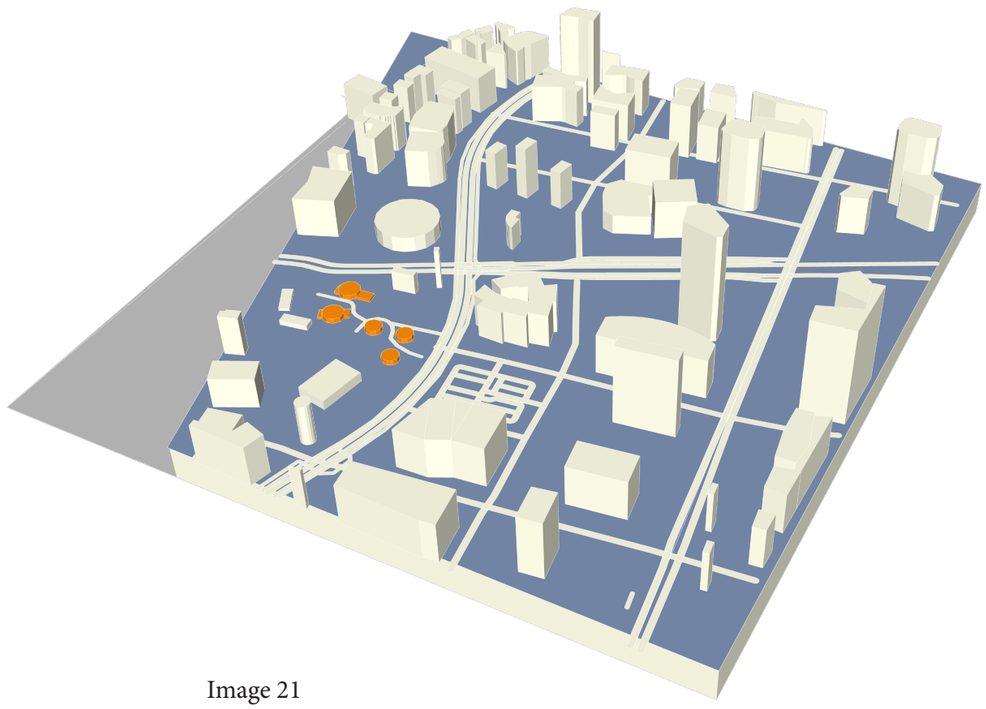

Image 21

The Shanghai Oil Tank Art Centre is a cluster of oil tanks located on the site of Shanghai Longhua Airport, on the west coast of Shanghai, which was originally used as an aviation storage tank. The main body of the renovation consists of five tanks and the project is divided into four main sections; the Green Platform, the Urban Forest, the Urban Green Island and the Urban Square. Outside, the park is open to the public, and in the design of the renovation, OPEN has connected the five tanks at different elevations in a Z-shaped 'superfloor'. Above the 'superfloor' is an open urban park for recreation and relaxation, while below the 'superfloor' is a large, integrated interior space.

The three small and two large tanks, five in total, were first cleaned and then 'reloaded' according to the minimalist character of the tanks. Tanks 3, 4 and 5 are connected by a large internal space covered by a 'superfloor', half of which lies beneath the superfloor, creating an open semi-underground space. Tanks 3 and 4 function as galleries, with No. 3 being retained in its entirety with only an openable skylight at the top, while No. 4 is a more traditional art gallery with a cube divided into three levels. "The outdoor stage faces the 'City Square' and the 'Lawn Square'.
The abandoned oil tanks have been transformed into a popular landmark on the Xuhui Riverfront, saving resources and bringing economic benefits.

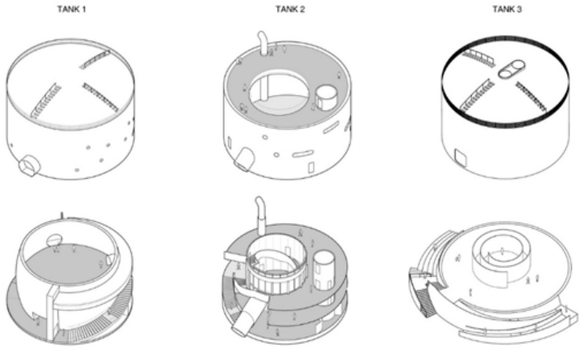

Image 22

Image 22 : Axial mapping of No. 4-5 tanks
source / OPEN Architecture | (archcollege.com)

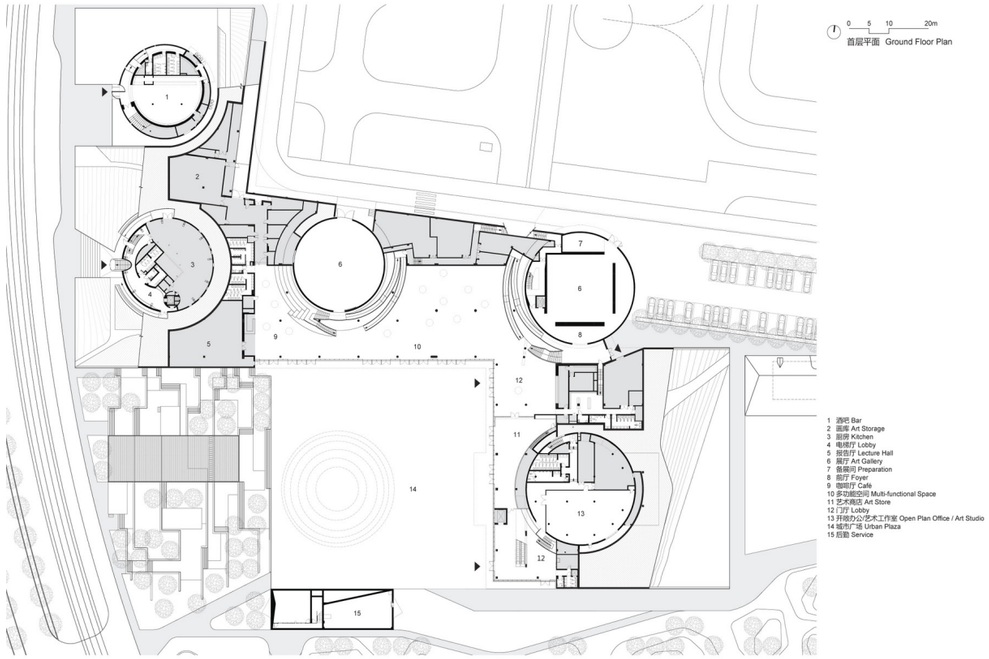

Image23 Ground floor plan

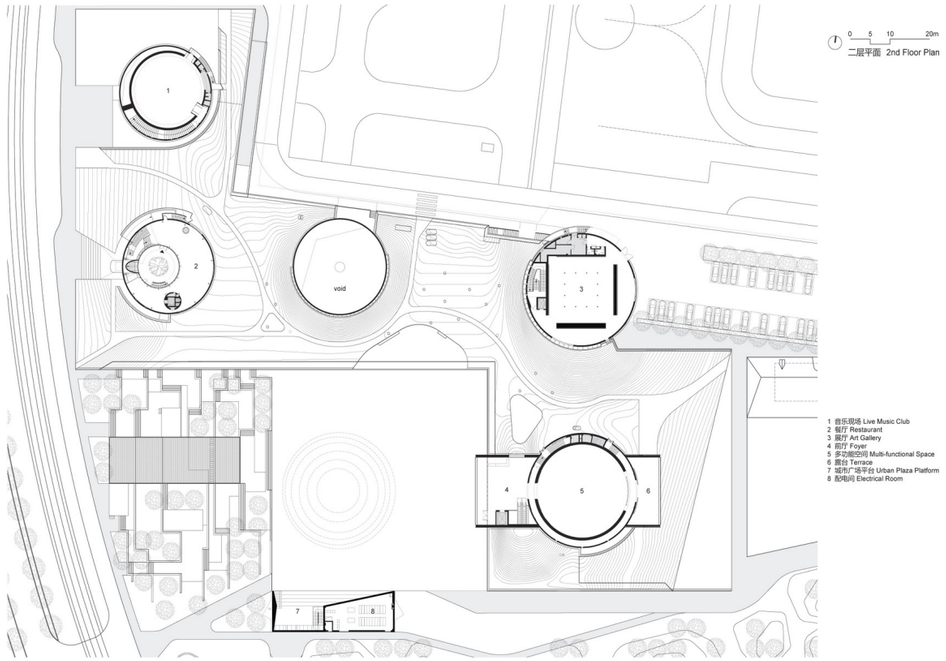

Image 24 First floor plan


teamLab: 油罐中的水粒子世界
teamLab: Universe of Water Particles in the Tank

image 25

2. Zhongshan Boda Bund Sales Center

Original use: Soy sauce oil factory
Ownership: Pubic
Completion time: 2016
Current use: Commercial space
Location: 8 Qigang Road, Zhongshan District, guangzhou
Architect: Open studio
Total area: 1657 square meters

Design Concept:
Transforming the soy sauce oil factory into a sales center to implement "public, open and interesting"

Manipulation of reset:
Introduce wood, glass materials, green plants. Unclosed segmentation of the space.

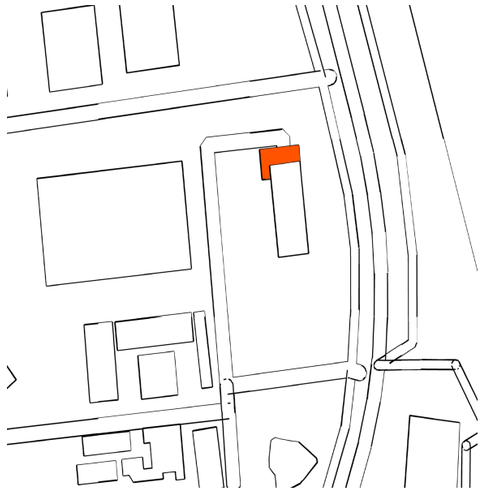

image 26

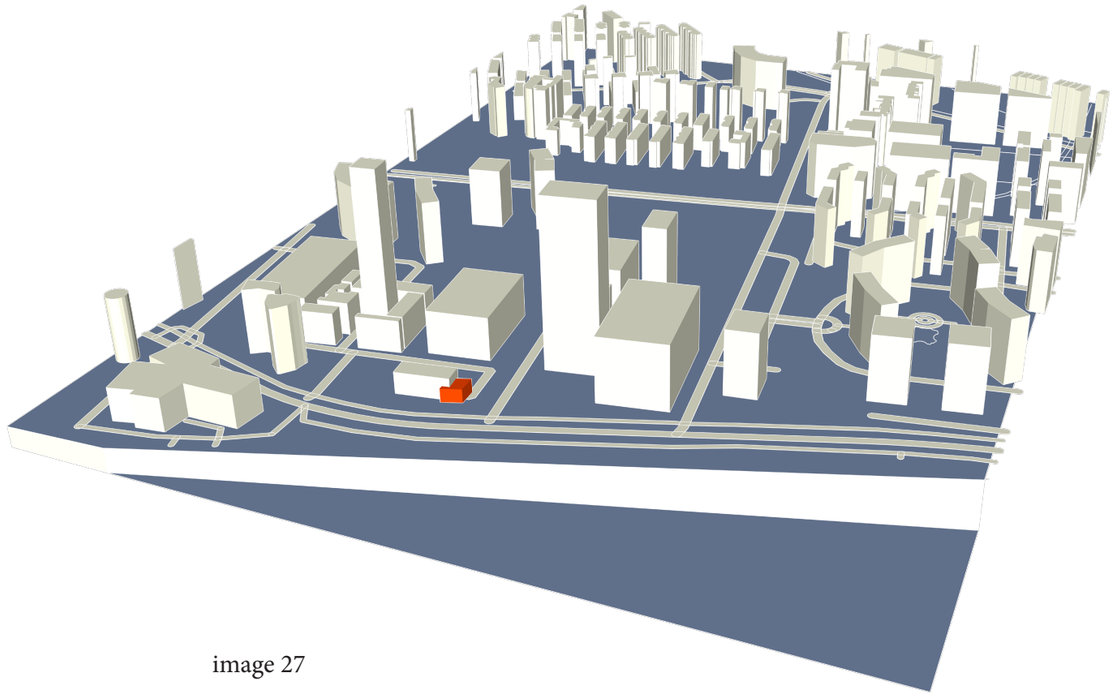

image 27

The renocvation of the building is characterised by the coherence and openness of the space as a whole, with a number of boiler holes retained in the floor to link the upper and lower spaces, and vertical iron frames placed in the holes, which are covered with greenery to give the old building an outdoor feel. The original patinated walls and rustic panels have been retained on the brick walls while new wood and glass materials have been added. The interior of the building has both semi-open business areas and open public spaces for circulation.
A large bookshelf spans two storeys, with towering bookcases and iron brackets adding a sense of verticality to the space, while a large glass wall opens up the space and views, allowing light from the outside to shine through, increasing the connection between the outside and the inside.
In the sales centre, people can not only buy and sell properties, but also read, draw and communicate. The function of the building has been changed and given multiple interests and emotions. The designers have combined the old with the new in terms of materials, the open with the private in terms of space, and the function has moved from the single to the multiple.

Image 28 Internal photo

Image 28 Internal photo :
source : https://www.sohu.com/a/131189778_652964

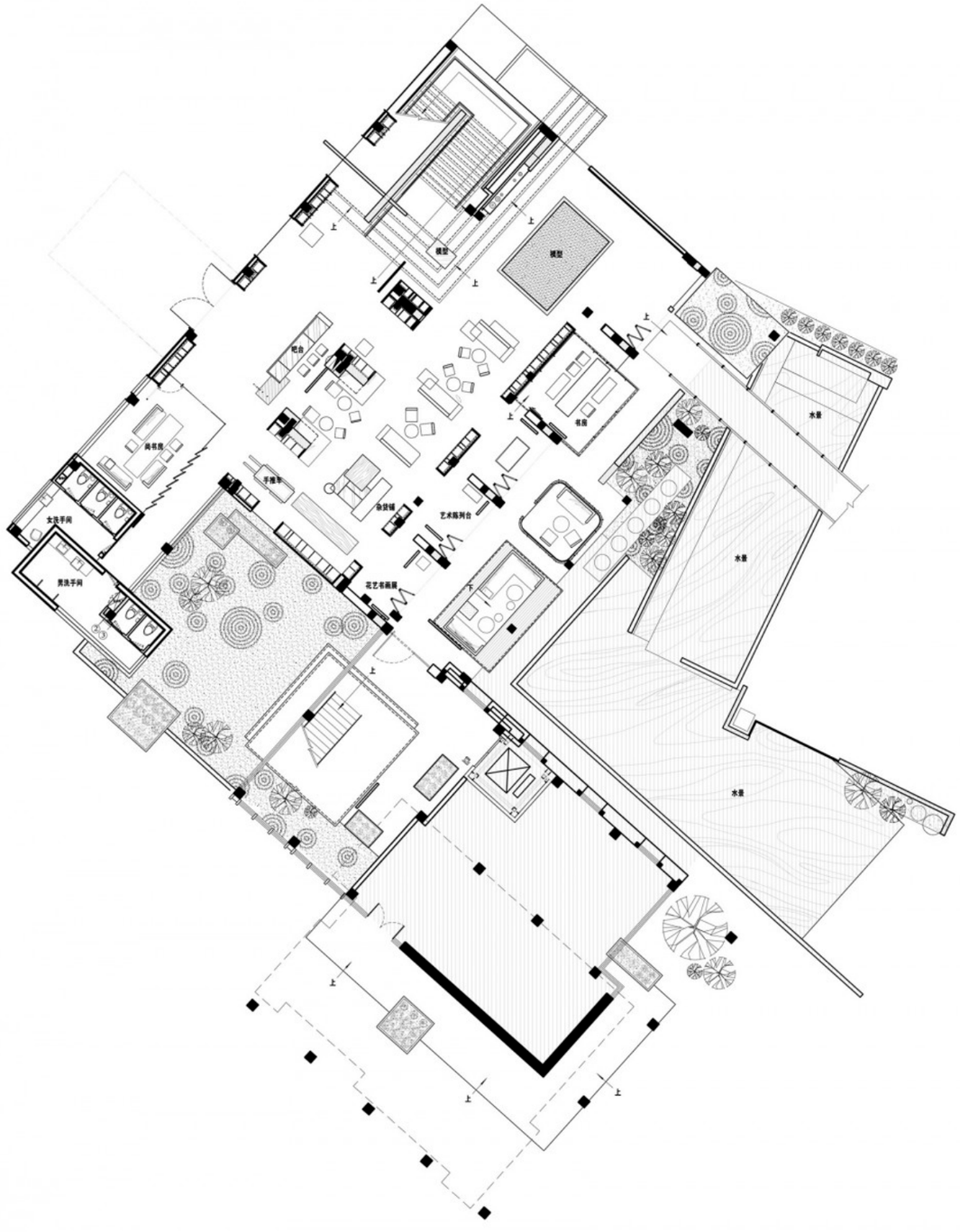

image 29 Ground floor plan

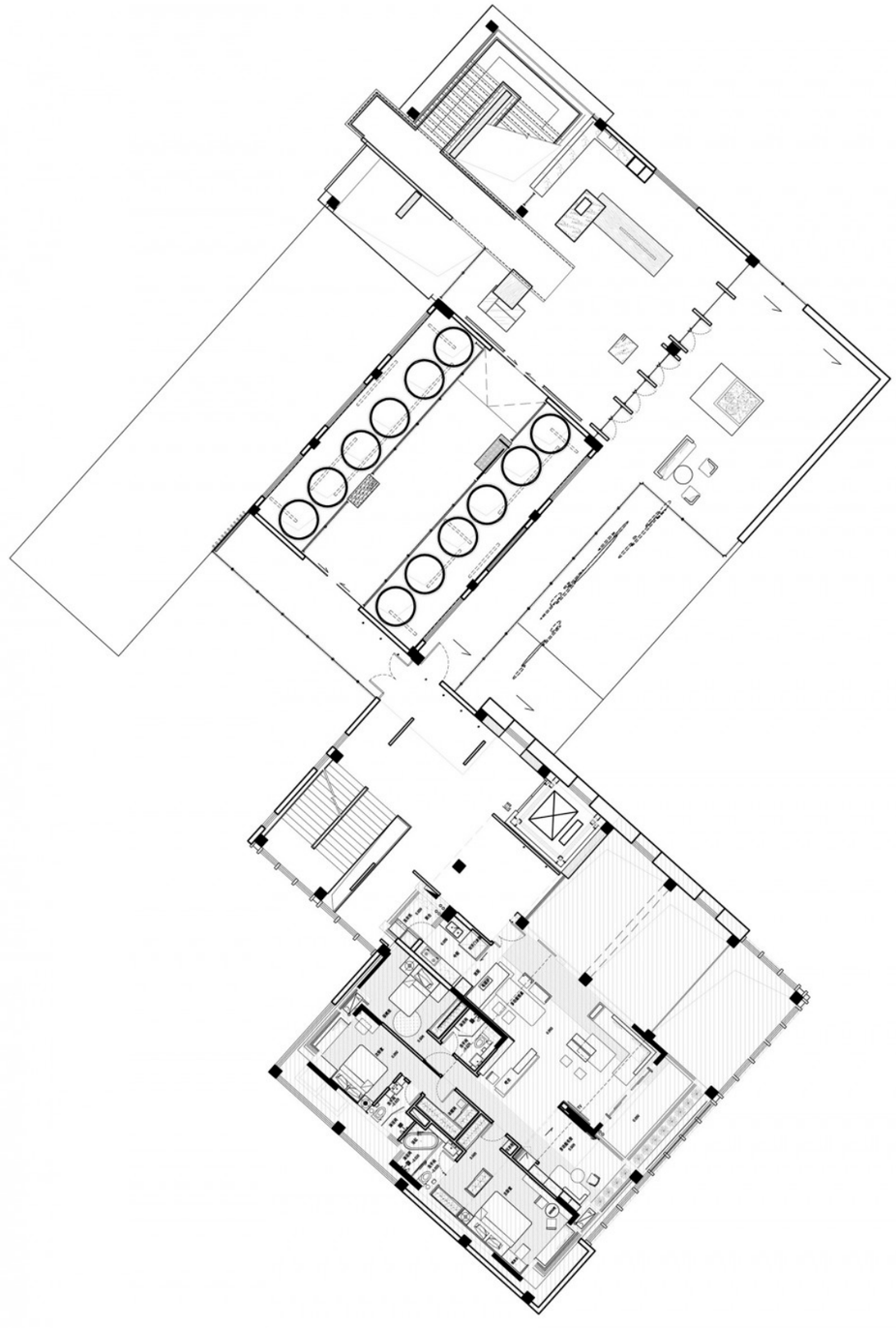

image 30 First floor plan

3. Rotermann Grain Elevator

Original use: Store food
Ownership: Pubic
Completion time: 2016
Current use: Office building
Location: Tallinn, Estonia
Architect: KOKO Architects
Total area: 5600 square meters
Function:Office, dance studio, commercial space

Design Concept:
To the greatest extent, the inner and outer style of the building was retained, and the Windows and roof were added.

Manipulation of reset:
The building is divided horizontally to respect the historical original.

