Urbanized Strategy of Factory Buildings Renovation——Conservation and Reuse of Fiat Mirafiori

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by

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Abstract

Under the background of Industry 4.0, the transformation and upgrading of industrial heritage is an important embodiment of responding to the national "Made in China 2025" strategy. This study has made a tentative response to how to adapt to and stimulate the urbanization sustainable renovation and renewal of industrial heritage of giant buildings in cities, focusing on the thinking in the field of architecture and exploring operable renovation and renewal strategies.

Compared with historic or non-historic old buildings, old industrial buildings mainly have the following characteristics: unique design concept, high aesthetic value, strong main structure, wide space and large volume, which will be detrimental to the environment, etc., and then it is an important building type for the reuse of old buildings. Therefore, from this perspective, it is of vital practical significance to deeply analyze the ways and methods of reuse.

In this study, aiming at the traditional building type of huge old factory building in the current urban construction and development process, the development history, theoretical achievements and implementation strategies of the reuse of old industrial buildings are deeply explored and expounded, and the relevant practical cases in Italy are used for reference, so as to summarize the reuse strategies of foreign old industrial buildings, and analyze the operability and popularization of the reuse of old industrial buildings in the urban construction and development of our country.

Based on the actual operation of Fiat's old factory in Mirafiori, Turin Province, Italy, this paper explores the renewal and development strategy of factory industrial heritage aiming at "urbanization" along the renewal strategy of excavating resources-sorting out problems-proposing vision-planning strategy-point-by-point implementation.

Keywords: factory building; urbanize; conservation; reuse

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Chapter 1 Introduction

1.1 Background

The report of the 19th National Congress of the Communist Party of China pointed out that strengthening the protection and utilization of cultural relics and the protection and inheritance of cultural heritage should be regarded as a part of cultural self-confidence and determination. Focusing on the transformation and upgrading of the industrial heritage in the city is a manifestation of actively responding to the national "Made in China 2025" strategy.

In the context of Industry 4.0, the advancement of smart factories, network entity systems, the Internet of Things, self-organizing production models, and integration of production, education and research has enabled the transformation of industrial heritage to go beyond the traditional transformation to cultural and creative industrial parks in the same direction. Form a new industrial complex integrating urban space, basic services, office, research and development, light and heavy laboratories, and business incubation. At the same time, the transformation and upgrading of industrial heritage is an important manifestation of responding to the national "Made in China 2025" strategy. This research has made a tentative response to how to find a sustainable urbanization renovation and renewal that adapts to and stimulates the industrial heritage of huge factory buildings in the city. It focuses on the thinking in the field of architecture and explores feasible renewal strategies. Compared with historical or non-historical old buildings, old industrial buildings mainly have the following characteristics: unique design concept, high aesthetic value, strong main structure of the building, wide space and large volume, whether it is demolished or rebuilt , Will not be conducive to the environment, etc., and then it is an important building type for the reuse of old buildings. Therefore, from this perspective, it is of vital practical significance to deeply analyze its reuse methods and methods.

As an important industrial town in Italy, Turin has a large number of successful cases of transformation and reuse of outstanding industrial remains. In fact, the existence of industrial heritage in contemporary society is not only a spatial structure and material form, but also a local lifestyle and tradition. It is a product of getting along

with urban life in the industrial age. In the new era, how to meet the development trend of the times, while promoting the modernization of the city, formulate a feasible plan to continue and preserve the cultural connotation of the industrial heritage, so that it can better promote the development of urban construction. The main content.

1.1.1 The value and challenge of industrial heritage transformation in urban renewal

First of all, the industrial heritage has a certain aesthetic value. The industrial revolution can be said to have opened up the civilization of modern industrial society, and industrial buildings can be said to be an effective carrier for industrial production activities at that time, and can significantly demonstrate the connotation of industrial civilization. Replacing the aesthetic laws of classical architecture with the beauty of machines greatly enriched the practical connotation of architects. Some scholars even regard the power plant as a cathedral in the twentieth century. Such industrial buildings can be said to be a profound manifestation of modern language and the spirit of the times. And social production increasingly depends on the machine's production speed and efficiency, practicability, and orderliness. These characteristics are beautiful in themselves.

Secondly, industrial heritage has historical and cultural value. Industrial architecture has gone through more than 150 years of development, and it has been truly raised from architecture to the height of aesthetics, making architectural art, engineering, and industrial production more perfectly integrated. Many outstanding and historically significant modern industrial buildings have been included in the heritage lists of the world and countries.

At the same time, the transformation and reuse of the industrial architectural heritage in the city still faces many challenges. The special attributes of industrial buildings often occupies a relatively large area, which splits the city. Can the industrial heritage be subdivided and reorganized into the city while preserving the collective memory of the city, and given effective project planning, while participating in the economic life of the city? Many issues such as these pose challenges for architects.