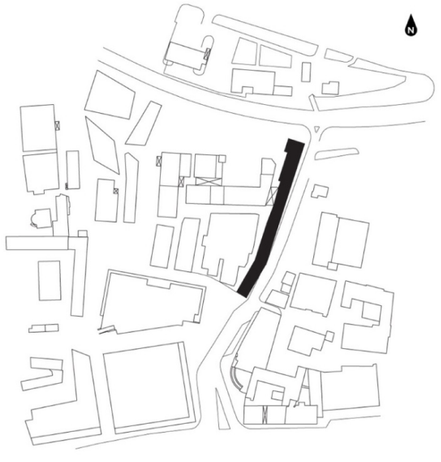

Image 32

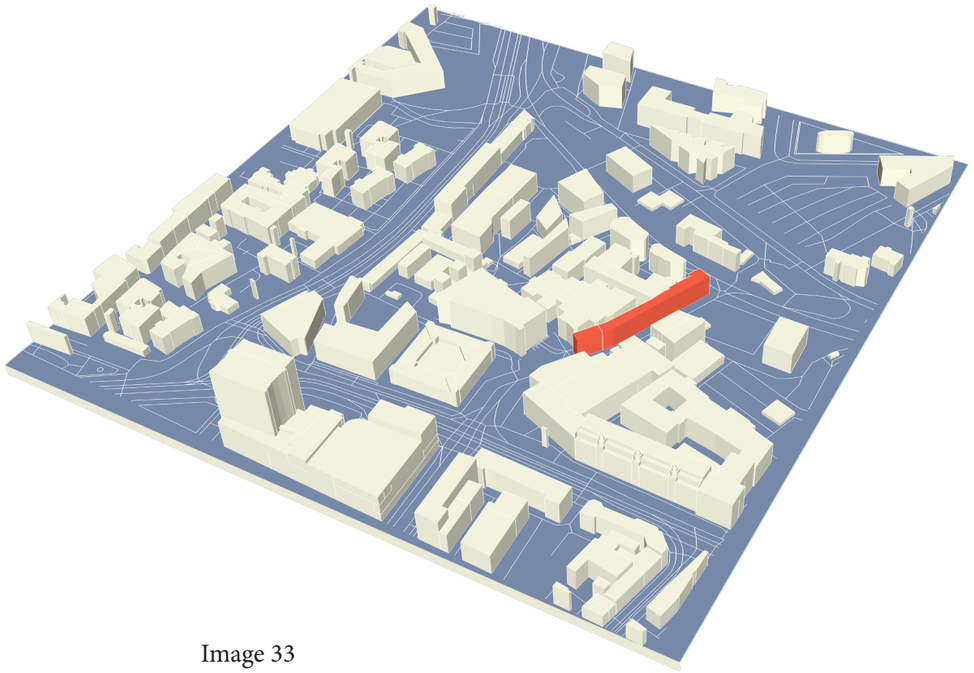

Image 33

The area is rich in history, with the establishment of the Romant factory by Christian Abraham Romant in 1829, which started the development of local industry, and is a witness to the historical changes in the area's industry and trade. The buildings were destroyed during the Soviet era and became increasingly dilapidated as the years went by. In 2001, the Estonian National Heritage Board approved the renovation and upgrading of these old buildings to discover new functions, and the renovation of the old buildings has been very effective, and the barn renovation is one of the successful cases.
Due to the special structure of the building, which is about 110 meters long and 10 meters wide, it is relatively long and narrow, with no windows on the exterior walls, and the windows and the exterior of the building are made of limestone reinforced walls.

The main change was the addition of additional roof skylights and balcony windows on the fifth floor, which allow the office to overlook the entire Rotman district and Old Town. Another important change was the addition of floors to the interior spaces, changing the original spatial appearance of the interior of the barn, and the rebuilding of minor structures such as storm drains and hardware. A building in front of the barn was converted into a restaurant, and the roof of the building was severely damaged, so the designer raised the roof one meter and added glass windows to allow natural light to enter the second floor.

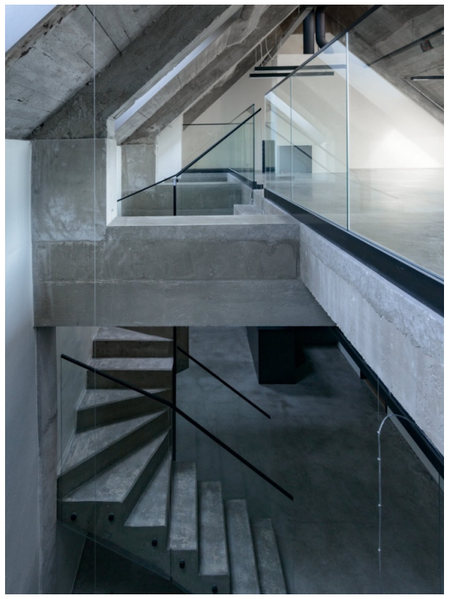

Image 34

image 34: Internal photo
source : http://www.cityupdate.cn/index.php?c=show&id=164

image 35 Section diagram

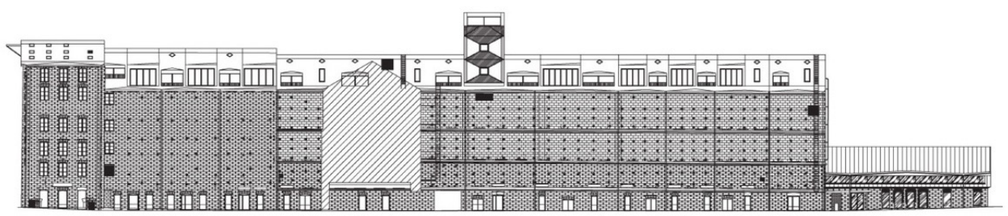

image36 : Elevation plan

image 37: Internal photo
source : https://www.archdaily.com/798658/rotermann-grain-elevator-koko-architects?ad_medium=gallery

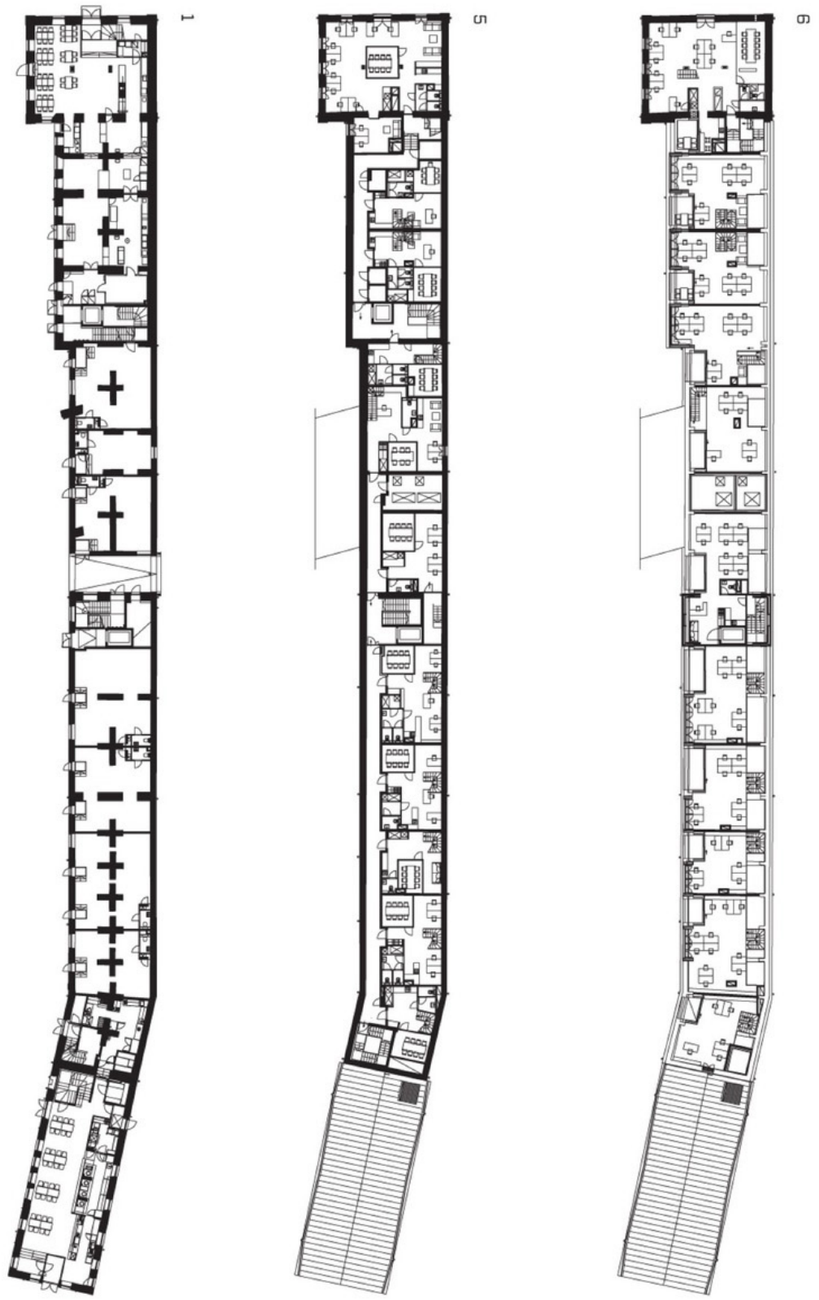

image 37 : 1-3F floor plan

image 38

4. The Silo

Original use: Store food
Ownership: Pubic
Completion time: 2017
Current use: Residential apartment
Location: Copenhagen, Denmark
Architect: COBE
Total area: 10000 square meters
Function: Residential apartments and public

Design Concept:
The spirit of the “silo” is preserved, the facade is changed, the internal structure is preserved, and the private residence and public space coexist.

Manipulation of reset:
The combination of new materials and old materials not only meets the use function of the building, but also perfectly presents the original appearance of the building.

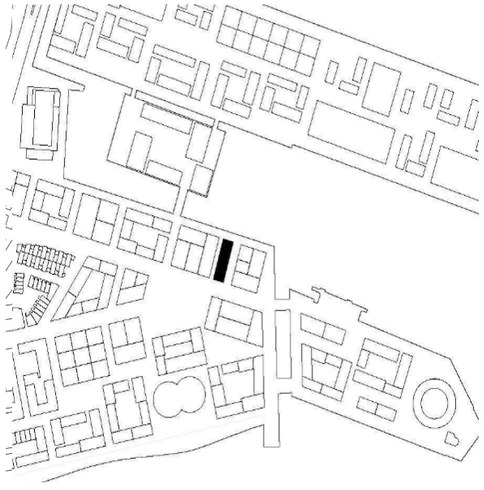

Image 39

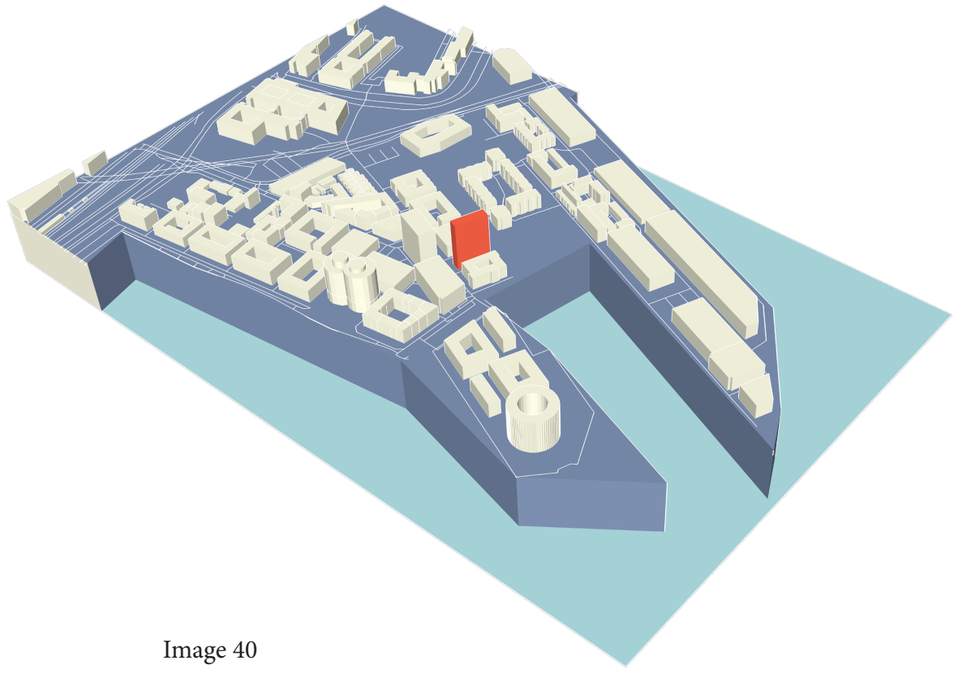

Image 40

Located in the heart of Copenhagen's North Harbour, standing on the edge of the harbour, the "Silo" apartment is part of a huge post-industrial area, originally the largest industrial building in the North Harbour, originally used as a "silo" for storing food, but the original function of this historic industrial building can no longer be used, in 2013 the Danish company COBE Construction began construction andreuse, completed in 2017. Dan Stubb ergaard, Creative Director of COBE, said: "Through thereuse, the silo will be included under a completely new skin, upgrading the old industrial building to a modern standard". Using the original structure of the building, the façade was simply remodeled, and the interior space of the silo, such as the concrete wall columns, will be preserved, preserving the historical imprint of the "silo" to the greatest extent

The existing 62-meter-high "silo" function has been transformed into an apartment residential building with 38 public residential units in the apartment building, each floor varied, so that the size ranges from 106 square meters to 401 square meters.

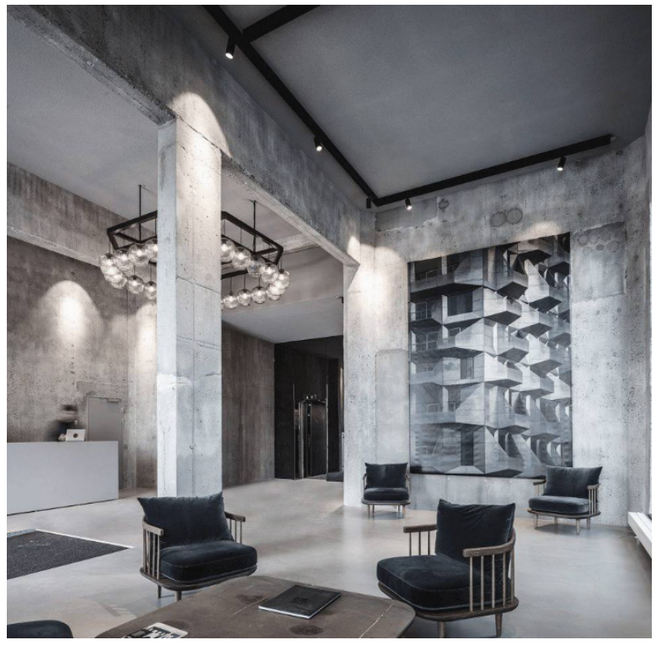

Image 41

Image 41: The Silo Internal photo
source: http://www.gooood.hk/the-silo-in-copenhagen-by-cobe.htm

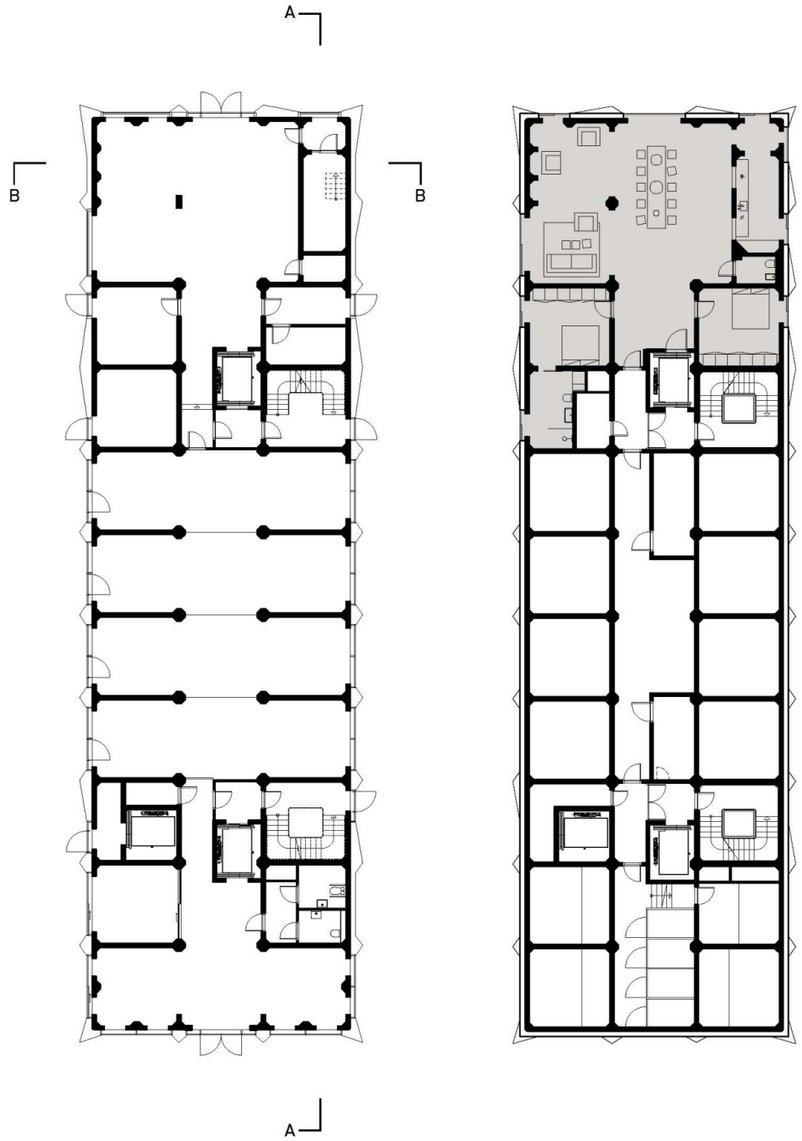

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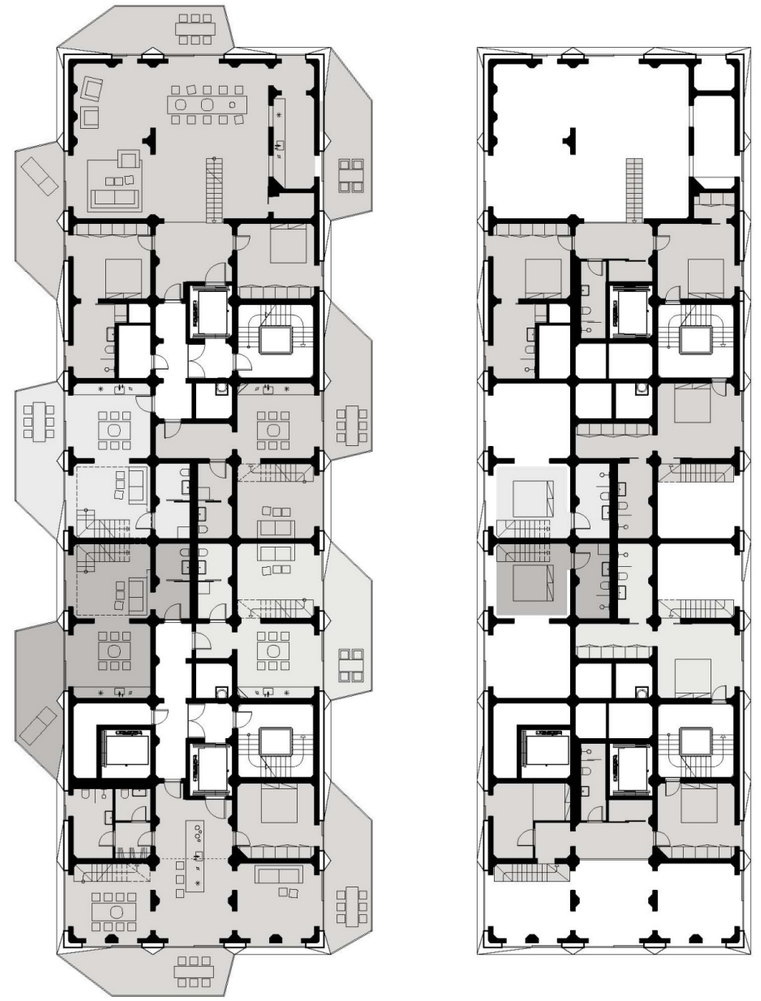
image 42



4

5

image 43

image 44

Summary

Through the analysis and research of the above four cases, it can be found that the designers did their best to retain the structure and texture of the factory when transforming the old industrial buildings, and then realized new functions by resetting the internal space. The functional transformation of each building is based on the structure of the original building and then spatial planning is carried out through different design methods.
I organize the four case columns and analyzes the design concept and function reset, so as to get the reset method of each case and draw lessons from it.

Chart 8 : Summary of case analysis

Name of project	Design Concept	Original function	Reset of function	Manipulation of reset
Shanghai Oil Tank Art Center	Break the boundaries of the building and maximize the protection while enriching the function. Keep the original beauty of the oil tank.	Oil storage tank	Art Center	Industrial heritage is connected and integrated with art, nature and city.
Zhongshan Boda Bund sales center	Transforming the soy sauce oil factory into a sales center to implement "public, open and interesting"	Soy sauce oil factory	Commercial space	Introduce wood, glass materials, green plants. Unclosed segmentation of the space.
Rotermann Grain Elevator	To the greatest extent, the inner and outer style of the building was retained, and the Windows and roof were added.	Store food	Office, dance studio, commercial space	The building is divided horizontally to respect the historical original.
The Silo in Copenhagen	The spirit of the "silo" is preserved, the facade is changed, the internal structure is preserved, and the private residence and public space coexist.	Store food	Residential apartment	The combination of new materials and old materials not only meets the use function of the building, but also perfectly presents the original appearance of the building.

Chart 8

6 Design Proposal

image 45: map of luoyang

Luoyang City is located in the western part of Henan Province, between 111.8′ and 112.59′ east longitude and 33.35′ to 35.05′ north latitude.

Luoyang has a history of more than 4,000 years. It is one of the “Seven Ancient Capitals” in China, and Yang is known as the “Ancient Capital of the Nine,” which is the state of emperors and the birthplace of Chinese civilization. It is the oldest city in Chinese history, with the most dynasties and the longest capital construction period.

6.1 Physical geography

Luoyang is in the northern temperate zone, and its climate is characterised by seasonality, continentalism and diversity. The annual prevalence of northeasterly or westerly winds, with a frequency of 10% each; the wind speed is greater in winter and spring, mostly greater than 2 m/s, and smaller in summer and autumn, less than 2 m/s.

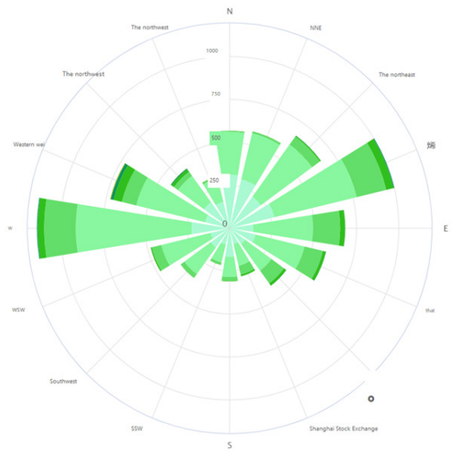


Chart 9

Chart 9: Wind-Rose Map of Luoyang City
Source:https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/luoyang_china_1801792

The annual average temperature in downtown Luoyang is 14.7°C; the hottest month is July and the coldest month is January; the annual difference in average monthly temperature is 26.8°C.
Winters are cold and summers are hot, while springs are warm and autumns are cool. The average annual precipitation is 579.7 mm, mainly concentrated in July, August and September.