1.1.2 Reuse of industrial heritage under the background of Industry 4.0

The concept of "Industry 4.0" was first proposed at the Hannover Messe in 2013. According to the current consensus, "Industry 4.0" is an intelligent era that promotes industrial transformation with information technology. It is proposed to improve Germany's industrial competitiveness. my country’s "Made in China 2025" coincides with it, and has a long history of cooperation and docking.

In the "Industrial 4.0 Era" based on the Internet of Things and artificial intelligence, the global economic and industrial structure has undergone disruptive changes, while traditional industries are gradually declining. Industrial buildings that have long used "production materials" as their specific identity have realized their identity and functions. The double upgrade of the building not only has significant social and cultural value, but also has profound artistic and historical connotation value. By virtue of the effective protection, utilization and transformation of old industrial buildings, it can ensure its greater function.

1.1.3 The typicality of giant factory buildings as research objects

The key research object in this article-the Mirafiori plant of Fiat Chrysler in Turin, is extremely representative. The renewal and transformation design of the single-story, continuous multi-span giant factory building meets the domestic demand for major industrial development and transformation from the founding of the People’s Republic of China in the last century to the 21st century. Countless domestic industrial remains with similar structures can be used as a reference.

1.2 Topic selection and research object

1.2.1 Source of topic

The research of this project is a self-selected research design task under the real background, and the renewal plan led by the Fiat Mirafiori factory as the Party A.

1.2.2 Research object and scope

The project is located in the urban area of Turin, Turin Province, Piedmont, Italy. The design scope includes part of the discontinued and abandoned part of the original factory, involving a scale of 49,800 square meters. This study will select a typical

single-storey multi-span factory building in an abandoned factory. Focus on architectural design research, with an area of 12,000 square meters for the key design part.

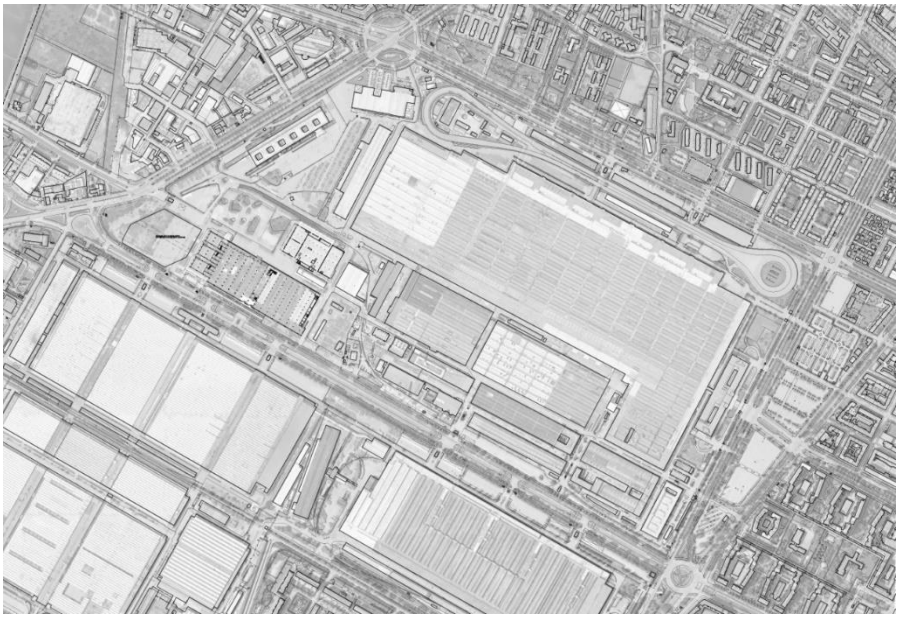


图1.1 米拉费尤里工厂工业集合

图片来源：笔者自绘

图1.2 设计地段范围

图片来源：笔者自绘

1.3 Related research review

By consulting relevant information, it can be learned that the history of the protection of cultural relics in Italy can be traced back to the Renaissance in the 15th century, when the emphasis was on the restoration and protection of ancient Roman buildings. In 1872, Italy's first cultural heritage building protection law was officially issued and implemented, and the protection and restoration of architectural heritage was officially included in the national management system. In 1932, on the basis of the "Athens Charter", the government issued the document "Restoration Standards for Cultural Relics". In the same year, the "Rome Charter" was formally published and became the guiding international norm for the restoration of ancient buildings. In 1956, the headquarters of the Center for the Protection and Restoration of Cultural Relics (ICCROM) was officially established in Rome, and Italy established a leading position in the field of architectural protection and restoration. In 1964, the famous "Venice Charter" was passed at the Second Congress of Architects and Technicians of Historic Buildings. The charter stated exactly: "It aims to inherit the authenticity of cultural relics as well as possible." However, the protection of Italy at that time The focus is on "restoration of cultural relics", and no policy for the protection of old industrial buildings has been proposed. Until 1982, the "Florence Charter" proposed the preservation and maintenance of the overall environment of the natural landscape. At this time, the urban renewal theory has undergone a subversive change, and the scope of protection has also been expanded a lot, from the previous single building to the building complex. , Urban landscape, and architectural environment, and launched the urban core revitalization movement focusing on the reuse of buildings. In this context, the protection of old Italian industrial buildings has received unprecedented attention.

Originally as a branch of archaeology, Michael Rix of the University of Birmingham in the United Kingdom first mentioned the term "industrial archaeology" in 1955 "Industrial Archaeology", aiming to strengthen the in-depth exploration of the existing industrial relics, monuments and machinery in the UK And protection. On this basis, more scholars have carried out research on the protection and utilization of industrial buildings, involving the protection, management and reuse of industrial heritage. In 1963, British Kenneth Hudson put forward the theory of industrial archaeology in the book "Introduction to Industrial Archaeology", discussed and divided the time definition and research field of industrial heritage, and discussed its

research methods. In 1973, the United Kingdom established the Industrial Archaeology Association (AIA). In 1974, R Angus Buchanan, director of the Research Center for the History of Technology at the University of Bath, published "British Industrial Archaeology". The Netherlands established the Federation of Dutch Industrial Heritage (FIEN) in 1984. The Italian Federation of Industrial Archaeology and Heritage (AIPAI) was established in 1997.

At the Industrial Heritage Conference held in Russia in 2003, the "Nizhny Tagil Charter on Industrial Heritage" was unanimously approved, and the most authoritative interpretation of the concept of industrial heritage: "Specially built for the development of industrial activities Buildings, technical methods, and tools, including historical, technical, social, and scientific values, including industrial cultural heritage. The specific manifestations are industrial buildings, old machinery, refining and processing plants, warehouses, energy generation, transformation and utilization areas, And industrial-related social activity sites." In this context, the protection and utilization of industrial heritage is actively carried out all over the world.

Italian scholars Augusto Ciuffetti and Roberto Parisi renewed the study of Italian industrial society in the book L'ARCHEOLOGIA INDUSTRIALE IN ITALIA, Storie e storiografia 1978-2008 (Italian Industrial Archaeology: Stories and History (1978-2008)). Starting from its physical remains, the epistemological positioning of industrial archeology was re-proposed.

Professors Ronchetta C. and Trisciuoglio M. of the Politecnico di Torino draw on the teaching experience of master students in the book Progettare per il patrimonio industriale (Industrial Heritage Design), which provides an effective reference for dealing with industrial heritage design issues for further research and operation. , And aims to arouse interest in architectural projects related to industrial heritage.

For the study of the location, the book Maie Technimont FIAT engineering projects detailed the whole construction process of the Mirafiori factory as an excellent example of the Italian machinery industry. Colombo and Martina discussed various issues that are conducive to the restoration of abandoned industrial buildings in the article Riutilizzare gli edifici industriali dismessi: residenze universitarie a Mirafiori Sud (reuse of abandoned industrial buildings: Mirafiori Sud's university dormitory), such as the urgent need to limit land consumption , The importance of increasing population density and protecting people's collective memory and historical status

symbols.

In China, due to the gradual improvement of the concept of industrial heritage protection, industrial heritage has begun to be included in the scope of cultural relic protection. In the 1990s, domestic scholars made a value analysis of industrial heritage and achieved certain research results. In 2006, a seminar with the theme of "Focusing on Industrial Heritage" was held in Wuxi, and the first domestic document on the protection of industrial heritage, the "Wuxi Proposal", was unanimously approved. After that, a series of documents were issued one after another. In this context, domestic industrial heritage renovation projects have increased significantly. Domestic research works have been published successively, such as Wang Jianguo's "Post-Industrial Era Industrial Building Heritage Protection and Renewal", Liu Boying published "Urban Industrial Land Renewal and Industrial Heritage Protection" and so on. Domestic scholars' analysis of typical foreign cases include: Wu Weijia's analysis of the problems and remedial measures in the framework of the Emscher Park International Architecture Exhibition in Ruhr, Germany to promote regional renewal; Zhang Jie analyzed three aspects of policy, planning, and development. The transformation process of London Docklands; Zhang Xianfeng and Zhang Yunfeng's research on the "mixed use" mode in the urban renewal of Brindley in Birmingham. Liu Jian's systematic introduction to Vancouver's Granville Island renovation and renewal practice.

In addition, a large number of theoretical studies and practical results on the regeneration of old industrial areas from the perspective of urban renewal have emerged in China in the past few years.