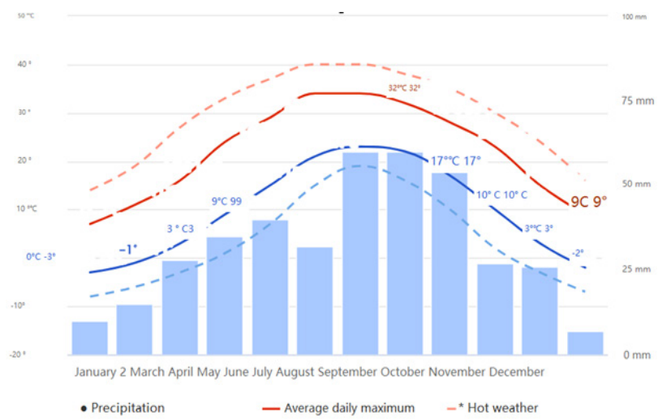


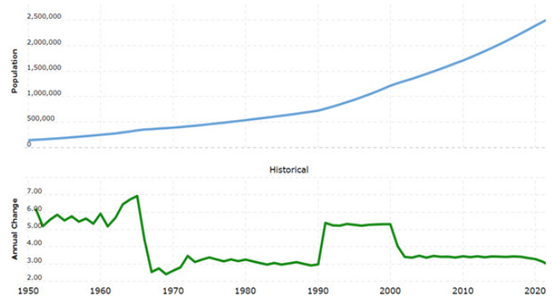
Chart 10

Chart 10: average temperature and precipitation in Luoyang City
Source:https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/luoyang_china_1801792

Population

Large-scale industrial construction brought a large number of industrial migrants to Luoyang during the “First Five-Year Plan” period, and the population migrated a large number of foreigners for industrial reasons. The Luoyang industrial population served as a source of labor. The majority of them are from Northeast China, Shanghai, and Guangdong. According to Professor Yang Jinyi’s research group’s statistics on the origins of 27,1407 people from eight police stations in Jianxi District in the 1990s, nationalities from other provinces accounted for 34.11% of the total number of statistical people. [1] Between 1967 and 1990, as a result of the Chinese Cultural Revolution and the Soviet Union’s withdrawal of technicians, poor factory efficiency, large population movements, lower birth rates, and an imbalance in the ratio of men to women.

1: Ding Yiping. Industrial Migration and Social Change in Luoyang from 1953 to 1966 [D]. Hebei Normal University,2007



Industrial migration and the change in the society in luoyang city (1953-1966),

Chart 11

Chart 11: China's Population: Census: Henan: Luoyang from 1950 to 2020
Source: https://www.macrotrends.net/cities/20612/luoyang/population

6.2 Research on the history of industrial development in Luoyang

6.2.1 Overview of Luoyang's Industrial Development

Start

Luoyang's modern industry slowly grew from the bottom - up. Between 1890 and 1920, Luoyang was the capital of Henan Province, and modern capitalist industry and commerce began to sprout in this historic and cultural city.

Western industrial products such as foreign cloth and oil began to enter Luoyang at the end of the Qing Dynasty in 1898, and the number of industrial categories began to increase in 1917 when the Republic of China was established. Manufacturing civilization expanded after 1932, when Luoyang became the seat of the National Government. [2]

Due to the advantages of the inland area, a large amount of capital was concentrated in Luoyang after the outbreak of the war of resistance in 1937, and Luoyang's daily chemical, leather, and food industries developed rapidly. The Japanese army attacked Luoyang in May 1944, bombing the city's houses into rubble, and modern industry was largely destroyed, slowly recovering and developing over the last decade.

Handicraft workshops continue to dominate the industry, and the city's economy is still based on the traditional business model of a front shop and a back factory.

2: Luoyang city local history compilation committee. History of Luoyang City [M]. Zhengzhou: Zhongzhou Ancient Books Publishing House, 1998.

Image 46 : luoyang picture in 1932 source https://new.qq.com/rain/a/20190722A02TT500

image 46

Brilliance

After the founding of New China in 1949, Luoyang gradually developed into an important industrial base in the country, and in 1953, the first five-year plan of the Republic placed six of the 156 key projects in Luoyang, including the First Tractor Manufacturing Plant, the Mining Machinery Plant, the Luoyang Ball Bearing Plant, the Luoyang Thermal Power Plant, the Luoyang Non-Ferrous Metal Processing Plant, and the Henan Diesel Engine Plant, which was complemented by the Luoyang Cement Plant. In 1958, during the Second Five-Year Plan, the State also arranged for the Luoyang Glass Factory, the refractory materials and cotton spinning factory and the locomotive factory to be built in Luoyang; in the following decade, the State also built the largest monocrystalline silicon plant and oil refinery in the country at that time.

Luoyang grew into a major industrial center, with the machinery and equipment, petrochemicals, building materials, non-ferrous metals, and textile sectors serving as cornerstones; in addition, more than ten ministerial-level scientific research units were built, completing the industrial system in Luoyang. [3]

3: Luoyang Municipal Bureau of Statistics. Luoyang Forward Forty Years [Z]. Luoyang Library Collection, 1989

image 47

Image 47 : luoyang picture in 1958 source : https://www.sohu.com/a/330151356_513558

Breakthrough

With the development in recent years, Luoyang has formed five advantageous industries such as equipment manufacturing, non-ferrous metals, energy and power, petrochemicals, silicon photovoltaic, and photovoltaic, which account for more than 75% of the city's industrial added value.
From 2006 to 2010, Luoyang's total economic output doubled, its GDP reached 200 billion yuan with an average annual growth rate of 14.6%, [4] and the per capita GDP and local general budget revenue doubled compared with the end of the 15th century.

In the field of equipment manufacturing, the market share of heavy mining equipment manufactured by YTO Group ranks first in China; Luoyang has successively won a series of honors such as China's manufacturing city, the national new material high-tech industrial base, the national new material and photovoltaic high-tech industrialization base, and the national new industrialization industry demonstration base for energy-saving and environmental protection equipment.

4:source :https://www.163.com/dy/article/H98JUAR10525A5GL.html

Chart 12: View China's Gross Industrial Output: Henan: Luoyang from 1996 to 2016
Source: Gross Industrial Output: Henan: Luoyang | Economic Indicators | CEIC (ceicdata.com)

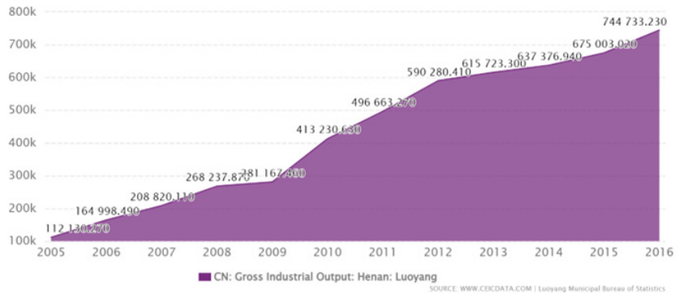


Chart 12

Image 48:Map planning of Luoyang Industrial Zone in 1945 (Luoyang City Magazine and Urban Construction Magazine)

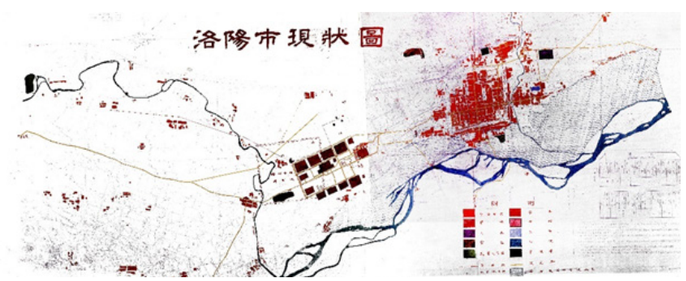


Image 48

6.2.2 Evolution of Luoyang's industrial layout

The growth of Luoyang Jianxi District Industrial Park may be loosely split into four periods based on the progress of industrialization and social development in China following the establishment of the People's Republic of China:

1) The Soviet Union's stage of large-scale aid construction.

Because "the manufacturing railway line is close to the Luoyang railway track," Luoyang is one of the central and western regions' hub cities, with good natural resources and other benefits. After the start of the First Five-Year Plan, 7 of the 156 projects aided by the Soviet Union settled in Luoyang, 6 of which were in Jianxi District, and there were also large residential areas and modern research institutes and schools built with factories, which comprised the majority of the population. [5]

5: Luoyang Jianxi compilation Committee. Jianxi District of Luoyang [M]. Beijing: Haichao Publishing House, 1990

Image 49

Image 49 :Industrial migration and the change in the society in luoyang city (1953-1966)
source : Luoyang City Magazine and Urban Construction Magazine

2) Self-contained construction, laborious progress

Beginning in 1960, Luoyang's industrial construction was hampered by a series of events, including the Cultural Revolution and deterioration of Sino-Soviet relations, which resulted in the withdrawal of engineers and technicians from the Soviet Union to aid Chinese construction, making the development long and tortuous. Simultaneously, Luoyang's industrial building was steadily formalized, and the city's development was reasonably stable.

Image 50 : Map planning of Luoyang Industrial Zone in 1955 (Source Luoyang historical Data Book)

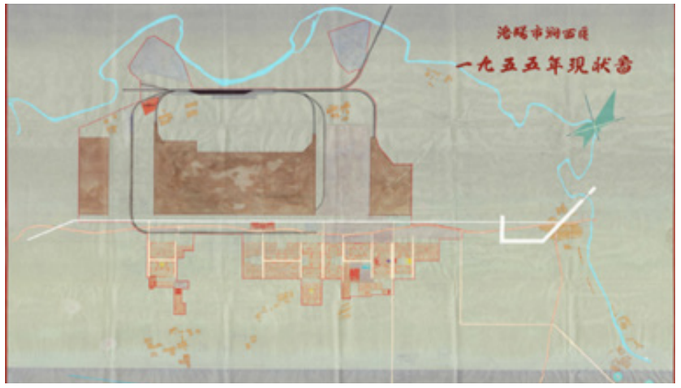


image 50

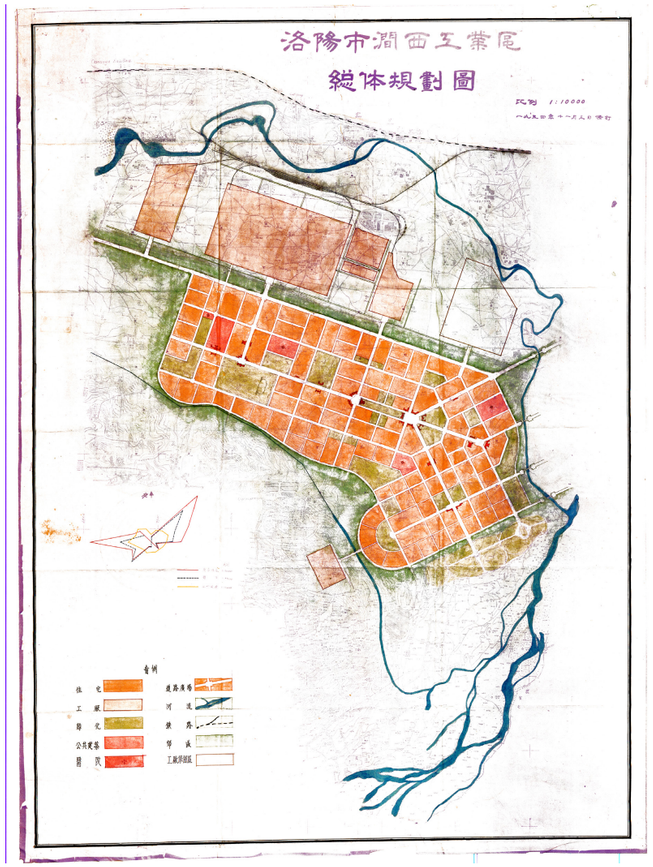


Image 51 : Map planning of Luoyang Industrial Zone in 1965
(Source Luoyang City Magazine and Urban Construction Magazine)

image 51

3) Return the development stage

With the revision of the state's policies in 1978, the emphasis moved to economic construction, and the industry in Luoyang Jianxi gradually resumed rectification, reform, and reorganization. The shift in company operating mechanism also results in the synchronized transformation of historical industrial buildings, with factory and office buildings in the production area and residential buildings in the living area being reconstructed and demolished in huge numbers.

Image 52

Image 52: Map planning of Luoyang Industrial Zone in 1969
(Source Luoyang historical Data Book)

4) corporate transformation stage

With the development of mechanization and intellectualization, the early industrial model already can't satisfy the need of modern society. Under the wave of state-owned enterprise restructuring, large state-owned enterprises have also been restructured.

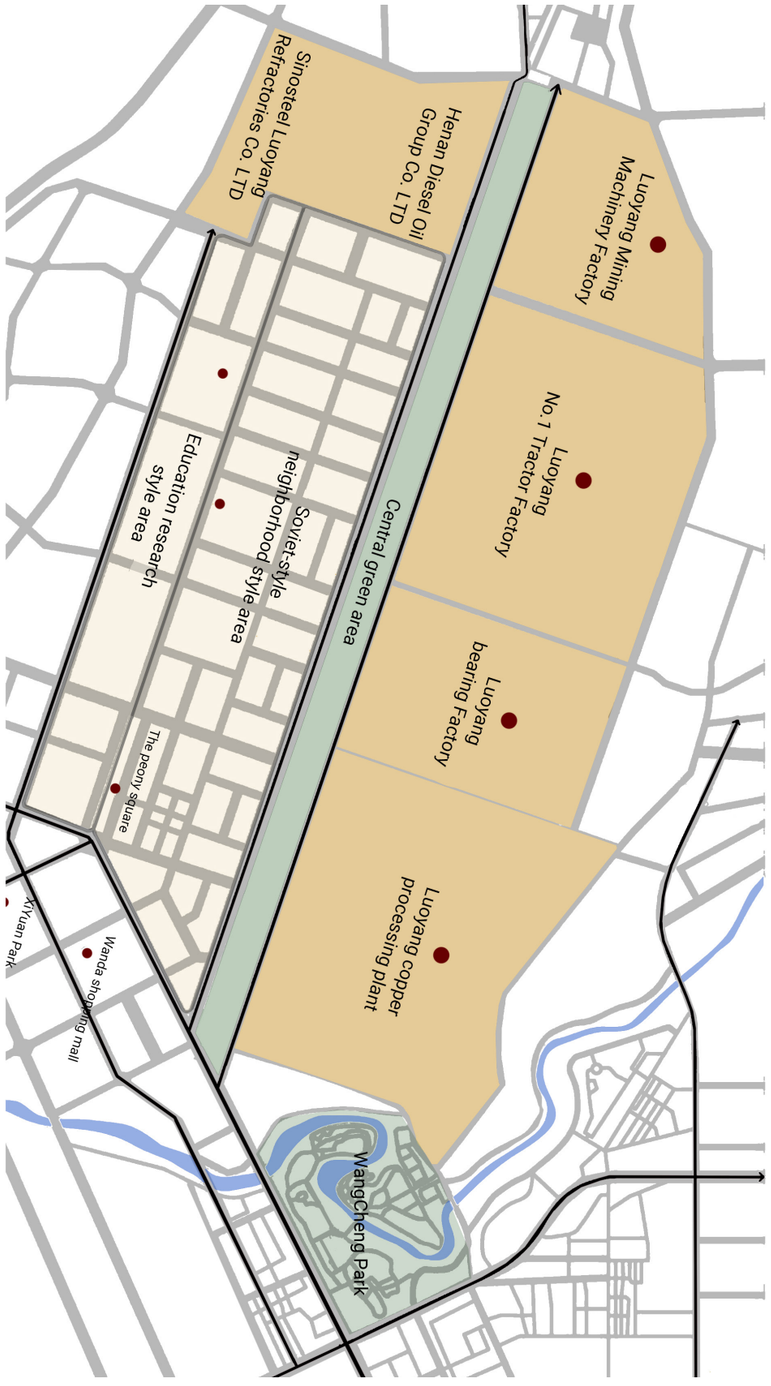


Image 53: Analysis of industrial zone (Draw by author)

6.2.3Characteristics of Luoyang's industrial heritage

Planning and layout features

Luoyang Industrial zone is a key industrial zone built during China's first five-year plan. Luoyang Industrial Park is centered on China's No. 1 tractor manufacturing plant, leaving behind many Soviet-style building complexes. The establishment of key enterprises has driven the industrial wave of Luoyang and even the whole Central Plains and has played a great role in promoting the development of industrial construction in modern China. Luoyang Industrial Park led by Yito, several factory joint plant plan, joint exploration, planning, design, and construction, in just three or four years, a particularly neat, rigorous, harmonious, majestic socialist large industrial zone, quickly towered on the land of China, becoming the most typical model of new China industrial park, known as the "Luoyang model". [6]

6: Sun Yuejie, Historical Research and Value analysis of Luoyang 156T Industry Heritage Group, Tianjin University, 2016

Image 54

Image 54: Luoyang City Master Plan for 1956
(Source: Luoyang City Magazine and Urban Construction Magazine)

Jianxi Industrial Park's overall planning is based on the concept of "South House North Factory": the production plant area and the plaza in front of the factory of four main businesses are lined up north of Jianshe Road, establishing a magnificent industrial building belt pattern.

Chart 13: jianxi area industry Planning Layout Diagram of luoyang

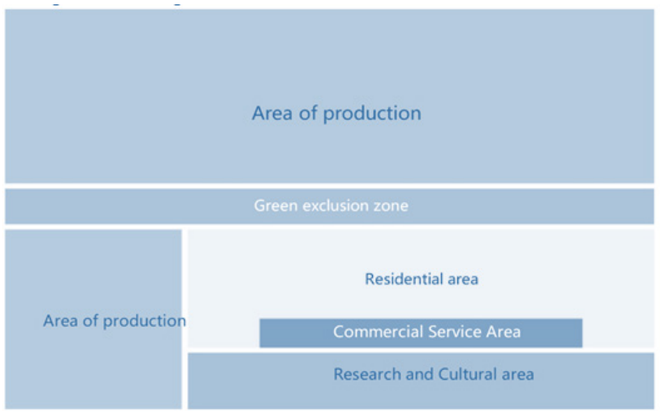


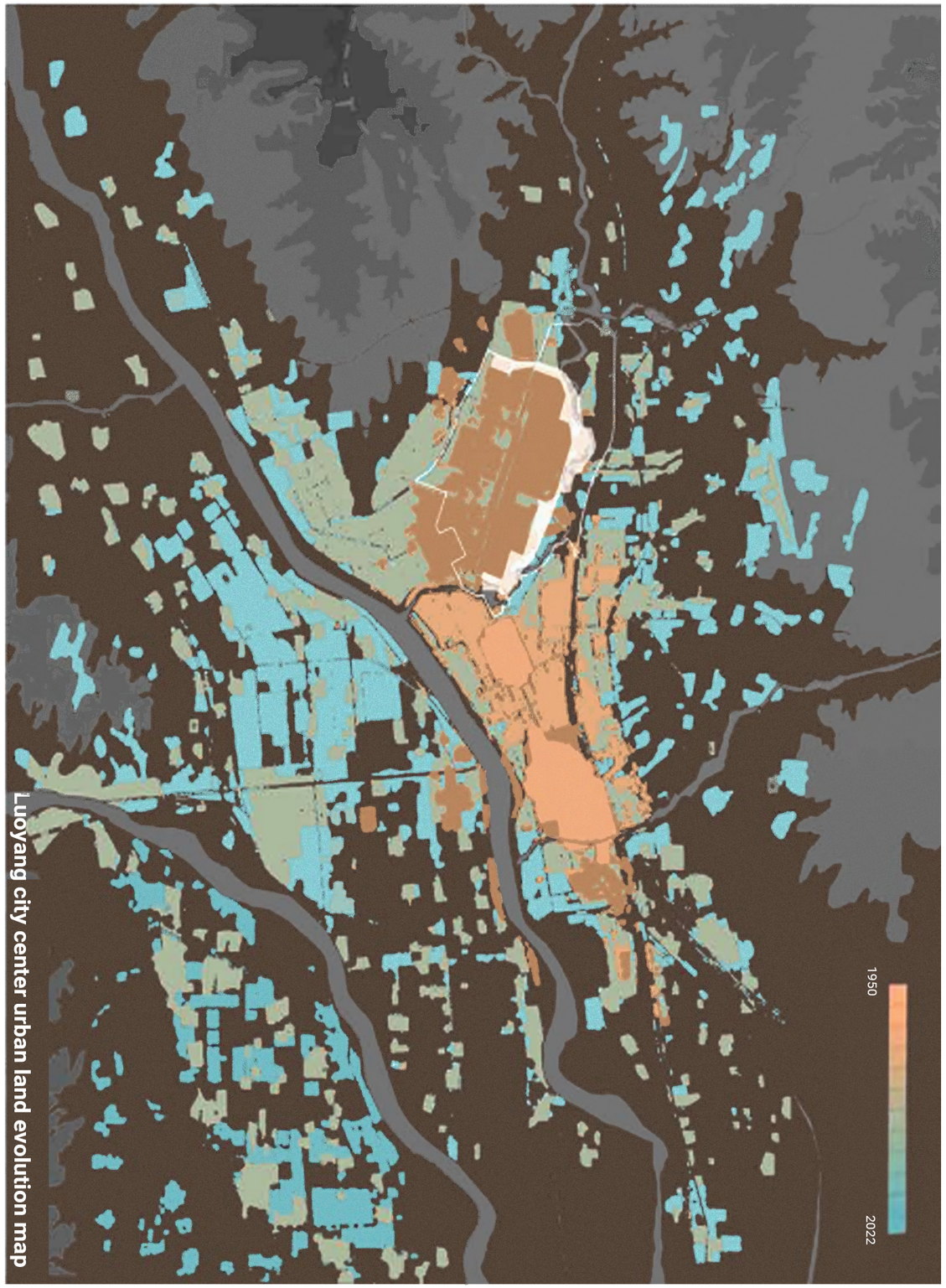
Chart 13

Structural and spatial features

Jianxi District's extant industrial legacy is mostly separated into two parts: production facilities such as factory buildings and factory buildings, and supporting family buildings, hospitals, libraries, and other living facilities. The existing ancient manufacturing buildings and warehouses in Luoyang Jianxi District are mostly single-story, with steel frame and row structures. The internal column network structure is regular, the column network spacing in the wide direction is around 6 to 12 meters, and the depth is quite shallow. The maximum width might exceed 20 meters, and the majority of the residential sections are built of brick and concrete.