1.4 Research content and objectives

1.4.1 Definition of "Industrial Heritage"

Industrial heritage is an important part of the world's cultural heritage, and it has received extensive attention from academia in the past ten years. Its precise definition has been clearly defined in the Nizhny Tagil Charter. Industrial heritage in a broad sense includes various ancient sites before the Industrial Revolution, such as water conservancy projects and mining and metallurgical sites. In a narrow sense, the industrial heritage is derived from the remnants of the industrial revolution in Britain in the 18th century that used steel, coal, and petroleum as raw materials and mainly

operated by machines.

Since the official convening of the Wuxi Conference in 2008 and the official establishment of the "Industrial Architectural Heritage Academic Committee of the Architectural Society of China" in 2011, this fully reflects the increasing importance of the Chinese industry in this field. And the focus of the research is mainly on the economic, technological, cultural, social, and historical values of industrial heritage. However, this research suggests that "urban value" is also an important connotation of industrial heritage. It represents a representative defining function for urban areas, and is a collection of buildings with many special features and production functions. Its value is not only reflected in the form of industrial buildings, but also an important component of urban space resources, which can greatly affect Optimization and development of urban space. With the current intensification of urban development, urban spatial resources have been transformed from "incremental planning" to "stock planning", with more emphasis on the value of industrial heritage, which not only effectively protects the industrial heritage, but also achieves In order to effectively improve the utilization efficiency of urban space.

1.4.2 research content

The research object is the production workshop of Fiat's Mirafiori plant in Turin. The workshop is a single-story continuous multi-span roof truss steel structure, which is highly adaptable. Because the production process uses a horizontal layout and accommodates heavy equipment.

The renovation and renewal design project was launched one year ago. Previously, there have been research and integration projects to study and analyze the Mirafiori plant from the planning level. A preliminary answer was made to how the Mirafiori plant, a site lacking in infrastructure services and with a single building form and function, can be effectively transformed and developed. This research will be based on this, focusing on representative architectural parts, further sorting out the problems existing in the Mirafiori factory, and responding to the problems of the site itself and surrounding areas, and trying to deal with the problems of Mirafiori. Mirafiori put forward a general idea for the transformation and renewal of the industrial heritage represented by him.

In addition to the analysis of the characteristics of the Mirafiori factory itself,

another key point of the research is the "Industry 4.0" with the smart factory as the core, how it can be more rationally applied in the renewal of industrial heritage, and how to industrialize it The construction technology is connected with the characteristics of the local climate, culture, society, etc., which are also the focus of research.

1.4.3 Research objectives

This research is carried out vertically with the design project as the guide. Through combing the whole work process, it summarizes the core concerns and innovation points of the project; by combining relevant domestic and foreign research and cases, it tries to extract a contemporary urban industrial heritage transformation and renewal model. . At the same time, taking the renewal project of the Mirafiori plant as the main practical basis, it explains how the previously extracted renewal model can be applied to the project in the specific rebuilding process.

In January 2015, the State Council definitely proposed: “Reinvigorate the vitality of resources such as idle factories to promote the development of creative industries”, which creates a good environment for tapping the value of my country’s old industrial buildings. I hope Mirafiori in this study Factory transformation can explore new possibilities for us.

1.5 Research methods and framework

1.5.1 research method

There are mainly the following research methods: literature research, field research, design example elaboration and analysis and comparison research.