Image 55:The overall style and features of the JianXi industrial factories.
source: Luoyang 156 industrial heritage group of historical study and value analysis, Sunyuejie

Image 55



6.2.4 Problems encountered in the reuse of industrial heritage

1.The preparation of plans for the protection of cultural relics of national security units

Since 2011, when Luoyang's Jianxi District's industrial heritage area was named the only industrial heritage street select as a "Famous Chinese Historical and Cultural Street," the Jianxi District government has organized the preparation of the Protective Planning for the Historic and Cultural Area of Luoyang's Jianxi District Industrial Heritage, the Protection Planning for Luoyang's Jianxi District Industrial Heritage, and the Tourism Planning for Luoyang's Jianxi District "Detailed Construction Planning of Luoyang Runxi Industrial Heritage Historic Landscape Area" and "Industrial Heritage Tourism Planning".

In 2013, the State Administration of Cultural Asset designated the Soviet-style industrial complex in Luoyang's Jianxi District as the eighth batch of national significant cultural heritage conservation units. However, no heritage conservation plan for the Soviet-style structures in Jianxi District has been developed thus far. The protected industrial legacy in Luoyang's Jianxi District covers a large area, and the most of it is located in lots with significant commercial development value. The economy would suffer severely if they were protected. Second, government departments are not doing enough to conserve industrial history, and the protection management mechanism is ineffective. [7]

7: Ningning, Research on protection and reuse of industrial building heritage in Jianxi district of Luoyang,Zhengzhou University, 2016

Image 57: Jianxi District "Soviet-style" building complex
(Source : https://www.sohu.com/a/323120732_141088)

Image 57

2.With the problem of urban development

Historic industrial neighborhoods are a component of the city's memory, a carrier of culture, and a record of its history. They are also the city's roots, and the success of their preservation and rejuvenation is intimately tied to the city's overall construction and development. At the same time, the problem of restricted urban development space is a challenge for many cities in the process of urbanization, particularly for old-school industrial cities, where vast industrial sites occupy the land in the city center, and Luoyang is really no unique.

The spatial pattern of 'greenery in the middle of the residential area in the south and north' has been increasingly destroyed with the development of the city, and the large square of green space between the factory area and the living area has been taken up by tall buildings, the historical streets and alleys are completely gone, and the buildings along the streets are mostly commercial and disorganized, with excessive building density.

Historical structures, heritage places, waterfront parks, railway lines, and so forth are all being preserved. The Jianxi district's industrial heritage is not only a significant carrier of industrial civilisation, but also an important aspect of Luoyang's urban culture. With rapid urbanization, the local government lacks a long-term vision of overall planning in the process of urban development, and does not do a good job of coordinating the relationship between urban development and industrial architectural heritage protection, and even opposes the two in some specific issues. [8]

8: Sun Ying , Research on Regeneration of the vitality of Jianxi Industrial Zone in Luoyang, Hunan University,2013.

Even when the objective is to protect industrial legacy, there is an underestimating of its value and a one-sided concentration on the commercial value of development at the expense of historical and cultural meanings in the conservation and reuse process. Industrial heritage conservation and reuse must be linked to urban growth.

3. The current damage to the industrial area of Luoyang and the lack of urban vitality

The copper processing facility in Luoyang City, for example, is located in the city's western industrial zone, near to the Luo River and Wangcheng Park, as well as other urban public landscape areas. Furthermore, the factory's massive enclosed size severely impedes regional linkages, and the entire area is densely populated, densely built up, and environmentally unfavorable.

The factory is also becoming progressively derelict as a result of relocation and other issues, and the surrounding region is covered with weeds and semi-deserted. The old Jianxi Industrial Zone, which connects the factory's inner and outer spaces, has grown isolated from the city. Because of the planned economy and administrative division, practically every old industrial area was established with all social functions linked to it from the start. The limits of the industrial zones are well defined, even by fences, and there is no connection between the industrial regions and the city, which invests in, builds, and uses them independently.

The old industrial zones are like 'heterogeneous' items that have been cut off from the city, ignoring their symbiotic link with urban space and life and damaging the city's integrity. Furthermore, the site's road network is unstructured and devoid of urban byways. The plan's huge scale is not conducive to historic protection or sustainable development. [9]

9: Wang Peiyu, Research on adaptive renewal of Luoyang industrial heritage from Luotong factory to Luotong plant,,Zhengzhou University, 2021

Image 58 :old industrial building

Image 58

6.3 Introduction to the design scope

6.3.1 Site base Scope

The Luoyang Metal Processing Plant, one of 156 significant projects developed with Soviet Union assistance during the First Five-Year Plan period, was renamed the Yellow River Smelting Plant in 1961 and the Luoyang Copper Processing Plant in 1972 before becoming the Chalco Luoyang Copper Company. The Jianxi Industrial Zone begins here, with the Luoyang Bearing Factory to the west and the Jian River to the north and east, Zhongzhou West Road to the south, and Wangcheng Park to the east. There is a specific line in the factory and the Longhai Railway, so traffic is convenient.

Image 59 : Site position (Draw by author)

Image 59

Image 60 :old industrial building overview

Image 60

6.3.2 Base Overview

The Luoyang Metal Processing Factory began construction in 1954, and the entire plant acquired a total of 2713 mu of land, including the factory area and living area, with the natural boundaries of the factory area being east to the Jian River, the northeast corner to the west wall of Wangcheng Park, west to Songshan Road, south to Jianshe Road, and north to the hilly area of Tongle Town. It is the largest copper processing factory in China, having been completed and put into service in 1965. It is one of New China's large-scale comprehensive non-ferrous metal processing backbone firms.

Chart 95:Aerial view of the study area (source factory file)

Image 61

1. Analysis of site resources

The existing layout of the plant basically maintains the initial design of the USSR, with further supplementary design in accordance with the actual situation of the production project and the production process.

The plant office building is located at the southern end of the plant, the main production workshops are arranged in the centre of the plant, and the auxiliary facilities such as packaging and transportation of finished products are located in the northern part of the plant. The layout of the production workshops is arranged according to the production process, with the production of copper ingots in the centre, copper strip and copper tubes and rods on the left and right sides, and additional design items such as the through electrolysis system and the production of aluminium-magnesium alloy systems in the north-west of the plant. Auxiliary facilities such as machine repair workshops, gas generating stations, protective gas stations, air compressor stations, circulating water pump stations as well as oil and raw material depots are arranged in the vicinity of the production workshops according to the principle of saving pipelines and reducing transportation, and most of them are located in the northern part of the plant. [10]

10: Compilation committee of Annals of Luoyang Copper Processing Plant. Records of Luoyang Copper Processing Plant [M]. Internal Issue, 1986

Image 62

Image 64:Analysis of the surrounding scene of the site (Draw by author)

Image 64

1.Base road analysis

In the front area of the factory, between Construction Road and Zhongzhou Road, is a green belt of trees and trees to isolate the noise and dust pollution of the factory and to ensure the hygiene and quietness of the living area, after which residential houses are built. Transport is mainly by rail, with a railway line running directly to Luoyang West Station and the Longhai Railway. The line is a permanent standard railway with a grouping station and 19 branch lines, with a total length of 9.3 kilometres, allowing trains to reach the main production workshops. The plant is easily accessible by car and electric car, with a closed inner ring road and three entrances and exits connected to the municipal construction road.

Base road analysis

At present, the area of Luotong factory is too large, the road is wide, about 10-20 meters, the scale is large, mainly for pedestrian and vehicular roads, there are potential safety hazards, and the road network system is not perfect. As a result, the internal road network in the area is too far apart, and the traffic is not smooth. There is no direct entrance and exit to the outside on the north side of the base, and you need to turn from the middle section of Fanghua Road to Songshan Road to enter the base.

Image 65: Site road analysis (Draw by author)

After analyzing the surrounding public transportation, it is concluded that the current road network is relatively fragmented, especially the secondary road on the south side has many broken roads, and the park road is not smooth, which cannot play a good guiding role. In addition, due to the limitations of the current conditions, it does not play the role of dividing the flow of people and vehicles.

Image 66: Public transit environment analysis(Draw by author)

2.Road section status quo

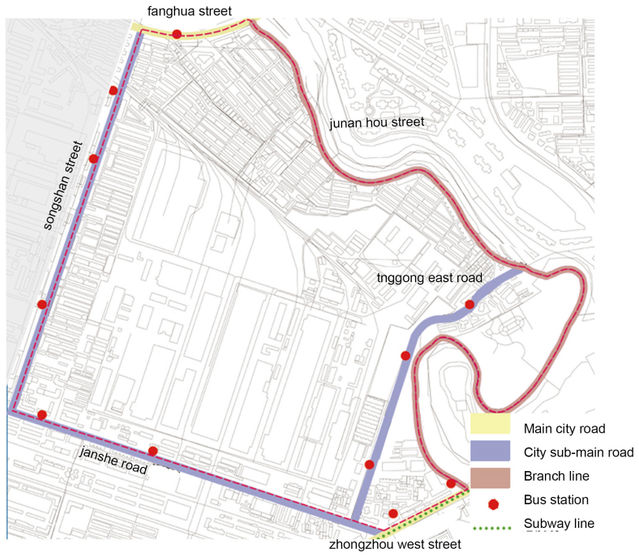


Image 67

Existing problems:

1. The large area of Luotong factory leads to the large distance between the road network in the area and the traffic is not smooth.
2, base on the north side there is no direct external entrances and exits, from youth to middle to songshan road into the base,
3. There are two entrances on the east side, Zhongzhou Middle Road and Hantun Road. However, since Hantun Road cannot directly enter the base, it still needs to enter Jianshe Road from Kanggong West Road, which does not play a role in traffic diversion.

Image 67 :heze road (Draw by author)

Image 68 : jianshe road (Draw by author)

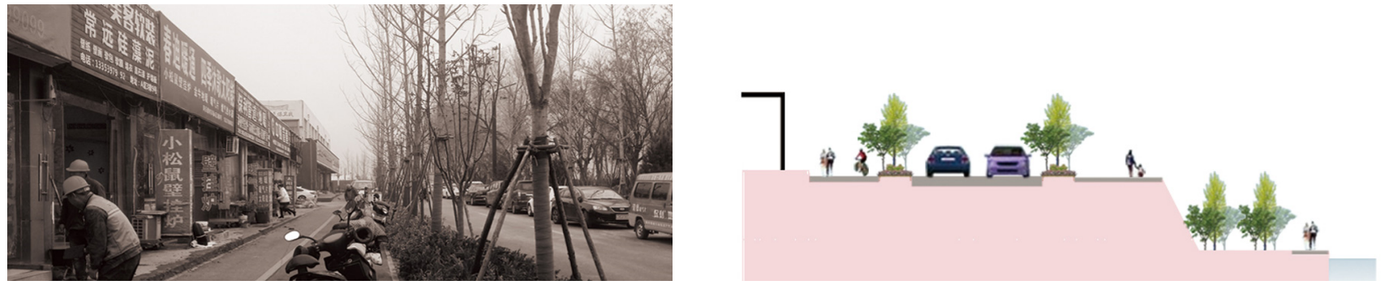


Image 69 : yanhe road (Draw by author)

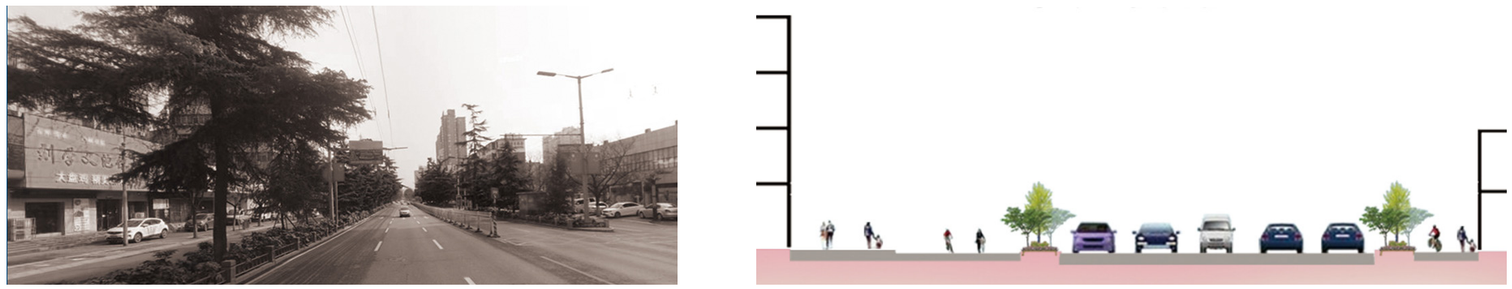


Image 70 : songshan road (Draw by author)

6.3.1 Analysis of architectural element——material resources

1. Material resource analysis

The buildings inside the copper processing plant were primarily constructed in the 1960s and 1970s; some residential and commercial structures in the surrounding area were constructed in the new century and are relatively new; the remainder of the residential and commercial structures were constructed in the 1980s and 1990s; Furthermore, numerous structures on the northeast side of the property were constructed prior to the 1960s. The contemporary factory layout essentially preserves the original Soviet Union design, and the design is further augmented according to the production process based on the real scenario of the production project. Only a portion of the industrial production lines in the manufacturing area remained after the majority of them were relocated to Yibin District., only part of the factory buildings were used for the factory's own use, and some were leased out.

Image 71 :Analysis of the internal building age of the site (Draw by author)

The copper processing factory has generally 1-3 levels; most of the nearby commercial buildings have 1-3 and 4-6 floors. The majority of residential structures have 7-11 levels, with 5 buildings having more than 11 floors. The current industrial area's overall environment is bad; most of the abandoned workshops, primarily from the first to the eighth branches, are well kept, while some warehouses and other ancillary buildings are poorly preserved.

Image 72 :Internal building floor analysis of the site(Draw by author)

The buildings around the copper processing plant have a single function, mostly residential and commercial buildings; The southwest side of the site is a government building.

Image 73 : Functional analysis of buildings within the site(Draw by author)

Image 74 : buildings within the site(Draw by author)

Image 75 : Functional analysis of buildings within the site(Draw by author)

Image 76 : photo of road (Draw by author)

The second branch plant
source : From the Luoyang factory log

The first branch factory
source : From the Luoyang factory log

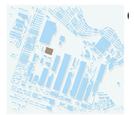
Office building
source : From the Luoyang factory log

The third branch plant
source : From the Luoyang factory log

Warehousesource
source : From the Luoyang factory log

The sixth branch plant (view one)
source : From the Luoyang factory log

The sixth branch plant (view two)
source : From the Luoyang factory log



The fourth branch plant
source : From the Luoyang factory log

2. The structures

although not directly involved in industrial production activities, play an important role in production activities. The site is mainly paved with large areas of concrete paving, and the overall green environment is poor, with waste materials piled up everywhere, presenting a rather dilapidated scene. Many structures and mechanical tools related to copper processing remain in the factory. The area in front of the factory, between Construction Road and Zhongzhou Road, was originally designed as a wooded green area according to the original Soviet design to isolate factory noise and remove air pollution. In the garden, there are many smoke and water tower structures, most of which are well preserved, and the air corridors, which are well preserved, can be used for passage through the park, enriching the spatial level of the road system.

Five Soviet-style workshops have been preserved in the northern production area. These workshops are large in scale, well designed and aesthetically pleasing, with a number of design aspects that are still relevant, such as the design of the air vents, which ensured good ventilation in the absence of air conditioning at the time. There are 21 Soviet machines still in use, as well as a series of Czech machines. Even some of the disused pipework is clever and well constructed. Some of these plants, machines, components and processes are still in use, while those that are not have heritage and industrial aesthetic value.

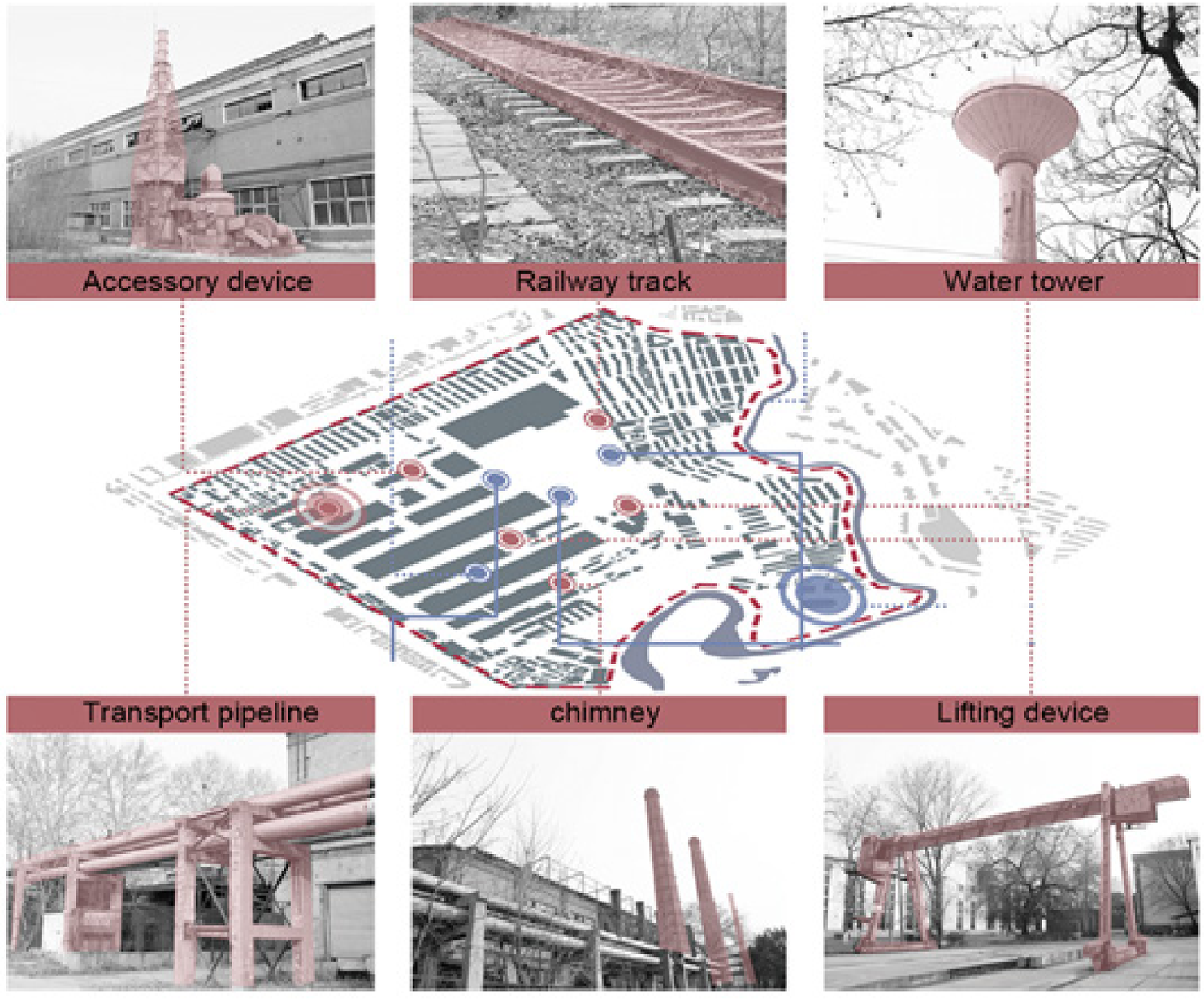


Image 77: building Structure analysis of the site (Draw by author)

3. Plant resources analysis

Inside the plant.
The plant was built in 1955 and has been in operation for over 60 years, with many trees over 30 years old, with thick branches and a dense canopy, and of great ornamental value

Outside the plant
1. King's Castle Park, a royal park 200 years ago
2. Riverfront landscape line

(Source :Super impressive! Under the "God's perspective", it turns out that you are such a Luoyang! - Luoyang Peony Culture Festival (luoyangmudan.cn)

Image 78

Image 78 :Plant resources analysis of the site
(Draw by author)

4. Railway and industrial facilities and equipment analysis

Factory railway private sidings for permanent standards, with marshalling yards and 19 feeder, total length of 9.3 km, the train can be open to all major production workshop.

Image 79

Image 79 :Railway and industrial facilities and equipment of site
(Draw by author)

6.3.2 Analysis of architectural element——non-material resources

1.Great cultural value. The early years of the founding of New China, later referred to as the “First Five-Year Plan” period. The goal of this period was the rapid transformation from a traditional agricultural country to a large industrial country. Therefore, industrial construction was the main focus and urban development was a complementary one, emphasising that the modernisation of cities had to be achieved through industrial modernisation. Soviet-style industrial complexes were built with the help of the Soviet Union.

2.Cultural values. The Luoyang Copper Processing Plant is also currently the largest copper processing plant in China, with 3,906 sets of various types of production equipment and a total weight of 27,100 tonnes. In general, the copper smelting and alloying technology is still first-class in China, with a small number of leading technologies, most of which can be displayed, except for some confidential technologies, which have considerable value for science and technology tourism. The smelting process has been preserved in its entirety as it is still in use. It was transported across the country by rail. The transport tracks and the sugar workshop are still intact, and the space is recreated through the creation of a botanical garden of raw materials for swallow sugar and the sugar process experience, taking into account the characteristics of the site. [11]

3.Emotional value. During the long development process, under political and social influences, this spirit has coalesced into the “spirit of Luotong”, while tens of thousands of employees have developed special feelings for “Luotong”, which is both a humanistic spirit and a tourism and educational resource.
the protection management mechanism is ineffective.

11: Luoyang Jianxi Industrial Zone planning description: 1954-10-25[B]. Luoyang First Archives (Quanzong 67, Volume 1) .

6.3.4 Interpretation of the superior plan

According to the notice of Luoyang Municipal Government on the issuance of Luoyang City People’s Government on the promotion of the protection and utilization of industrial heritage in old industrial cities to create a living show belt, Luoyang Municipal Government intends to protect and repair and develop and utilize the old factory buildings with equal emphasis, and revitalize the old factory buildings in the old factory area, and the relocation project of Luoyang Copper Processing Factory has been included in the industrial key projects.

According to the Luoyang Urban Territorial Spatial Planning (2020-2035) issued by the Luoyang Municipal Government, it is proposed to build the original factory site at the end of 2035 on the basis of the protection of the original industrial heritage, and to make functional adjustments to the current industrial land.

Image 80 :Urban Land and Spatial Planning (2020-2035) (from Luoyang Municipal Planning Bureau).
(Draw by author)

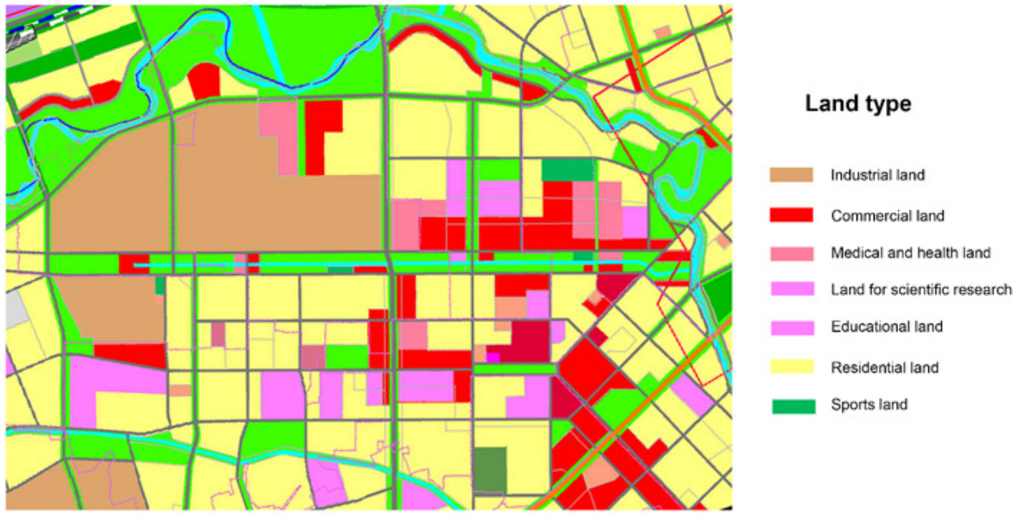


Image 80

6.4 design proposal

6.4.1 General Design

Design and transformation basis

Image 81 : Building height control map within the scope of design

1. Luoyang Urban Territorial Spatial Plan 2020-2035
2. Luoyang City Industrial Heritage Site Plan
3. The Fourteenth Five-Year Plan for National Economic and Social Development of Luoyang City
4. Regulations on the Protection of the Historic Industrial and Cultural City of Luoyang City
5. Action Plan for the High-Quality Development of Manufacturing Industry in Luoyang City
6. Implementation Plan for the Three Major Transformations of the Manufacturing Industry in Luoyang City (2021-2025) Planning
7. Plan of Action for the High-Quality Development of the Industrial Manufacturing Industry in Luoyang City
8. Planning of Commercial Network in the Downtown Area of Luoyang (2021-2030)
9. Luoyang Municipal People's Government on the Issuance of the Work Plan of Luoyang City for Promoting the Protection and Utilization of Industrial Heritage in Old Industrial Cities to Create a Living Show Belt

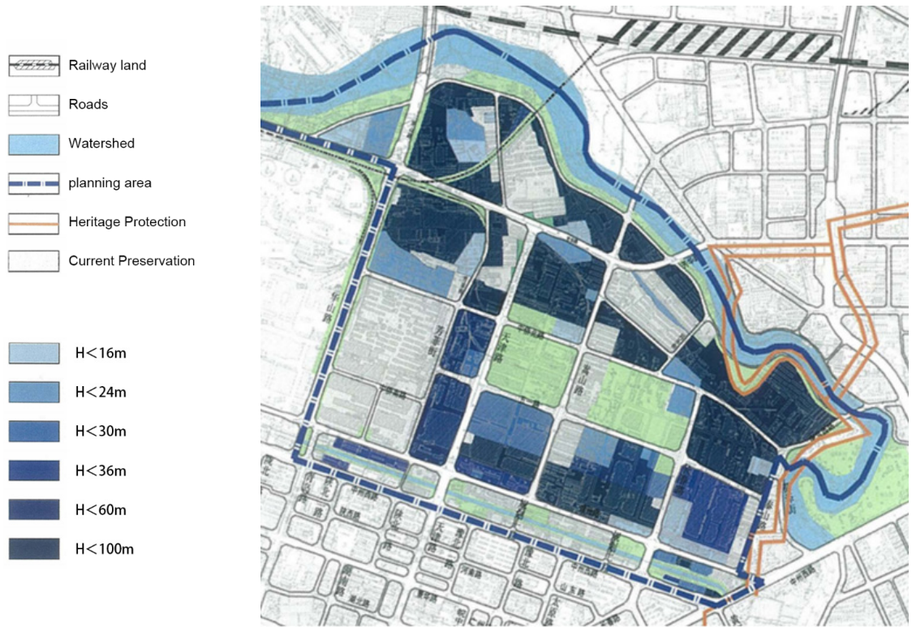


Image 81

Design concept

Image 82 :Building density control map within the design area

Building density = total base area of building/planned construction land area

The overall design objectives should be:

1. Make full use of the original planning system structure, protect the cultural connotation and context characteristics;
2. Break and reintegrate as appropriate; Reasonable demolition, renovation and construction;
3. Based on the original planning advantages, inject modern fresh elements, replace the original functions of the factory area, and make it re-energize;
4. And scientific analysis of the relationship between the factory and the city, breaking the "island" type of existence, so that it and the city overall coordination and integration.

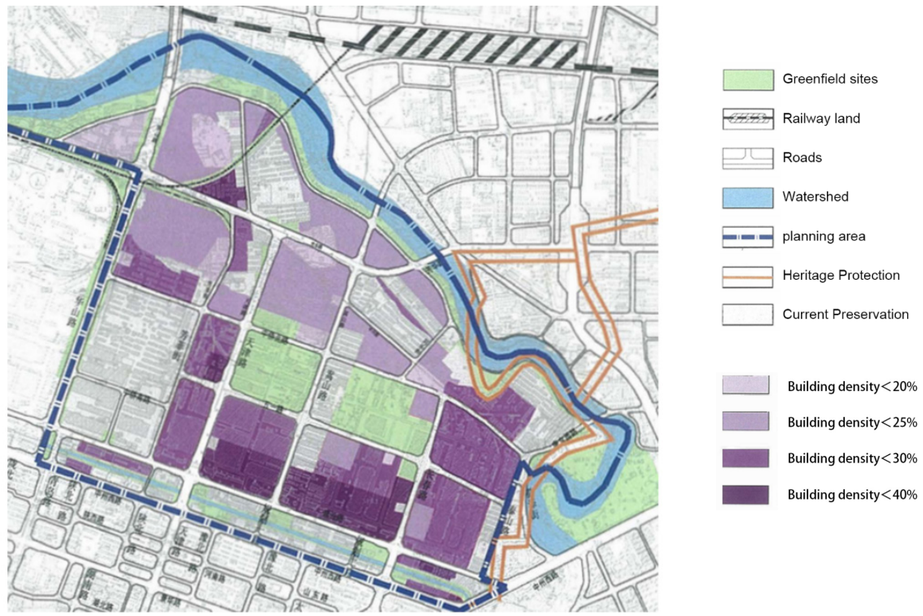


Image 82

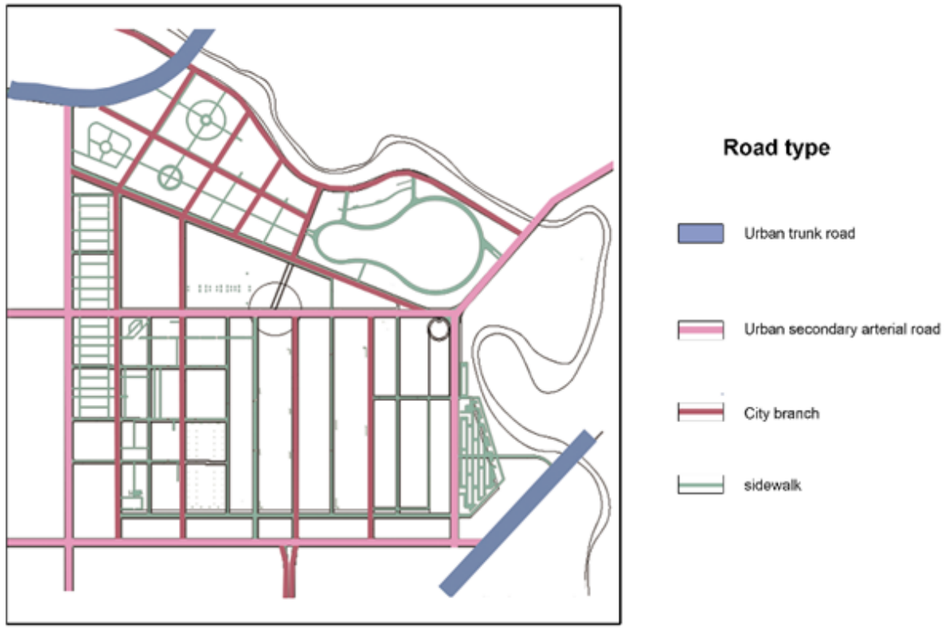


Image 83

Image 83: General Design of road level (Draw by author)

Image 84 : Secondary Level Raod: 26M (Draw by author)

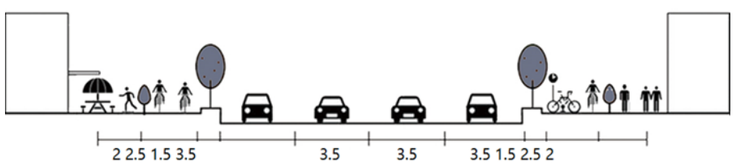


Image 84

Image 85 City Branch: 17m (Draw by author)

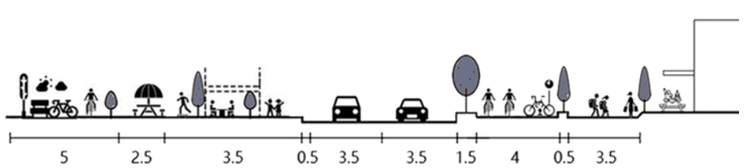


Image 85

Divider barrier	Separation guardrail should be laid with the intersection stop line as the starting point, the starting point should be set end warning signs; single piece of guardrail length to 3m is appropriate, the net height of the railing should not be less than 1.1m, and should not be higher than 1.3m
Road greening	Road space with conditions, road at all levels should try to improve the road greening rate; give full consideration to the actual situation of roads and greening in the region; road greening design should deal with road lighting, traffic facilities, above-ground poles, underground pipelines and other relationships.
Green barrier	The width of the warped sub-belt should be large dry etc. 15m less than 15m with sub-flower boxes etc. for distribution should be less than or equal to 0.5m, should ensure that the road boundary is not encroached; flower boxes as the net distance after the isolation belt need to meet the requirements of the road 25m-50cm lateral residual width.
Rest facilities	Pedestrian spaces between 2.5m and 4m in width can be provided with a small number of seats combined with street greenery, fences, etc.; pedestrian spaces with a width greater than 4 can be provided with flexible forms of seats combined with amenity strips and tree ponds; seats should avoid traffic and fire evacuation areas.
Barrier free facilities	The pavements around the main commercial streets, pedestrian streets and visually impaired areas of the city should be set up; all road intersections, ramps should be set up at the edge of the up and down slope of the blind; the blind paths set up at the entrances and exits of places and buildings around the road should be connected with the blind paths of the road. The minimum width of the blind walkway should not be less than 30cm, when the width of the pedestrian space is greater than 4m, the width of the blind walkway can be increased appropriately, the maximum width should not be greater than 60cm. the blind walkway is generally set near the side of the street tree pool, 25-50cm from the tree pool is appropriate.
intersection	Pedestrian crossing and pedestrian secondary crossing, there is a central divider of the road, the central divider can be used to set up pedestrian crossing safety island. The width of the secondary pedestrian crossing islands should not be less than 2m, or 1.5m when conditions are limited, and the effective length of passage should not be less than the width of the pedestrian crossing, and avoid the misalignment of pedestrian crossing lines as far as possible.
Entrance and exit	In addition to expressways and special areas, urban roads at all levels should be set up continuous two-way non-motorized access. Existing non-road should be combined with the road network to improve the regional non-motorized access, but also with road reconstruction projects to add non-motorized lanes and corresponding traffic facilities. The minimum width of non-motorized lanes should not be less than 2.5m, the central urban area can be compressed to 1.5m under particularly difficult circumstances.
Non-motorized lane	In addition to expressways and special areas, urban roads at all levels should be set up continuous two-way non-motorized access. Existing non-road should be combined with the road network to improve the regional non-motorized channel, but also combined with road reconstruction projects to add non-motorized lanes and corresponding traffic, traffic facilities. The minimum width of non-motorized lanes should not be less than 2.5m, the central city in particular difficult circumstances can be compressed to 1.5m.
Bus channel	The width of the bus parking lane should be 3m, when the conditions are limited, not less than 2.75m; the height of the stopping platform should be 15cm20cm; the width of the platform should be 2m, when the conditions are limited, the minimum width is not less than 1.5m, and the limit value is not less than 1m.
sidewalk	Sidewalks should be spatially integrated with the front areas of buildings, with reasonable layout of pedestrian circulation space, facility belts and parking space to meet the functional needs of pedestrian circulation, parking and facility layout. The width of the pedestrian space (including the pedestrian space in front of the building) can be reasonably determined by taking into account the development intensity of the land on both sides, the degree of functional mix, the interface business, public transport facilities and other factors.

Chart 13:Railway and industrial facilities and equipment of site (Draw by author)

2. Building Type Guidelines

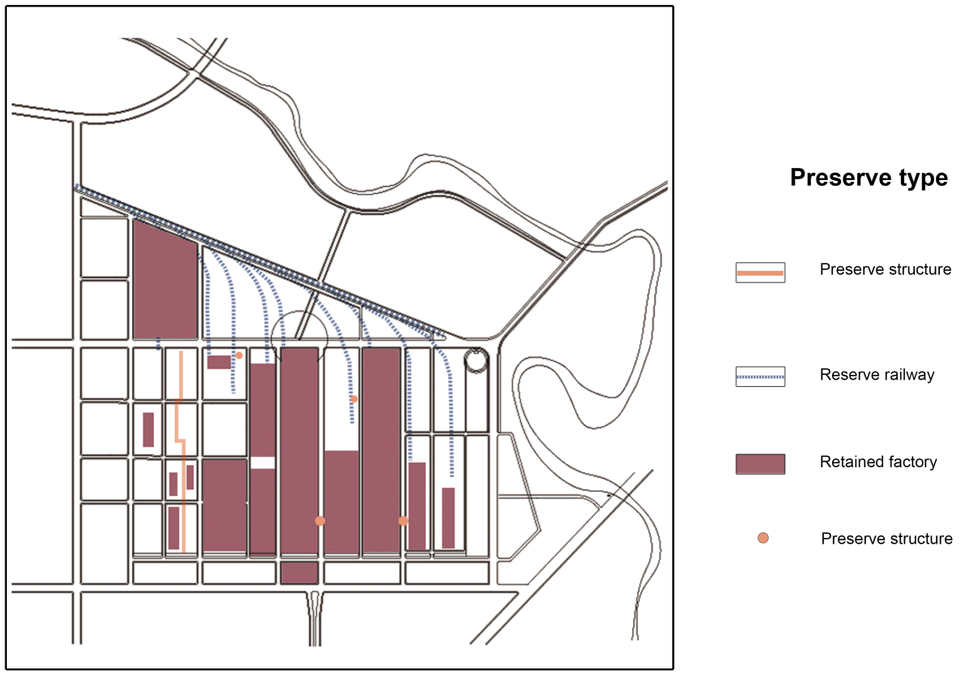


Image 86

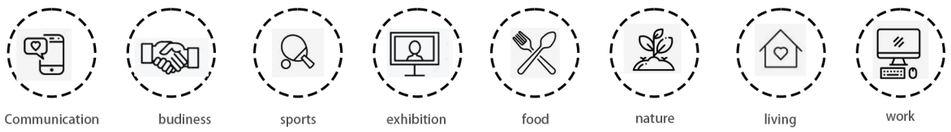


Image 87

Image 86: Building Type Guidelines

Image 87: Intended functional transformation plan

Analysis of industrial structures and function future use

3. Landscape guidelines

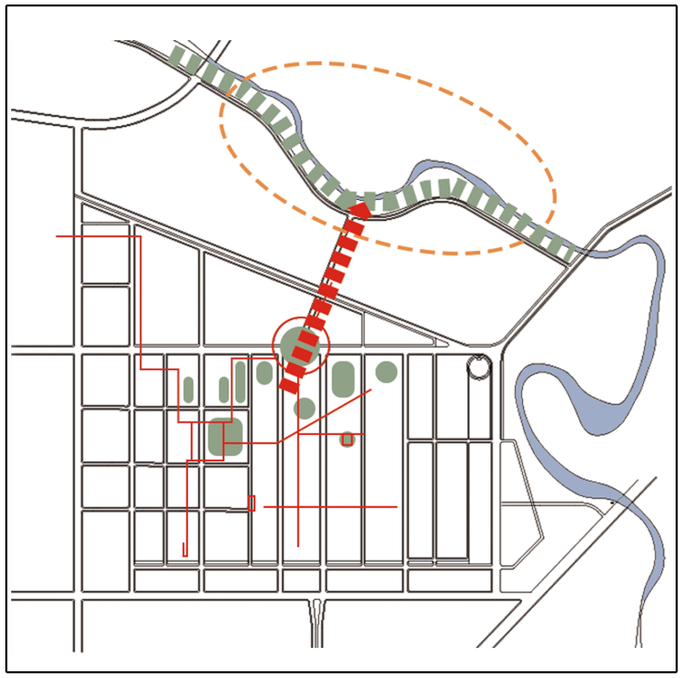


Image 88

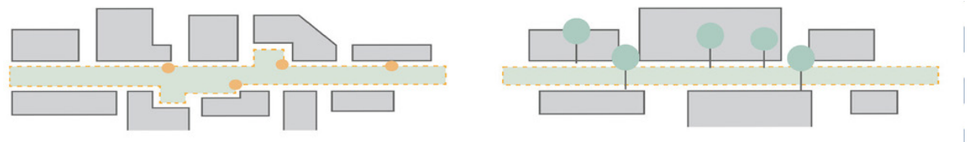


Image 89

1. Forming a visual corridor + riverfront park
2. Adding bridge to strengthen the connection of the site
3. Designing plazas to enhance the interest and hierarchy of the site

Image 88 : General Design of landscape (Draw by author)

Image 89 : Diagram of the landscape corridor space (Draw by author)

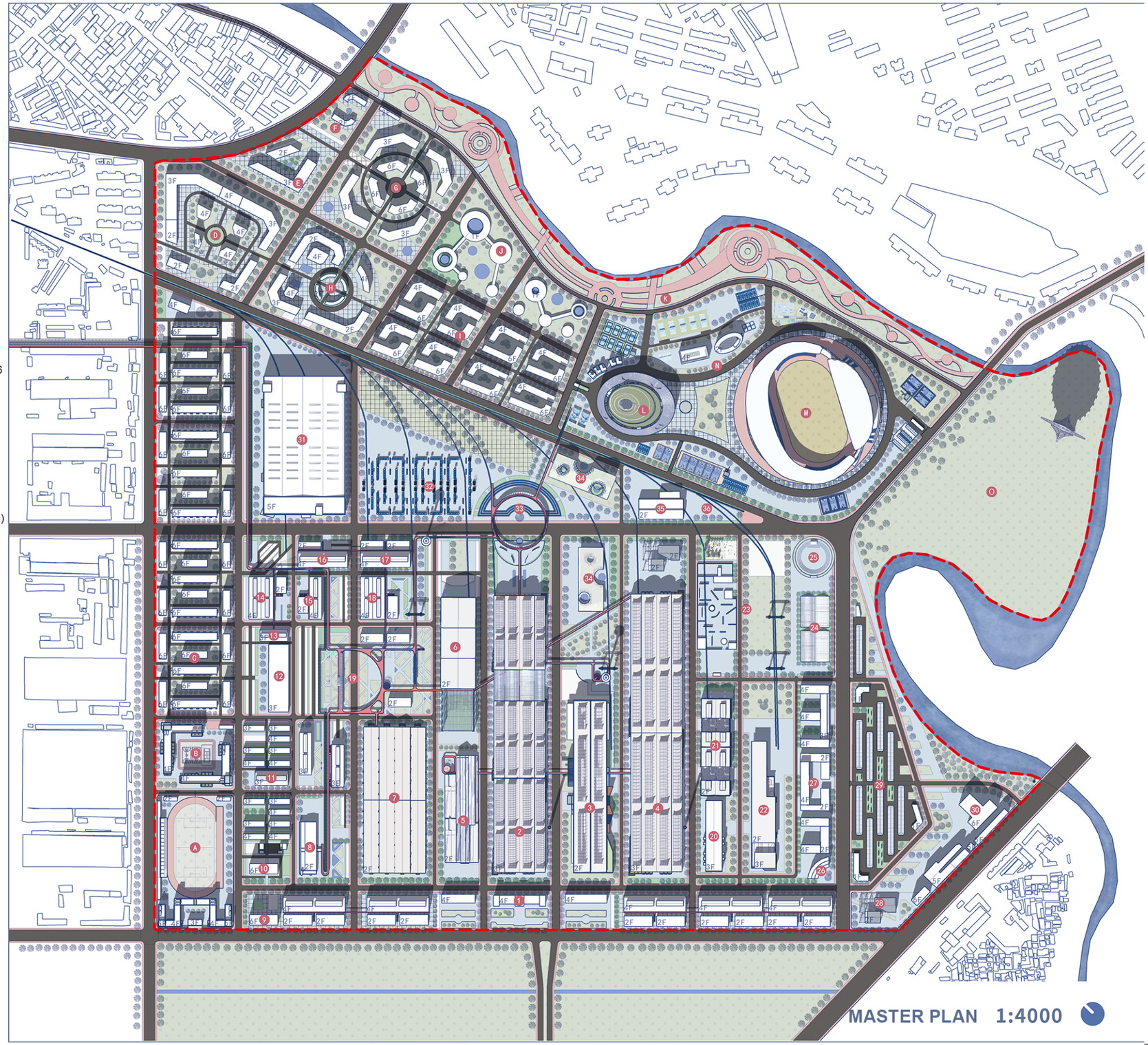
6.4.2 Overall design

Image 90 :Master plan (Draw by author)

List of major facilities

1 Cultural protection Building (Luotong Office Building)
2 Creative intelligence Industry incubator (renovation)
3 Exhibition and Exchange center (renovation)
4 Industrial museum (renovation)
5 Industrial Design Center (renovation)
6 Soil Remediation Research Center (renovation)
7 New Material Research and Development Institute (renovation)
8 Industrial Landscape Design Research Institute (Renovation)
9 Dong West Library (relocation, upgrading)
10 Jianxi Cultural Center (relocation, upgrading)
11 studio (retention)
12 Luoyan Hotel (retention)
13 Qiuhe Art Space (retention, upgrading)
14 small theater (renovation)
15 Industrial Hostel (renovation) 16 Reception center (renovation)
17 Media Studio (Renovation)
18 Research Institute of Mechanical Arm and Intelligent Construction (renovation)
19 Pipe Support Park
20 Research Institute of Industrial Heritage Protection (renovation)
21 Research Activity Center (renovation)
22 Research dormitory (renovation)
23 Research Sutuo site
24 Research planting experience Ladder
25 Sinking square and stage
26 Comprehensive service center
27 Intelligent soho Area
28 Jianxi Xuanguan Square
29 parking lot and urban public Gallery
30 Computer City (retention, promotion)
31 Cultural and creative industry incubator (renovation)
32 Better life creative market
33 Tongxin Square
34 City meeting room
35 Sports fitness factory (renovation)
36 Organizing Station

A Middle School
B Primary School
C Neighborhood
D talent Apartment
E business Show Station
F primary School
G Binhe high-end living area
H living service area (including convenience, pension and childcare)
I intelligent open block
J ecological oxygen Park
K Binhe Park
L Stadium
M athletics field
N Special sports hall
O Wangcheng Park



6.4.3 Scope Design

1. Planning strategy

Image 91

Image 91 :Planning strategy (Draw by author)

In terms of traffic interaction between the city and the factory, the factory is based on the regional urban axis, strengthening the establishment of secondary road systems, increasing the density of the road network, establishing a complete pedestrian system, forming a continuous and friendly urban traffic network, reshaping the texture of the area, and improving the accessibility of all points in the area.
In addition to this, five types of flow lines, including the riverfront ecological axis, the industrial plant axis and the Soviet-style architecture axis, have been strengthened. At the same time, the area is divided into a cultural, sports, scientific and educational zone, an intellectual and creative industrial zone, and a gravitational living zone.