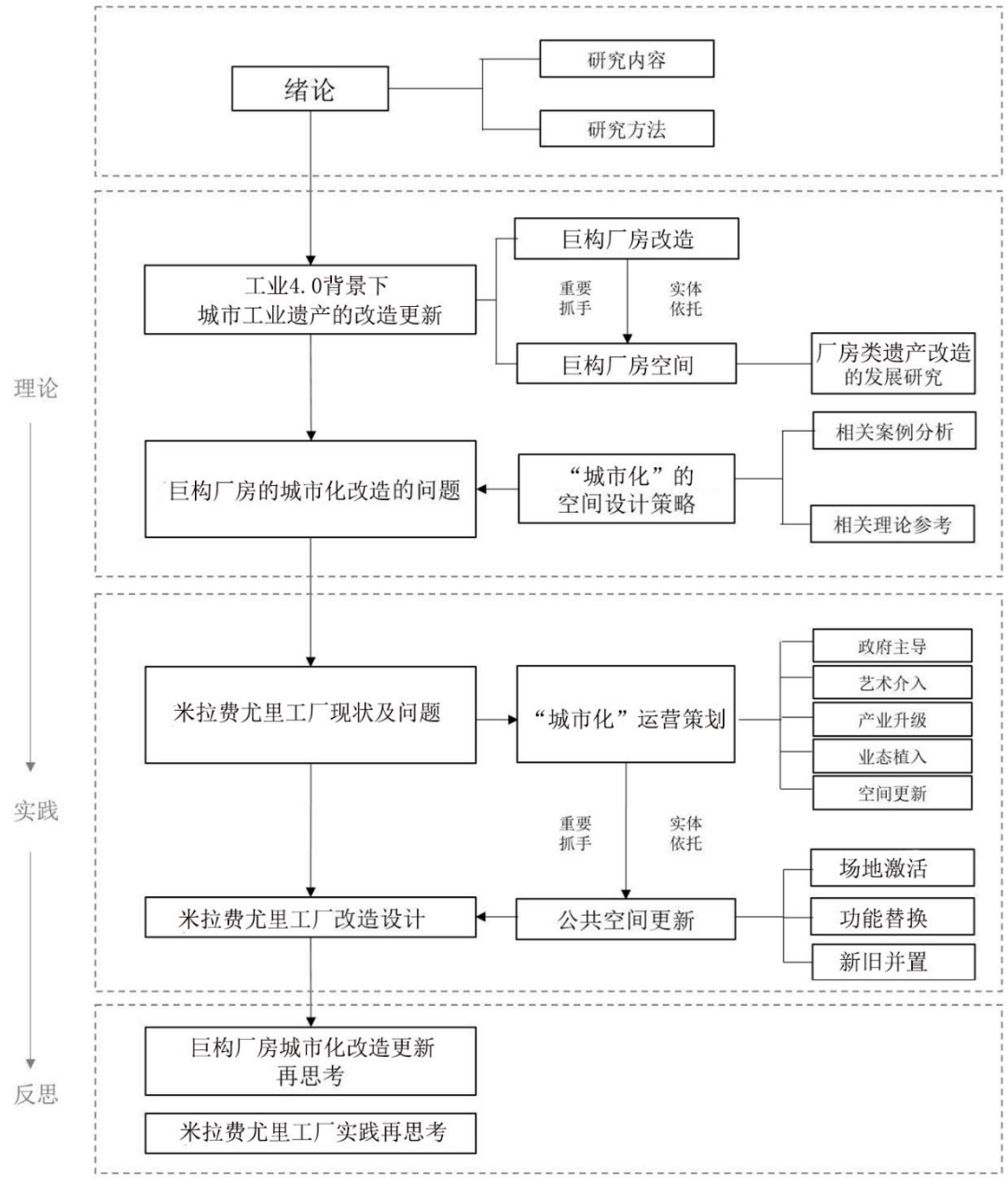
Relying on libraries, online access, and periodicals and magazines, etc., collect and sort out the literature in this area. The data collected must be comprehensive and extensive, not only including the transformation and renewal of industrial architectural heritage, but also a wider range of urban renewal theories, architectural heritage, and research on cultural relics protection in a broad sense. The purpose is to understand the various social and academic backgrounds related to the project design. Through the collection and research of relevant domestic and foreign documents, clarify the development process of industrial heritage renovation and renewal theory, compare the strategies adopted with the logic behind it, compare various attitudes and methods, and

clarify the project's research on renovation. Position, critically build your own attitude and understanding.

Before writing the thesis, the author collected and sorted out information about the current situation of the Mirafiori factory by participating in field surveys. This information includes the geographical and cultural information of the lot, and the surveying and mapping of detailed nodes. In addition, I also listened to the thoughts and demands of the person in charge of the factory, which will help the research of this topic.

In the process of writing the thesis, in addition to paying attention to the practice of the project itself, at the same time, it is possible to actively compare and analyze with other thoughts and theories, so as to better provide guiding opinions on the renovation and renewal of the Mirafiori factory, and then seek Mira The proper way to renovate and renew the Mirafiori factory.

1.5.2 Research Framework



Chapter 2 Research Summary and Case Studies of Italian and International Industrial Heritage

2.1 Development status and strategy of international industrial heritage protection

As developed countries in Europe and the United States enter the post-industrial era, industrial civilization is gradually declining due to many factors such as economic and technological globalization, energy structure transformation, industrial structure upgrading and transformation, and the growing popularity of sustainable environmental concepts. The industrial land and industrial landscape that were once deeply rooted in the material and spiritual life of human beings have evolved from industrial production carriers to abandoned relics, and faded from people's sight during the urban renewal movement. The protection of these industrial heritages, which have witnessed the evolution and change of industrial civilization, has been widely recognized by scholars, social groups and the international community as an important part of human cultural heritage, protected and adaptively reused.

Industrial heritage, to a certain extent, can be regarded as a typical representative of the land used by various functional groups in the city, not only covering industrial production land, but also involving cultural heritage land. And in the process of function replacement, the boundary space of land use is a medium and dialogue platform for "heritage land" and "non-heritage land". "Modern Factory Building Space and Environmental Design" (1989) has the following questions about the boundaries of industrial factory areas: "If every factory occupies an area for camping, builds a high courtyard wall, and separates its borders, what kind of situation will it look like? The scene?" The industrial building itself is tall and bulky, and the fence with barbed wire directly faces the citizens in an imposing manner, which can be regarded as a destruction of the urban environment and a demonstration to the residents. It can be seen that dealing with boundary issues, attaching importance to the exchange and dialogue of the space environment inside and outside the factory, and integrating the industrial factory into the urban environment are the problems faced at the beginning of

the urbanization strategy.