1. Landscape axis analysis

Landscape environment optimisation is an important part of site environment optimisation and plays an important role in the beautification and comfort of the factory environment. Therefore, in the design, in the optimization of its landscape environment should respect the industrial culture of the factory, continue the texture of the factory, retain the cultural heritage of the site, enhance the spatial environment of the site iconic, and shape the characteristic public space for the city.

In this design, for the landscape design, I take the industrial characteristics of the factory as the basis, with industrial memory display as the theme, the park retains the core of the main plant and road, sorting out the texture of the site, retaining the spatial structure of the site, integrating industrial equipment and elements into the new landscape design, using modern landscape planning and design concepts and artistic creation techniques for redesign, fully displaying the industrial elements of their own artistic qualities and cultural The design of the new landscape will incorporate industrial equipment and elements into the new landscape design;

The site's ecology and industrial history are combined with the planning of water-friendly spaces, green spaces and other rich open spaces in appropriate areas, and the plazas, streets, green spaces and courtyards of the park are interlinked to enhance the value of the landscape space of the factory, create comfortable and dynamic public spaces, and form a multi-level landscape system;

The original industrial buildings and machinery are reused to design landscape structures that also serve as outdoor displays, displaying many contemporary sculptures and setting up interactive installations that allow visitors to participate in them and carry out various spontaneous activities to stimulate the park.

2. Landscape system

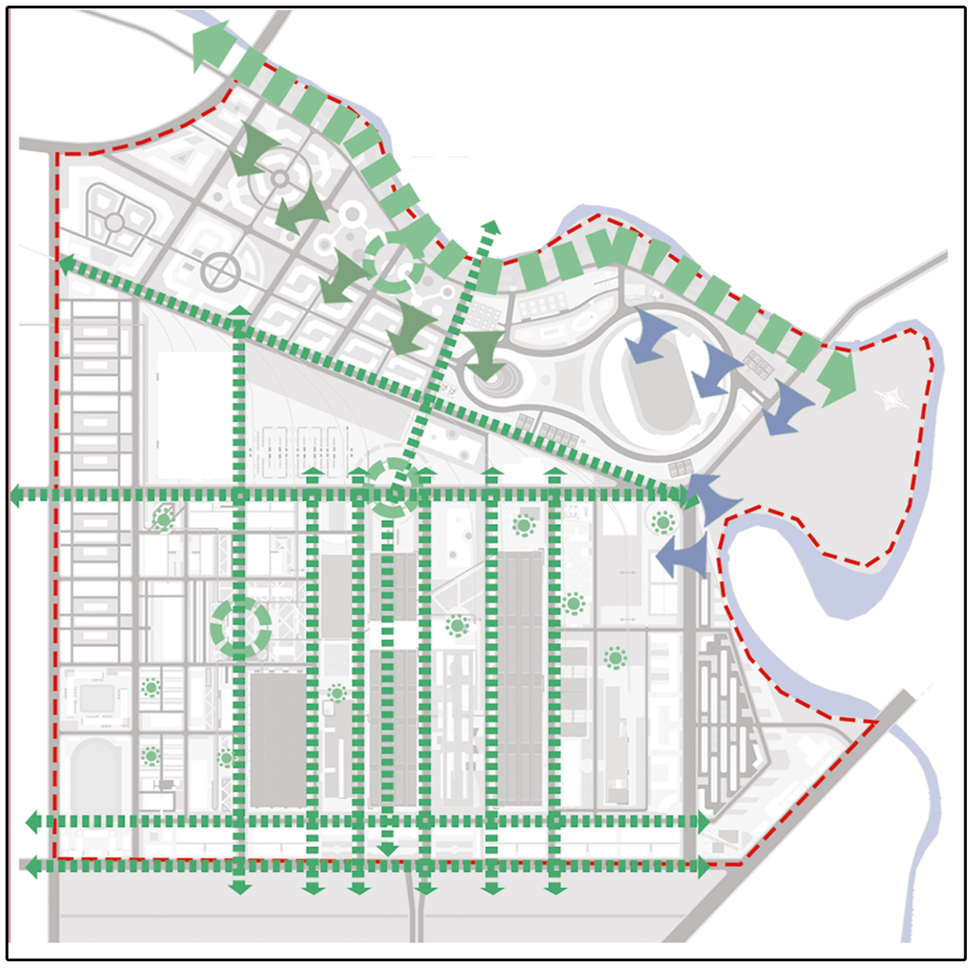


Chart 113:Landscape system (Draw by author)

Factory landscape green axis

Core square

Landscape node

Riverside green belt

Water system/landscape

Image 92

In addition to this, the integration with the surrounding landscape of the Jianhe River will be considered. In order to promote the integration of the Jianhe River landscape belt to the urban industrial area, the east side and north side of the factory buildings can be demolished to form a beautiful riverfront landscape interface.

The demolition area will be complemented by green landscape, widening the waterfront green space and forming an urban green landscape belt from the urban waterfront landscape belt to the industrial landscape belt.

Within the green landscape zone, activity plazas and other cultural nodes are set up, as well as ecological plants, to shape the waterfront green space with a dynamic landscape approach. At the same time, there is a large park in the vicinity. To strengthen the connection with the Wangcheng Park, a public space has been established.

The final formation of the Jianxi landscape axis, which consists of a river landscape belt, green landscape belt and industrial heritage landscape belt, will effectively enhance the overall ecological environment of the region.

Image 92 ::Landscape system (Draw by author)

Image 93 :Square design drawing (Draw by author)

Image 93

Road system

3.1 Base Road type system

City branch

Urban secondary arterial road

Urban trunk road

Image 94

On the basis of retaining some of the road layout, the traffic network is improved. Secondly, the three-level garden road system is enriched and improved, with three levels of secondary roads, feeder roads and pedestrian paths, with clear hierarchies and connections to various nodes.
In the renovated area, walking paths are laid out to improve the efficiency of the landscape nodes; and by continuing the current texture of the site, the landscape corridors are increased, thus enriching the vertical traffic flow.

There are two main roads in the east-west direction and one main road in the north-south direction in the base. The total width of motorized roads, non-motorized roads and sidewalks is 26m, and the main roads in the block area are the first three combined, which together are 17m. The road plays a role in maintaining neighborhoods and connecting city residents.

Image 94 :Road type system (Draw by author)

Image 95 A-A cross section design (Draw by author)

Image 96 B-B cross section design (Draw by author)

Image 97 C-C cross section design (Draw by author)

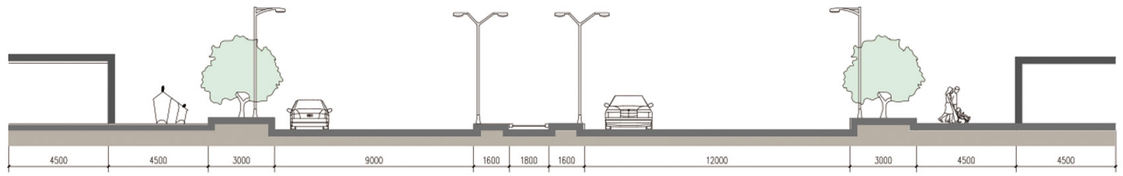


Image 95

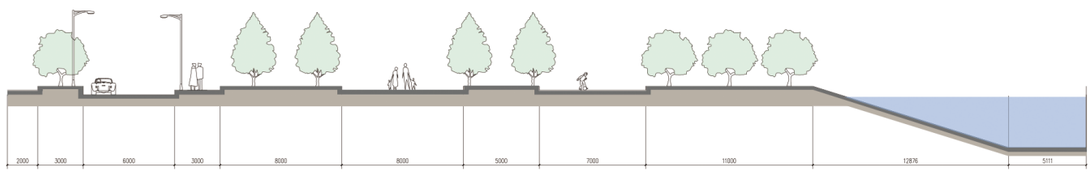


Image 96

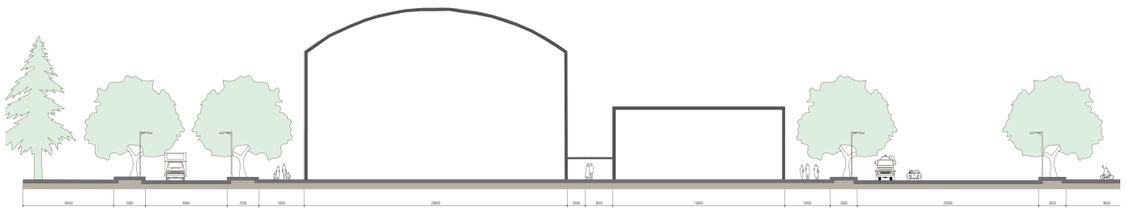


Image 97

3. 2 Parking system

Image 98

image 98: Parking system (Draw by author)

After the transformation of the site, the flow of people will increase to a large extent, so the combination of surface parking and underground parking is adopted, and sufficient parking spaces are set up.
In addition, an underground garage will be built under the commercial grass slope in the east to supplement the underground parking in the park.
On the west and north sides of the residential area, above-ground parking areas will be created, including parking areas for motor vehicles and bicycles. It is convenient for all kinds of people to use

Image 99 :Parking (Draw by author)

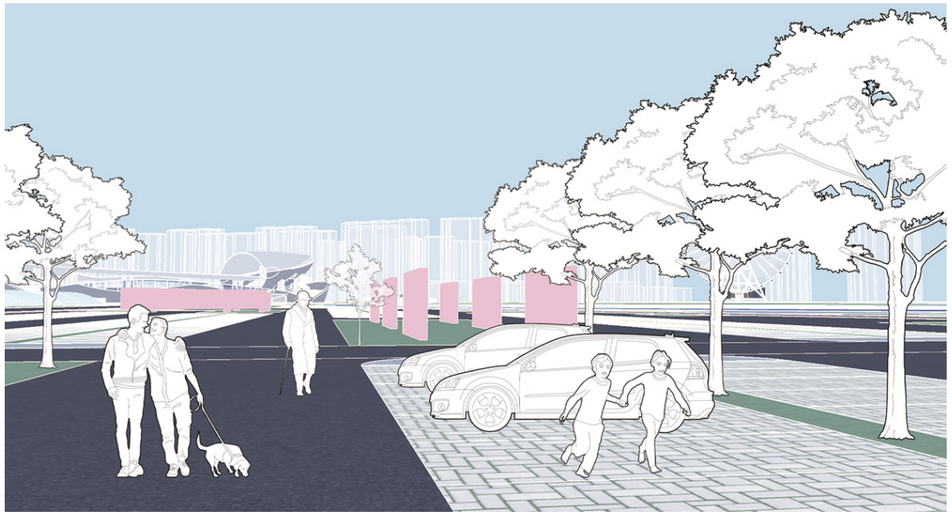


Image 99

Scope Design

3.4 Landscape walkway system

Image 100

image 100: Road type system analysis
(Draw by author)

Landscape walking roads are very important in daily life

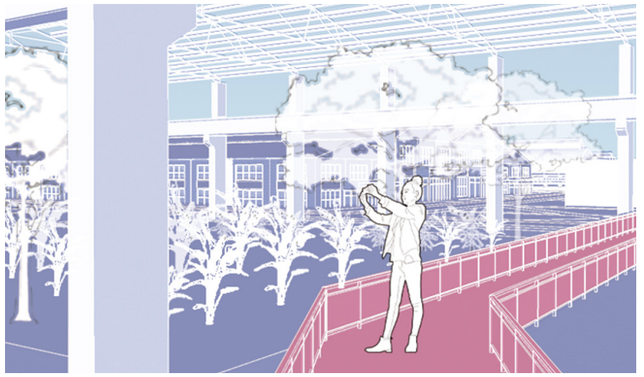


Image 101

Image 101 :road view between building (Draw by author)

Image 102

Image 102 :walking road view(Draw by author)

Image 103

Image 103 :road view(Draw by author)

6.4.4 Functional Design

1. Planning strategy

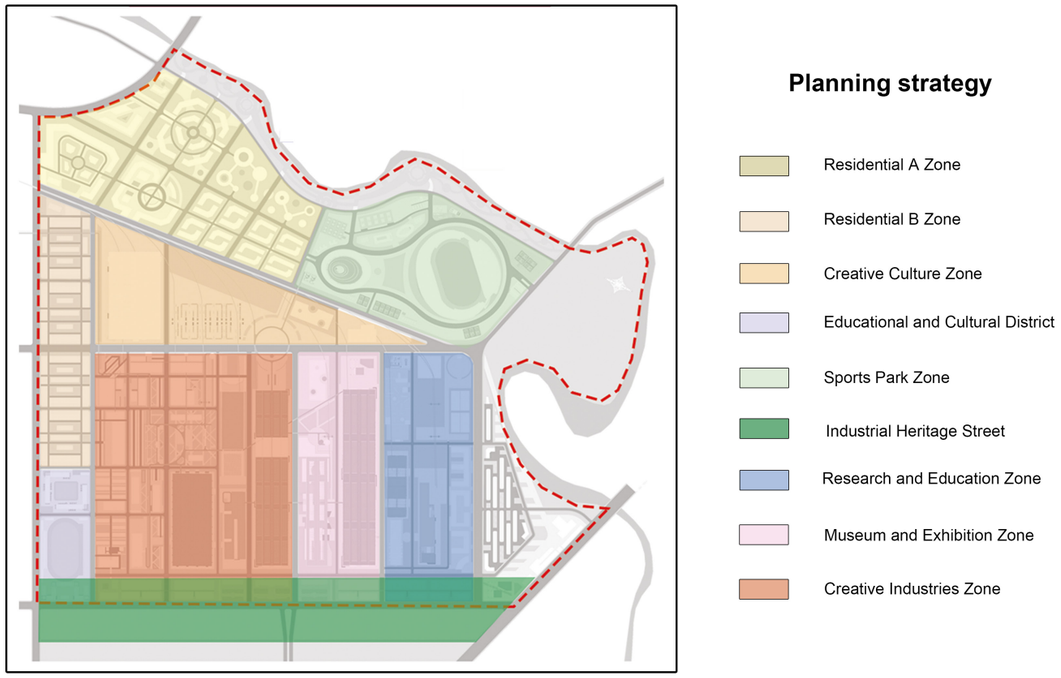


Image 104

image 104: zone Planning strategy (Draw by author)

image 105:Space-level reuse analysis (Draw by author)

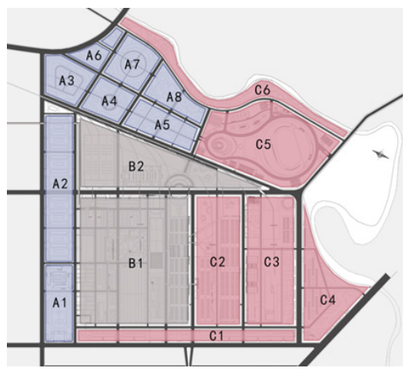


Image 105

A: Residential area

B: Commercial area

C: Common functional area

1. Landscape axis analysis

Landscape environment optimisation is an important part of site environment optimisation and plays an important role in the beautification and comfort of the factory environment. Therefore, in the design, in the optimization of its landscape environment should respect the industrial culture of the factory, continue the texture of the factory, retain the cultural heritage of the site, enhance the spatial environment of the site iconic, and shape the characteristic public space for the city.

In this design, for the landscape design, I take the industrial characteristics of the factory as the basis, with industrial memory display as the theme, the park retains the core of the main plant and road, sorting out the texture of the site, retaining the spatial structure of the site, integrating industrial equipment and elements into the new landscape design, using modern landscape planning and design concepts and artistic creation techniques for redesign, fully displaying the industrial elements of their own artistic qualities and cultural The design of the new landscape will incorporate industrial equipment and elements into the new landscape design;

The site's ecology and industrial history are combined with the planning of water-friendly spaces, green spaces and other rich open spaces in appropriate areas, and the plazas, streets, green spaces and courtyards of the park are interlinked to enhance the value of the landscape space of the factory, create comfortable and dynamic public spaces, and form a multi-level landscape system;

The original industrial buildings and machinery are reused to design landscape structures that also serve as outdoor displays, displaying many contemporary sculptures and setting up interactive installations that allow visitors to participate in them and carry out various spontaneous activities to stimulate the park.

1.Industrial migration and the change in the society in luoyang city (1953-1966),

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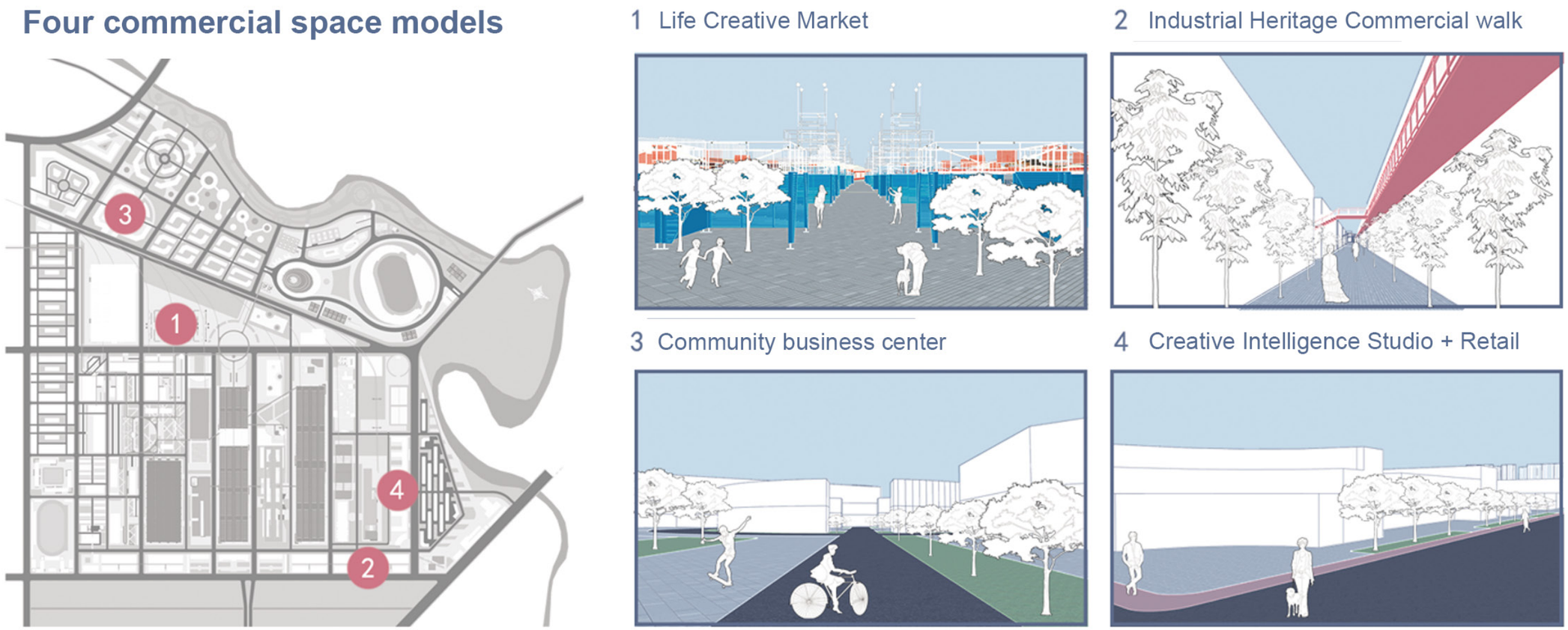

Image 106

Chart 112:Planning strategy (Draw by author)

In terms of traffic interaction between the city and the factory, the factory is based on the regional urban axis, strengthening the strengthened. At the same time, the area is divided into a cultural, sports, scientific and educational zone, an intellectual and creative industrial zone, and a gravitational living zone.