2.1.1 International Charter and Standards

The development and reuse of industrial heritage is carried out in the continuous improvement of the awareness of the protection of the industrial heritage of old buildings. Before the 1960s, such as the Athens Charter in 1933 and the Venice Charter in 1964, the analysis of the importance of historical buildings to mankind and the world's cultural heritage, as well as the preservation of values of historical buildings, was involved. Has begun to derive. People set definitions and standards to determine which historical buildings have value, and the principle of historical authenticity of building protection is thus put forward. However, in the historical period at that time, the architectural practice activities were often new-style buildings, and there was not much research in the field of architectural heritage reuse.

Since the 1960s, European and American countries with more developed industrial development, under the influence of many factors such as energy, environmental awareness, and humanistic thinking, have begun to pay attention to the protection and transformation of industrial heritage and the reuse of old industrial historical buildings. The subsequent impact Continue to increase. In 1965, American scholar Lawrence Holplin summarized the theory of architectural "recirculation" by virtue of long-term in-depth research. It transformed an Italian chocolate factory into a multifunctional shopping plaza covering shops and restaurants. The original brick-concrete structure was preserved and remodeled to provide new functions, while also retaining traditional landmarks. This project received a huge response. Not only that, there are also some practical activities, such as the transformation of an old factory into a music resort at the Maltings Concert Hall in Snape, England. These are excellent examples in the early stages of industrial heritage development and reuse.

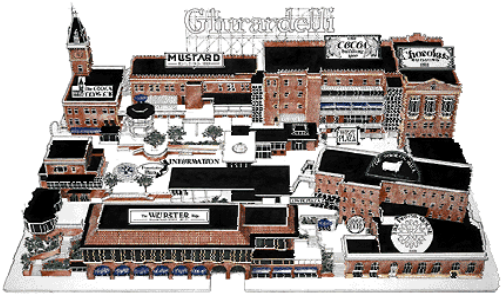


图2.1 吉拉德里广场鸟瞰

资料来源：ghirardellisp.com

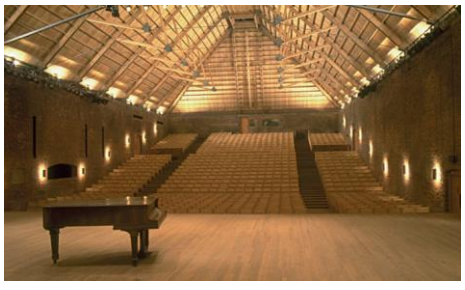


图2.2 Maltings音乐厅

资料来源： theguardian.com

From the mid-1970s to the late 1980s, the "Florence Charter" (1982) and the "Washington Charter" (1987) proposed the maintenance and protection of the overall environment of natural landscapes, emphasizing the protection of historic cities, ancient towns and neighborhoods . At the same time, it puts forward a pragmatic attitude and specific suggestions that need to consider the duality of preservation and sacrifice at the same time for historical preservation. By 1979, Australia formulated the "Barra Charter" based on the country's historical background and cultural conditions, which exactly gave the concept of "reconstructive reuse", which refers to the adjustment and transformation of a place to adapt and create New functions in order to preserve and replicate the importance of the site to the greatest extent, and to minimize and change the important structure, and this change can be restored. During this period, the concept of urban renewal has also undergone tremendous changes, and the urban center revitalization movement centered on the reuse of buildings has been widely carried out. For example, in Lowell Heritage State Park and Quincy Market in Boston, these renovations have pushed the reuse of old buildings to a new climax.

图2.3 洛厄尔国家遗产州立公园

资料来源：npplan.com

图2.4 昆西市场

资料来源： leisuregrouptravel.com

From the late 1980s to the present, driven by the trend of economic globalization, the crisis of cultural integration and convergence has become more and more obvious, and the principle of cultural diversity has been proposed accordingly. The development model of transformation, renewal and reuse of industrial heritage has also received unprecedented attention. The development of the city puts more emphasis on the symbiosis between people and the environment and the respect for people, history and culture. In the 1990s, the development and reuse of many large-scale industrial building collections highlighted their ability to promote urban regeneration. The transformation is not limited to the transformation of the building itself, but from the urban perspective, many single-function industrial buildings are changed to composite-function buildings.

For example, the Fiat Lingotto car factory (Fiat Lingotto) of 250,000 square meters in the province of Turin, Italy was reused as an exhibition center; the Carl Zeiss factory in Germany was transformed into a diversified university town and new urban center; Oberbau, Berlin Oberbaum City (Oberbaum City) became a 170,000 square meter city within a city. At the same time, in the large-scale popularization and diversified practice, the artistic methods of industrial heritage reuse are rapidly maturing. Many international architects, such as Frank O. Gehry, Renzo Piano, Norman Foster and Herzog & de Meron, are actively involved in the reuse of industrial architectural heritage, and have participated in many wealthy projects through various methods such as innovation, reconstruction and restoration. Innovative and ingenious architectural works.

图2.5 奥伯鲍姆城鸟瞰

图2.6 卡尔蔡司工厂鸟瞰

资料来源：*Architecture Reborn*

2.1.2 Practice of protection and reuse of foreign industrial heritage

Through (Table 2-1), we can further clearly see the popularization process of foreign industrial heritage reuse from sporadic development to large-scale development, and the types of buildings with rich and diverse uses after reuse.

图（2-1）20~21 世纪国外旧工业建筑及地段再利用部分实践年表。

年代	国家	建筑名称	原建造时间	再利用时间	原用途	新用途	再利用设计者
1939	美国	纽约世界博览会芬兰馆(Finnish Pavilion)		1939	仓库	博览会馆	阿尔瓦·阿尔托
1964	美国	旧金山吉拉德里广场(Ghirardelli Square)	19世纪中叶	1962~1964	巧克力厂、毛纺厂区	商业综合区	劳伦斯·哈普林
1966	德国	汉诺威历史博物馆(Museum of History in Hannover)	17世纪	1966	兵器库	博物馆	迪特·欧斯特伦
1967	英国	索福克郡斯内普麦芽音乐厅(Maltings Concert Hall)	1894~1896	1965~1967	厂房	音乐厅	阿鲁普事务所
1978	美国	波士顿昆西市场(Quincy Market)	1824~1826	1976~1978	码头仓库区	商业综合区	本杰明·汤普森事务所
80年代	美国	旧金山渔人码头(Fisherman's Wharf)		1960~80年代	码头仓库区	商业综合区	
1982	美国	洛威尔国家历史公园(Lowell Heritage state Park)	19世纪20年代	1982	纺织厂区	遗存公园	E.A.F事务所
1983	美国	鱼雷工厂艺术中心(Torpedo Factory Art Center)	1919~1920	1982~1983	军工厂	展览中心	凯斯·康登·弗洛兰斯事务所
1984	法国	巴黎舒卢姆伯格工厂(Schumberger Factory)	19世纪	1980~1984	机电设备厂	电子设备园区	伦佐·皮阿诺事务所
1985	英国	伦敦新肯迪亚码头(New Concordia Wharf)	19世纪	1981~1985	码头仓库区	公寓楼	PTE事务所
1986	美国	巴尔的摩廷戴克码头(Tindeco Wharf)	1914建成	1984~1986		商业综合区	CWB事务所
	西班牙	巴塞罗那拉·鲁纳中学		1984~1986	旧厂房	中学	埃瑞克·米拉尔莱斯事务所等
1988	日本	北海道函馆湾仓库区	1880~1910	1988完成	码头仓库区	商业综合区	冈田新一事务所
1991	美国	洛杉矶西塔德尔城堡	1929	1990~1991	轮胎橡胶工厂	零售业商场	纳德尔事务所等
	德国	亚琛路德维格国际艺术馆	1927~1928	1988~1991	造伞厂	艺术中心	爱拉事务所

1992	德国	汉堡媒体中心 (Media Center)	19 世纪末	1983~1992	造船厂区	商业、电影院等综合区	ME DI UM 事务所
1993	新加坡	克拉码头 (Klarke Quay)	1880~1930	1988~1993	码头货栈	商业综合区	
1994	美国	底特律霍普高级技术中心	30 年代	1994		办公楼	SHG 股份有限公司
1995	比利时	金马布劳克斯农艺学院礼堂	1762	1993~1995	谷仓	礼堂	塞米思和帕特纳斯事务所
1996	德国	耶拿卡尔·蔡司光学工厂(Carl Zeiss Factory)	1890 始建	1991~1996	光学原件生产厂	商业综合区	DEGW 事务所
	法国	诺宜斯尔雀巢法国总部 (Nestle Headquarters)	19 世纪中后期	1993~1996	巧克力厂	办公区	莱克恩和罗伯特事务所
1997	意大利	都灵林格图大厦(Fiat lingotto Factory)	1917~1920	1988~1997	汽车厂	会展中心	伦佐·皮阿诺事务所
	英国	切尔西拉蓝鸟汽车修理厂(Bluebird Garage)	1911~1923	1996~1997	汽车厂		康冉事务所
	德国	埃森德国设计中心(Germany Design Center)	1932	1994~1997	锅炉房	艺术中心	福斯特、帕特纳斯
1999	德国	卡尔斯鲁厄艺术及媒体技术中心(Karlsruhe Center for Art and Media Technolgy)	1915~1918	1993~1999	兵工厂	艺术中心	彼得·施威格尔事务所
2000	德国	柏林奥伯鲍姆城(Oberbaum City)	1906~1914	1993~2000	灯泡厂区	商业、办公综合区	多家事务所
	英国	伦敦泰特现代艺术画廊(Tate Gallery of Modern Art)	1947~1963	1994~2000	河岸电厂	博物馆	赫尔佐格和德·梅龙事务所
2004	英国	伦敦圆屋	1847	1998~2004	仓库	艺术中心	约翰·迈克阿斯兰及其合作者
	英国	伦敦巴特西发电站		2001~2004	发电站	商业中心	