In terms of traffic interaction between the city and the factory, the factory is based on the regional urban axis, strengthening the establishment of secondary road systems, increasing the density of the road network, establishing a complete pedestrian system, forming a continuous and friendly urban traffic network, reshaping the texture of the area, and improving the accessibility of all points in the area.
In addition to this, five types of flow lines, including the riverfront ecological axis, the industrial plant axis and the Soviet-style architecture axis, have been strengthened. At the same time, the area is divided into a cultural, sports, scientific and educational zone, an intellectual and creative industrial zone, and a gravitational living zone.

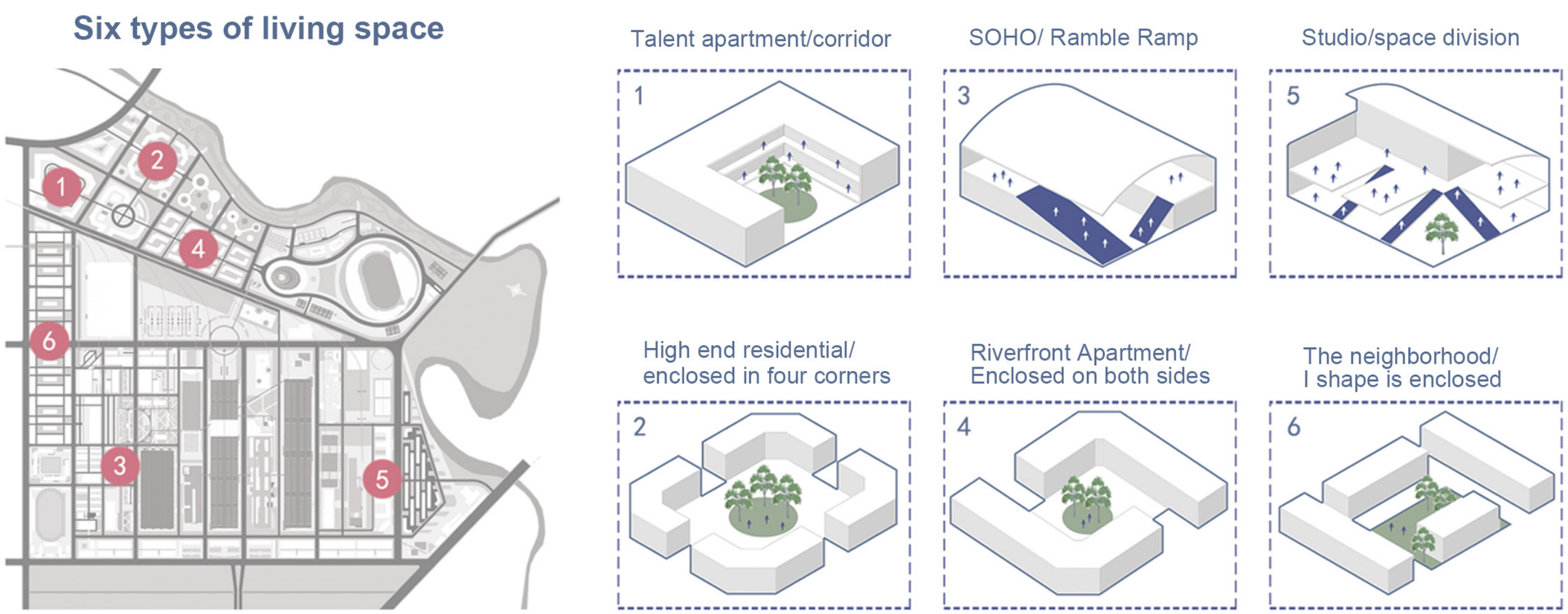

Image 107

Image 107 :Six types of living space(Draw by author)

Image 108 :Schematic diagram of the Soho transformation (Draw by author)

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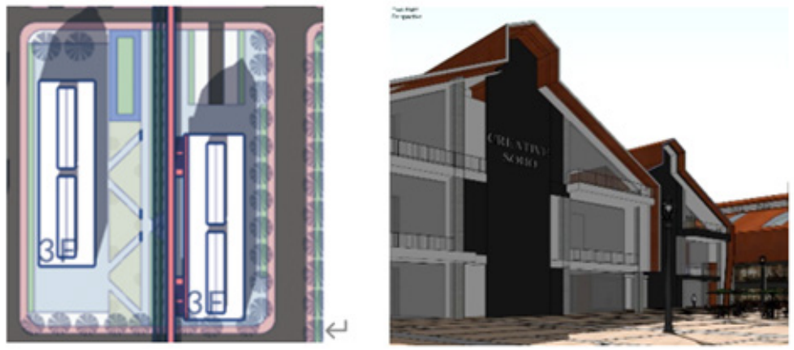

Image 108

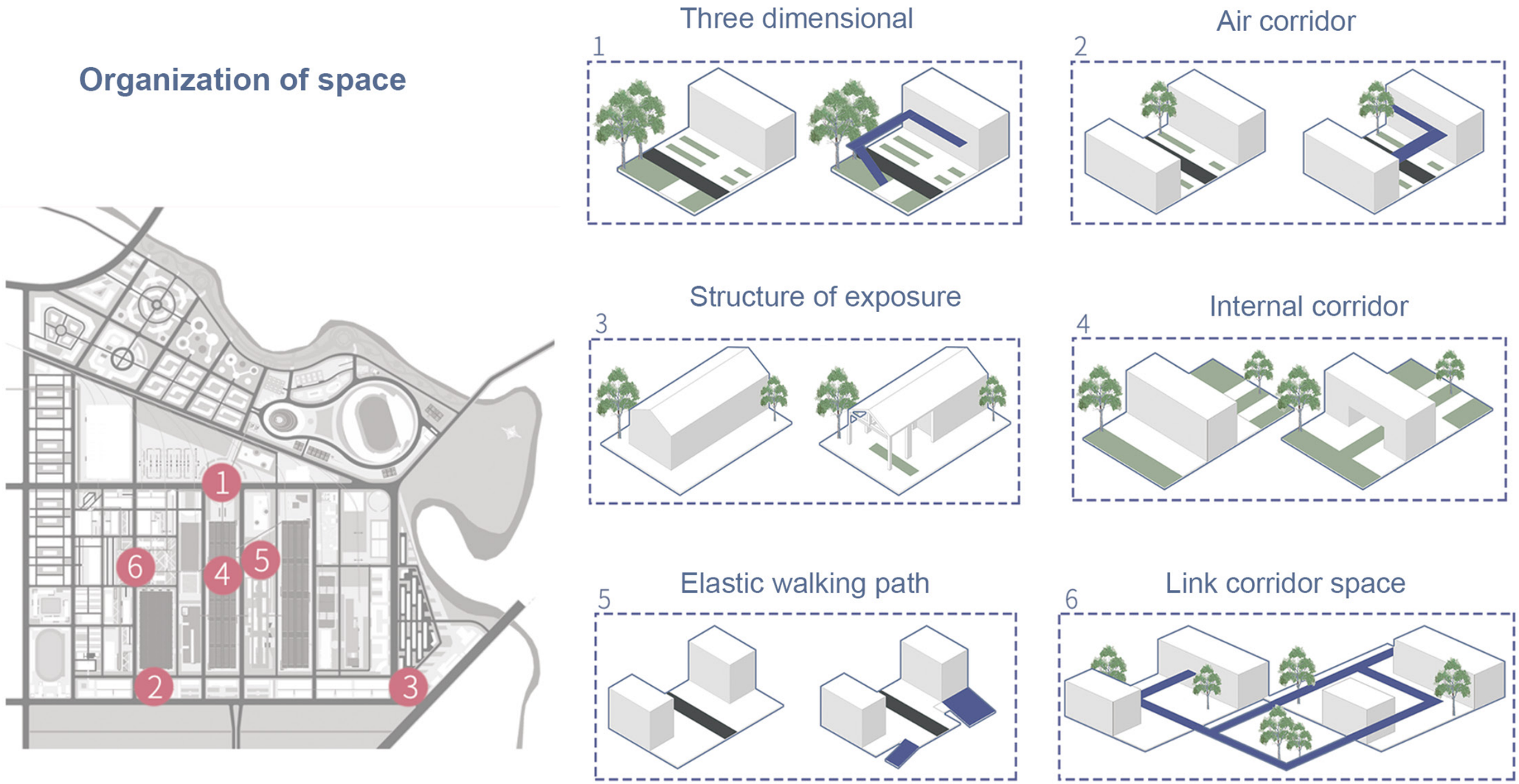

Image 109

Image 109 :Organization of space (Draw by author)

In terms of traffic interaction between the city and the factory, the factory is based on the regional urban axis, strengthening the strengthened. At the same time, the area is divided into a cultural, sports, scientific and educational zone, an intellectual and creative industrial zone, and a gravitational living zone.

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6.4.5 Landscape walkway system

Image 110

Image 110 :Preserve type strategy (Draw by author)

Old Buildingreuse Concept: Low-Tech Strategy

The low-tech strategy runs through the entirereuse and design of the old buildings in the factory area. The so-called “low-tech strategy” means: “ In the face of reality, choose the relative simplicity of technology, pay attention to economic cheapness and feasibility, fully emphasize the exploration and utilization of the advantages of ancient historical civilizations, give full play to strengths and avoid weaknesses, and strive to create a high degree of artistic quality with low cost and low technical means through convincing design philosophy and sufficient intellectual power, and seek a balance between economic conditions, technical standards and architectural art, so as to explore an architectural strategy suitable for economically backward but civilized countries or regions “ It emphasizes sustainable design concepts such as circularity, naturalness, low cost and low technology. The “low-tech strategy” requires that the construction materials and technologies used in thereuse design of the old factory area should be able to maintain the characteristics of the old buildings of the factory area as much as possible and retain the original appearance of the building skin. In the case that the original abandoned building materials cannot be used, even if new materials and new technologies are used, materials that are the same as or can be adapted to the original architectural characteristics should be used, and the characteristics of the old industrial buildings should not be destroyed contrary to the original intention of industrial heritage protection.

Guiding ideology of old building reuse design
The higher value plant in the factory area has a greater impact on the overall factory appearance and pattern, so it is necessary to strengthen the protection and control of the main building space pattern Therefore, it is necessary to strengthen the protection and control of the spatial pattern of the main buildings, and cannot be overbuilt or demolished to avoid damage to the authenticity of the spatial pattern of the factory area. The transformation design mode of the industrial plant in the factory area mainly has three categories according to the texture of the factory area and the architectural style

Category A: For buildings with high cultural expression value, the following two methods can be used to renew according to the situation. This kind of basic investment is small, the cycle is short, the intervention in the old building is small, the surrounding environment is small, and the spatial effect is objective, which can efficiently and quickly promote the transformation of old industrial buildings.

(1) Reservation as a whole.
The buildings and structures with high heritage value are preserved as a whole, so the original buildings and structures in the factory area retain the original structure to the greatest extent and continue the spatial texture of the factory area. The specific measures are based on the functional replacement of the building, the repair of the part of the building and the improvement and upgrading of the original old facilities and equipment; With routine maintenance as the mainstay, regular repair is supplemented, and basic work such as decontamination, anti-corrosion and reinforcement is carried out to prevent further damage to the building and avoid or reduce large-scale structural changes.

Category B: For buildings with average retention value.
(1) Local transformation. When the building is limited by its own conditions and cannot meet the building function, under the premise of meeting safety, the building is transformed and added to insert new functions. The plan comprehensively evaluates multiple groups of buildings in the site, and comprehensively considers the building space and urban functions, and then renovates and designs some buildings in the original site to give new functions, retain the personality of the place while meeting the needs of the city, and give it an appearance that is integrated with the overall factory architectural style.
(2) Under the premise of not affecting the overall image of the original building, the design elements with a sense of the times were appropriately added to improve the modern cultural expression of the appearance of the building, and the external skin and structure of the building were repaired and new functions were inserted, forming an area with dense distribution of heritage. Retain the external style and internal structure of the building to create an industrial environment atmosphere, form a complete display surface and display system, and let visitors have a more comprehensive understanding of the industrial history of the park.

Category C: Reasonable demolition.
For completely worthless buildings, such as poor building quality, poor structure, poor space utilization, based on the structural danger of the building and the irreconcilability of the style, such buildings are demolished, and built according to the superior planning requirements and urban space feeling, in line with modern design requirements , a new building in harmony with the overall style of the park, which increases the modern vitality while retaining the individuality of the site. At the same time, a new building was built on the site, and the design was carried out in a way that integrated the old and the new exterior.

Reuse of old building space

1.Height of the plant space

Through the modification of the cement plant production area of some old plant building internal space is high, in the design should be based on the requirement to add a floor in part or the entire divided floor height, set up mezzanine to increase space utilization.
The height of the additional floor slab and the size of the floor area should be determined by the transformation function and must be within the tolerances of the existing building construction system.
For this type of space utilization transformation, we should pay attention to vertical space division; a large space can be splitted into several small spaces with appropriate floor heights depending on the requirements of the use function, and adding a traffic system that links these mezzanine spaces can create a suitable spatial proportion relationship.

Image 111 :Schematic diagram of interior height reuse (Draw by author)

Image 111

The vertical floor slab can not only split the space for different functions and coordinate the proportion of the internal space, but it can also hide the old building's equipment and structural components that have no artistic value, as well as the new equipment introduced for the renovation, in the specially divided equipment layer or the lowered ceiling, saving space. The employment of interior space provides extra maneuvering space.

Image 112 :Schematic diagram of interior structure height reuse (Draw by author)

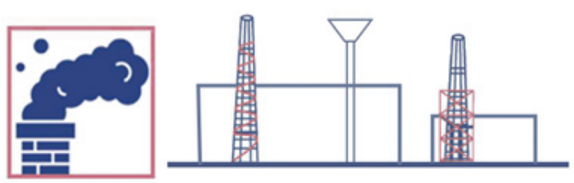


Image 112

Image 113: Schematic diagram of interior space design (Draw by author)

Segmentation of plant space

Cement plants have many abandoned buildings such as single-story factory buildings or large-capacity warehouses for production. This type of building roof truss structure is mostly steel truss or finished reinforced concrete beam frame, because there is no need for excess column support, and the formation of open, tall building internal space. In view of thereuse and utilization design of such old factory buildings, on the basis of completely retaining the original appearance and structure of the old building, the space is “deconstructed” and secondary limited according to the new use function, and the original large space is divided into several small spaces by setting up partition walls to form a “house within a house”.

In the large space of the empty old factory building, the small space is divided, so that the sharing of the large space and the privacy of the small space are combined, which not only meets the new use functions, but also enriches the level of space in the old factory. The small space is arranged regularly, integrated into the large space of the factory, forming new visual space characteristics and psychological space characteristics. The small space formed after the large space is simply divided is often only a mechanical simple juxtaposition, and the absolute division will cause these spaces to be relatively independent. How to connect these spaces is also a question worth considering. This design mainly uses the following techniques

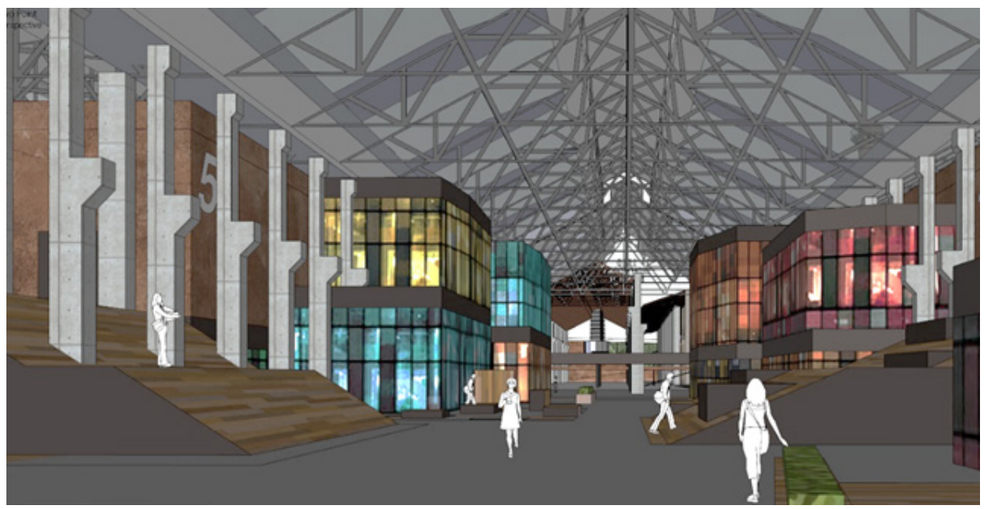


Image 113

a. Set up stairs or steps to connect individual spaces at different elevations. The steps have an upward guiding nature, in addition to solving traffic, it also gives people an upward momentum, so that the two independent spaces are organically connected. At the same time, the staircase as a new element can also create a rich spatial visual effect in the boring space of the old building.
b. Guidance and contact of floor paving. Conscious setting in the design of the paving pattern - some guiding information, throughout each individual space.
c. Use color for guidance. It is possible to psychologically perceive the existence of the next space and guide people from one space to another.

Green strategy analysis

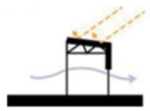
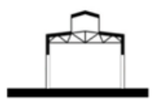
Schematic diagram	Description
	The workshop was subtracted and transformed to form a building side court to improve the indoor light environment and drive indoor heat dissipation and ventilation
	Subtraction transformation forms a building side courtyard to improve indoor light environment and drive indoor heat dissipation and ventilation
	Indoor and outdoor space conversion, shape the indoor and outdoor environment buffer, increase gas exchange
	Indoor and outdoor space conversion, the original indoor space into rain, ventilation, shade of the semi-outdoor corridor, forming a gray space
	The retention or modification of walls directs indoor ventilation and reduces indoor body temperature

chart 14

Chart 14: Green strategy (Draw by author)

Image 114 : green strategy detailed analysis (Draw by author)

Segmentation of plant space

Cement plants have many abandoned buildings such as single-story factory buildings or large-capacity warehouses for production. This type of building roof truss structure is mostly steel truss or finished reinforced concrete beam frame, because there is no need for excess column support, and the formation of open, tall building internal space. In view of thereuse and utilization design of such old factory buildings, on the basis of completely retaining the original appearance and structure of the old building, the space is "deconstructed" and secondary limited according to the new use function, and the original large space is divided into several small spaces by setting up partition walls to form a "house within a house".

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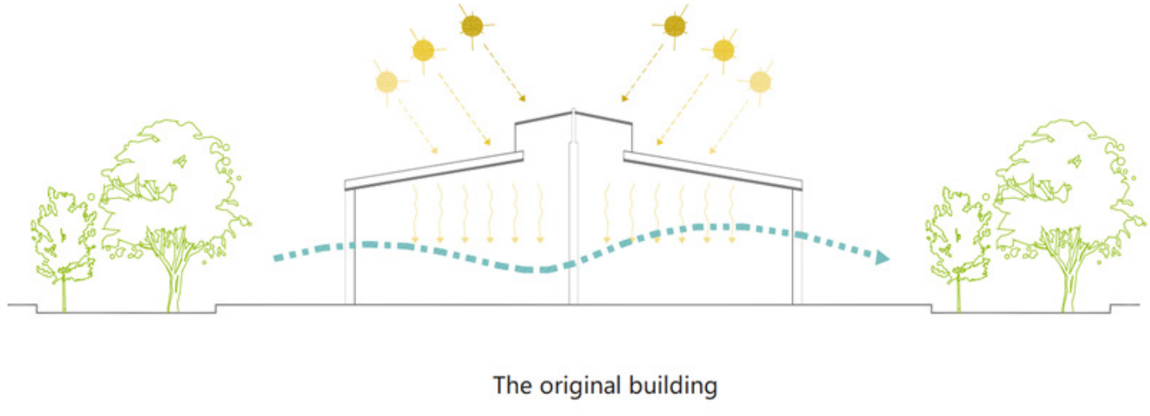

Image 114

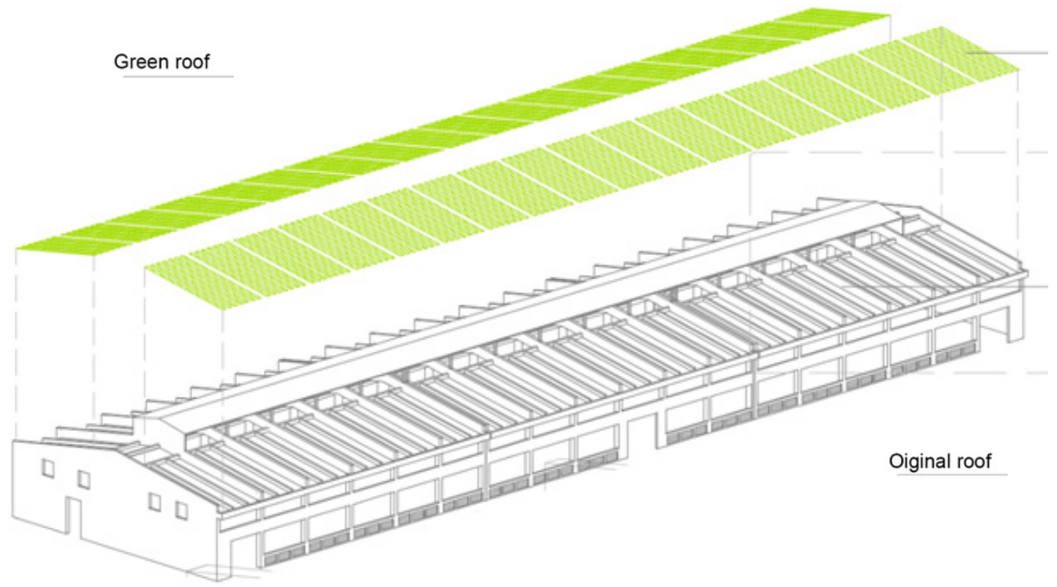

Image 114

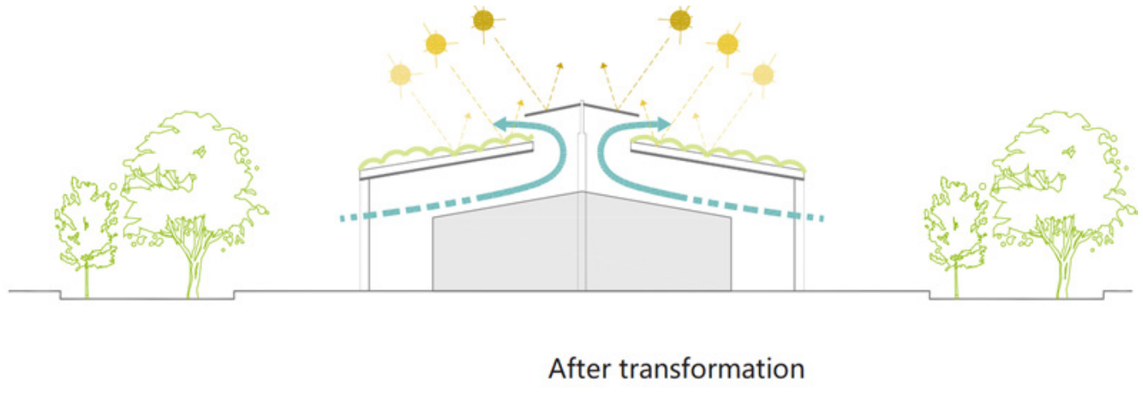

Image 114

6.5 Suggestions for improvement

6.5.1 How to archive heritage appropriately.

The value of specific factories within industrial plants in Luoyang City is difficult to assess and collate only through books such as factory histories. Therefore, it is recommended that firstly, the value assessment index and system of industrial heritage should be improved, the multiple values of industrial heritage should be verified, and a comprehensive evaluation system should be constructed according to the comprehensive evaluation needs of industrial heritage. [12]

The review of the current status of industrial land is divided into three main aspects. Taking the factory of this proposal as an example, the first step is to take into account the special properties of industrial land and the problem of pollution. Therefore timely governance treatment programmes should be implemented to achieve environmental sustainability of industrial conservation reuse. Professionals or institutions can be further commissioned to conduct land use potential analysis and land elasticity demand analysis to grasp the value of the land parcel for future development.

The second step is to assess the industrial buildings and residential support facilities in several existing factory sites, as well as to understand the development status and ownership relationship of the existing factory sites. The third step is an overall consideration to provide a basis for the subsequent secondary development of the site.

12: Liu H X. Value assessment and feasibility study on protection and reuse of third-line industrial heritage [D]. Huazhongke Technology University,2012

chart 15 : Status assessment model

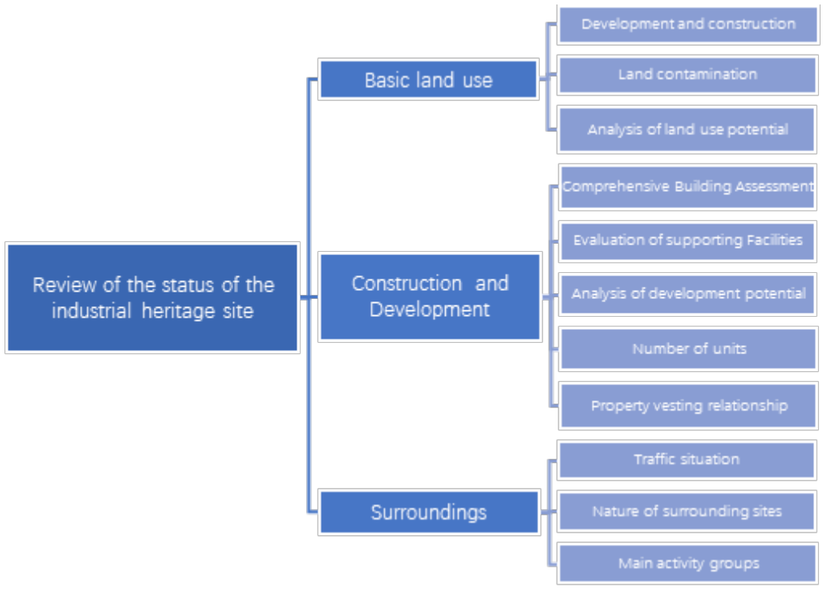

Chart 15

6.5.2 How to sustain the development and planning of old industrial sites

The second key is the sustainable development and planning of old industrial sites in the context of adapt reuse.

In the context of urban regeneration, economy and development are important reasons that influence reuse. In the process of renovation, the different interests and needs of the various subjects are the focal cause of conflicting interests. Therefore it is best to take the government planning department as the main body, listen to the suggestions of many parties based on the basic situation of the industrial heritage, delineate the scope of protection at different levels, put forward control requirements, ensure that the surrounding construction has a reasonable height and a harmonious environmental atmosphere with the industrial heritage, and finally satisfy the interests of all parties. [13]

The chart shows the current industrial classification of Luoyang City. The classification incorporates the relevant laws and divides the scope of protection into three classes.

(1) The protection scope of national key cultural relics protection units.

(2) The scope of the building control area. including within 300 meters on both sides of the factory square; copper processing office building.

(3) Environmental coordination area. It includes the area in the planning area other than the protection scope of cultural relics protection units, construction control zones, green areas and water systems.

Such a division is reasonable for industrial areas, but in the process of protection, there are more factory areas, and such a division has some limitations for the overall protection value of the factory area.

13: Lu ShaoMing. On THE PROTECTION AND UTILIZATION OF URBAN INDUSTRIAL HERITAGE [J]. Planner,2006,10

Image : 115 Hierarchy of Industrial Reserves in Luoyang

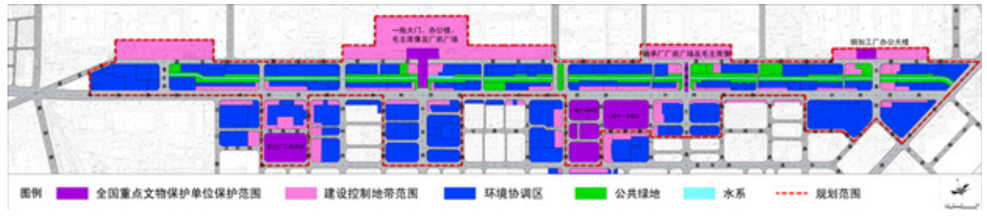

Image : 115

6.5 Suggestions for improvement of the actory problems

The proposal is for the overall protection of the specific factory area, and according to the industrial heritage to be protected, three levels are set to divide the core protection zone, the construction control zone and the style coordination zone. [14]

The core protection zone refers to the scope of the industrial heritage itself which is classified as a heritage protection unit. In accordance with the requirements of the corresponding heritage protection law, all the buildings themselves and the landscape environment shall be protected, and the original appearance and environment shall not be changed at will. If necessary reinforcement, repair, should be under the guidance of experts in accordance with the original restoration. Buildings and other structures in the area that affect the original appearance of cultural relics should be removed.

The construction control area is the surrounding area that must be controlled to protect the integrity and safety of the industrial heritage itself, i.e., in the core Outside the scope of the protection zone, depending on the current situation of the buildings and the layout of the surrounding land, a protection zone is set up. In turn, the environment around the industrial heritage is controlled to ensure that the surrounding construction activities do not interfere with it, and the height, volume, form and color of the buildings are generally controlled.

The coordination zone of landscape is for the industrial heritage with important value and large area, and then delineate the boundary at the periphery of its construction control zone, and put forward the protection control requirements for the environment in the zone, so as to ensure the reasonable transition between the old and new architectural space and landscape.

14: Peng Fang, Research on Legislative Protection of Industrial Heritage in our Country [D], Wuhan University of Technology, 2009

chart 16 : Status assessment model

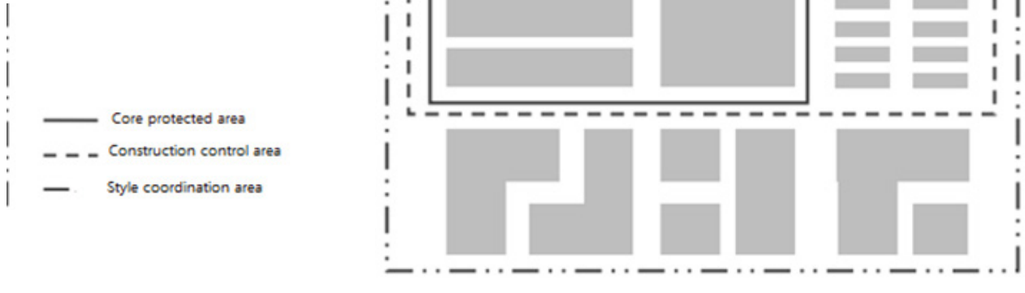

Chart 16

7.4.3 How industrial areas fit into urban development

In my view, the third key to exploring the relationship between adapt reuse and industrial heritage is to look at how industrial areas can be integrated into the development of the city from an economic perspective and become new functional spaces for the city. [15]

The city centre area.
This industrial heritage site is located in the city centre of Luoyang and therefore has to be considered in terms of pedestrian flow and traffic. It is recommended that the large factory buildings be reused as museums and exhibitions. Small or medium-sized factories are recommended to be reused for integrated property development, such as restaurants and entertainment facilities. In addition to this, it is recommended that the parts of the site close to the community be reused as a public space to cater for the daily activities of the surrounding community.

Waterfront Industrial Area
In the vicinity of the waterfront area, consideration is given to the relationship with the water when zoning is guided. As far as possible, waterfront trails should be designed using existing industrial buildings and facilities. Provide places for public activities, such as art galleries and museums. Secondly, areas close to the hinterland and far from the waterfront should be enriched with functional types of industrial heritage to harmonise with the overall function of the area and to create a vibrant area.

15: Wang Fang, LIU Lu. Discussion on the Design Idea of Experiential Tourism Development of Industrial Heritage [J]. Huazhong Architecture,2019,03

Chart 117

Aerial view

Chart 118

Conclusion

7.1 Literature research

In the theoretical part (Chapters 2 and 3), current industrial issues and theories related to adaptive reuse are investigated. Chapter 2 focuses on the current urban issues and theories related to industrial heritage.

Chapter 2 focuses on the current urban issues and theories related to industrial heritage.
The basic theories of industrial heritage are discussed from different dimensions, specifically including its basic connotation and characteristics, development, the evolution of industrial heritage in China, the driving force of conservation and utilization, stakeholders, and the value of conservation.

1. Industrial heritage conservation is influenced by its own material renewal and deep-seated functional activation, conservation in the context of urban renewal, sustainable urban development, cultural industry development, industrial culture inheritance, and industrial design heritage conservation, and has a strong demand for conservation and utilization. The preservation and utilization of industrial heritage areas with strong local characteristics and cultural values can make them distinctive from other cities.
2. As historical and cultural heritage, industrial heritage is also a public resource, and involves a wide range of interest groups. In practice, different stakeholders have different interests and demands and influence the final decision making and execution according to their own interests and demands. It is necessary to accurately grasp the demands of different stakeholders, bring together the forces of all parties in the most effective way, and give full play to their influence to jointly achieve the goal of urban cultural heritage protection and reuse.
3. In dealing with specific industrial heritage projects, it is important to consciously analyze clearly which part of the heritage needs to be protected and which part needs to be reused, and to find a balance between the two, taking into account the dual goals of heritage protection and reuse.

Chapter 3 firstly discusses the concept and evolution of adaptive reuse. Due to different national conditions, different levels of economic development and different cultural backgrounds, there are considerable differences and gaps in the ideology, policy regulation, technical means, financial resources and other specific implementation aspects of adaptive reuse of old industrial buildings in China compared with Western countries.
Therefore, we continue to analyze the mechanism of adaptive reuse in China, conservation policies as well as the content of conservation policies and conservation institutions. The dilemma faced by adaptive reuse is analyzed and studied.

Finally, we analyze and study the successful experiences and lessons of the four countries' architectural renovation and reuse, as well as the reuse models, and summarize the corresponding characteristics and development trends of the renovation of old industrial buildings to illustrate their successes in the conservation and reuse of industrial architectural heritage.
It is hoped that this will serve as a reference for the future practice of industrial heritage conservation and reuse.

In the fourth chapter of theoretical research, I put forward my personal insights
Combining the current problems of China's industrial heritage, we propose a system for evaluating the conservation value of modern industrial heritage and summarize feasible countermeasures for conservation and reuse, and the main research results are as follows.

(1) Six conservation principles of industrial heritage in Luoyang are proposed, including the principles of wholeness, historicity, flexibility and diversity, sustainable use, economy and feasibility. In view of the current problems in Luoyang, such as the poor effect of conservation work in the reuse of industrial heritage, I believe that the most important thing is the relevant participating subjects after analyzing the urban planning, local policies and governmental action efforts. Then, I divided the relevant industrial heritage conservation and reuse subjects into five parts, and studied and analyzed them, so as to improve the effect of conservation work in China's industrial heritage reuse from the interests of each subject and their own advantages.
Through the analysis of China's national conditions, the cooperation among the subjects is divided into four parts, namely, the decision-making part, the conservation part, and the monitoring part. In this paper, I put forward my ideas and opinions on how to improve these four parts respectively. In addition, I also analyze how to adjust the relationship between the participating parties.
It is hoped that by coordinating the interest needs of multiple participants and seeking the form of collaboration and profit model of participation, the benefits of adaptive transformation can be maximized in the context of urban renewal.

(2) It is proposed that the renewal objectives of heritage conservation in the post-epidemic era must pay more attention to the integration with sustainable urban development strategies. By combining sustainable development theories, we discuss industrial heritage values from four perspectives: ecological, economic, cultural, and social, and thus build a conservation hierarchy and gradient conservation method suitable for Luoyang's industrial heritage.

(3) To propose targeted recommendations in the context of the Luoyang copper processing plant case. In my opinion, the exploration of industrial heritage and adaptive reuse needs to revolve around three key issues: 1. how to archive the heritage rationally, 2. how to sustain the development and planning of old industrial plants, and 3. how to integrate the industrial areas into the development of the city. through the article, the Luoyang factory is used as an example to score its value, determine the conservation level, and analyze its transformation according to the proposed conservation principles and strategies. We use this case to verify the feasibility of the author's principles and strategies for the conservation of Luoyang's industrial heritage.

China's industrial heritage has a large number of types, and at the same time in China, as a mature industrial heritage assessment and recognition system and protection regulations have not yet been formed, the protection policy needs a certain degree of improvement, which is recommended as follows.

(1) Establish the correct concept of industrial heritage protection. The correct conservation concept of industrial heritage should include two: firstly, to solve social problems first and adhere to the priority of public interest; secondly, to implement the concept of sustainable development and achieve a virtuous cycle.

(2) Diversify and equalize the protection subjects. Change the current situation of government-led, "one voice", pursue the "PPP" (publicprivate partnerships) model, promote the coo-

peration between the public sector (government) and the private sector, and put government organizations, profit-making enterprises, non-profit organizations and other stakeholders on an equal footing. The public-private partnership model promotes cooperation between the public sector (government) and the private sector, placing government organizations, for-profit companies, non-profit organizations, and other stakeholders on an equal footing to form decision-making groups for specific T-industry heritage projects.

(3) Set up a dedicated management organization and rationalize the management system. The current multi-headed management is less efficient, and problems arise when they are mutually read, it is suggested that the industrial heritage management team can be set up within the Cultural Heritage Bureau, specializing in the census, identification, quality identification, protection and development and reuse of industrial heritage.

(4) expand funding channels, rich sources of funding. In the Bureau of cultural relics on the basis of special allocations can be moderate use of tax regulation, land revenue rights and other policy tools to improve the enthusiasm of enterprises to protect, to attract more social capital into the T industrial heritage; the establishment of industrial heritage fund, a wide range of private capital interested in industrial heritage protection; contract transfer, the use of corporate funds for the development and reuse of industrial heritage, while implementing the At the same time, we will implement the principle of "who uses, who protects" and supervise the reuse situation of enterprises.

(5) Increase propaganda, guide the society to correctly understand industrial heritage. Industrial heritage is synonymous with social backwardness in the eyes of those who pursue economic benefits. The historical value, social value, art and craft value and economic value of industrial heritage should be actively promoted to raise the public awareness of industrial heritage protection.

Industrial heritage in Chinese cities often coexists with other cultural and historical heritage in the city. Due to the general lack of awareness of industrial heritage preservation from the government to democracy, many industrial heritages are not given due attention in the process of urban renewal and gradually disappear. Meanwhile the situation of that in is not very optimistic.

By compiling cases, the author learns the ways of conservation and reuse and explores the strategies of reuse.

By analyzing and studying the above four cases of Shanghai Oil Can Art, Zhongshan Boda Bund Sales Center, Rotermann Grain Elevator and The Silo, the design concept and functional reset are analyzed so as to get the reset method of each case and learn the lessons from them. It can be found that the designers did their best to preserve the structure and texture of the factory when renovating the old industrial buildings, and then realized the new functions by resetting the interior spaces. Each building's functional transformation is based on the original structure of the building, and then the spatial planning is carried out through different design methods.

Through the analysis, it can be seen that the unused industrial space that has lost its original function needs to be better integrated with modern life through the implantation of various modern functions, and to be developed and used in a scientific and orderly manner from the specificity of its own condition and objective environment, so as to ensure the continuation of the city's historical heritage while ensuring that the historical buildings can play a new social function in the context of urban renewal, and also to improve the urban The industrial function groups in the city can also be improved.

7.3 Proposal conclusion

With the rapid development of China's economy and times, urbanization has intensified and some industrial relics have been abandoned or turned into wastelands. This situation not only causes urban pollution, but also hinders the progress of urban civilization. Industrial plants are part of the city and have a great influence on the development of the city. If we want to fully revitalize the old plants, we must put the plants into the development of the city and coordinate with the development of the city organically.

The Luoyang Copper Processing Plant is a plant that is still in use, with complete protection, and is currently intended to be relocated as a whole in five years. The plant in the center of the city will be abandoned soon. Therefore, based on the theory and methodology of the study, the authors propose a proposal that aims to provide potential solutions for the city of Luoyang to solve its current urban problems.

A conceptual planning and renovation design was made by using the old factory area of the copper processing plant in Luoyang City as an example. Based on the theoretical research related to the renewal of industrial abandoned sites and the adaptive reuse of industrial heritage conservation, combined with field research, a conceptual transformation design of the old factory area of the copper processing plant in Luoyang City is made.

In the early stage of the case design, the work needed to be done is to conduct basic research on the site, including the site's traffic and roads, hydro-meteorology, soil and vegetation, the current situation of the factory, and other content, and collected image data. After analyzing the site, we decided to protect the valuable buildings and demolish the non-valuable buildings, and designed the renovation of the old copper processing plant from several aspects, such as planning, architecture, landscape and roads.
Reviewing the renewal study of Luo Tong factory, we can find that the renewal of industrial heritage should be based on the preservation of history and culture, in order to break the closed restrictions of the factory and activate the factory life. By integrating and shaping the spatial elements around the factory, the historical pattern of the factory and its surroundings, the landscape of the factory, and the distribution of the spatial elements of the factory as a strategy for organic renewal, we can finally realize the preservation and activation of the industrial heritage value.
We should use the concept of sustainable development as the driving idea of industrial site protection and reuse, not only to protect industrial buildings, but also to protect the surrounding ecological environment; the protection and reuse of industrial buildings should not be limited to buildings with specific values, but should start from the overall environment, and industrial buildings with good elastic space should also be used.

In the building, the function is reset, not only to restore the outer skin of the building and replace the internal space, but also to adopt the method of spatial reconstruction, to divide, disperse and reorganize the space, to plan the interior area, to make the single space into a functionally rich integrated space, and to pay attention to improving the surrounding environment while transforming the function of the building.
Finally, the design with industrial sites must be linked to the social context of the city, as well as its history, culture and social needs, and cannot exist in isolation. The functional needs of various user groups should be studied and merged in order to better establish new functions and bring more fresh vitality and economic value to the area.
I hope to draw attention to industrial heritage sites and to provide new perspectives and directions for future industrial heritage site design. In the post-epidemic era, human beings are facing more challenges and opportunities, and it is important to clarify the right direction for the preservation, renewal and

regeneration of industrial heritage, so as to create more design achievements in line with China's national conditions.

Finally, i wish that these suggestions can be applied to the conservation of Luoyang's industrial heritage, thus promoting the sustainable development of Luoyang as an industrial city. Due to the limited knowledge of the author, there are some mistakes and errors in the paper, so we welcome scholars to correct me.

7.4 Research Shortcomings and Prospects

7.4.1 Research shortcomings

Due to the broad scope of the dissertation, the research work mainly relies on literature reading and sorting, which is affected by time and personal factors, and lacks in depth in the research. The presentation of cases is often not in-depth and detailed due to the lack of fieldwork and perceptual understanding. Due to the epidemic, we may not be able to conduct in-depth research on the site, and we need to conduct more in-depth research. At the same time, the understanding of industrial sites may not be too deep, and a lot of content needs to be further studied.

Because of the time and the limitation of my own level, both the theoretical research and the design of the reuse of the factory in Luoyang City lack depth and there are many imperfections in the scope of this paper. In my future study and work, I will make further efforts to continue the in-depth research on these topics.

7.4.2 Suggestions for future directions

1. Pay further attention to the practice of renovation of old industrial plants in western developed countries, discover new models and grasp new trends. To explore the strategies and development modes of old industrial plants transformation suitable for China's national conditions. We will study the transformation of old industrial plants in resource-based cities from the perspective of the urban planning profession by combining the policy research on the transformation of old industrial plants. The transformation of old industrial plants in cities is a phenomenon and a dynamic process. How to choose the suitable development strategy and adopt the correct means, it is necessary to strengthen theoretical research, establish relevant institutions, increase the exchange of disciplines, and participate in relevant practices, so as to realize the sustainable transformation of old industrial factory space.

2 Based on the ecological restoration, the project will be developed according to the local conditions, and the abandoned factory area will eventually become a place of leisure and creative production for citizens. On the basis of the overall grasp of the project, the renovation design is proposed. This is a practical application of the author's theories summarized above.

3. The depth of the research is limited by personal subjective factors, transportation, time, etc., and may be one-sided. Therefore, it is necessary to further strengthen the field investigation, enhance the relevant practice and further strengthen the scientific research ability in the future research. The spatial transformation of old industrial buildings can be further studied from the following aspects: the development of old industrial areas at home and abroad, in order to have a macro-level analysis and consideration of the dynamics of the spatial transformation of old buildings, and the ways of renewal.

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