2004	荷兰	西煤气厂文化公园	19 世纪	1997~2004	煤气厂	生态公园	Gustafson Porter 事务所
2006	澳大利亚	悉尼渥石湾码头区	1912~1921	1995~2006	码头仓库	酒店、公寓	安德鲁·安德森
2007	法国	法国第七大学教学楼	20 世纪	2001~2007	面粉厂	教学楼	Denis Honegger
		圣纳泽尔潜艇基地		2007	潜艇基地	会展中心	
2008	英国	纽斯卡尔奥斯本河谷保护区	17~20 世纪	2003~2008	复合工业区	商业、艺术	
2009	德国	汉堡港口新城		1997~2009	港口	居住、旅游、商业	
2010	德国	多特蒙德凤凰旧工业区	1841~1926	2000~2010	钢铁厂	新兴科技产业中心	
	英国	利物浦维拉尔水域		2009~	码头区	住宅、办公、教育	
2011	美国	纽约高线公园	1930~1970	2006~2011	铁路	空中花园	Diller-Scofidio+Renfro
	法国	南特岛复兴	19 世纪~1987	1987~2011	造船厂	全面复兴	
	瑞士	巴塞尔诺华园	19 世纪~1970	2001~2011	化工、制药厂	科技园区	诺华集团
2012	意大利	都灵多拉滑板公园	19 世纪~1980	2004~2012	钢铁厂	公园	Latz+Partner
2013	德国	柏林滕佩尔霍夫机场	1923~2008	2013~	机场	文化中心	

资料来源：部分资料来源于 历史性建筑再利用在 20 世纪的发展足迹. 时代建筑，2001(4)，P81；部分笔者搜集整理）

2.1.3 Basic design principles for reuse

In the development and reuse project of industrial heritage, there are many ways and methods. When studying the relationship between the basic condition of the old building and the new function, the following basic principles are generally followed to ensure the success of the development and reuse.

1. Matching principle

The matching principle refers to maintaining the characteristics of the old building, meeting the new requirements in terms of function, and striving to be reasonable in structure, economic feasibility and convenient maintenance, so that the building enters a new virtuous circle. It is mainly reflected in the relationship between the new function and the old form, and form follows function. Reuse faces the question of how the situation persists after the original function disappears or changes. To follow the matching principle, it is first necessary to study the relationship between the existing space and the original use and potential use at the form and function level, and analyze the possibility of area increase or decrease and the needs of the owner.

2. Principle of Comprehensive Benefit

In today's society, the inevitable problem in the reuse of buildings is economic benefits. The matching degree between the new function and the original building, the maintenance of the original building (commonly known as the "base"), the location in the city, and the economic background determine the benefits of "reuse". It is complex and uncertain. Strong.

Therefore, it is not comprehensive to evaluate the project simply from the economic benefits of the developer. It is also necessary to conduct a comprehensive benefit rating from the perspectives of society, economy, culture, environmental protection, etc., to ensure that the industrial heritage after reuse is not only possessed The economic vitality also possesses the vitality of citizens' lives.

3. Follow the principle

Following the principle means that in the process of designing the plan, please respect the history of the old building and follow its historical architectural logic, while tapping the potential of the space. For old buildings with high historical and artistic value, attention must be paid to the preservation and protection of their facades and surrounding environment; for general old buildings, the original construction logic, volume and spatial structure characteristics, construction technology, etc. should be

followed. Try to adapt it to new functional requirements. For the expansion and addition, the design also needs to follow the original construction logic. The "Nairobi Proposal" pointed out: When buildings must be rebuilt or rebuilt, the original spatial organization relationship must be respected, mainly the original plot division and scale, and consideration must be given to assigning the value of the original building complex to the new buildings. As long as it does not destroy the overall sense of harmony and introduces factors with contemporary characteristics, it is conducive to the richness of the architectural complex.

2.1.4 Strategies for the protection of French industrial heritage

The protection of French industrial heritage focuses on the deconstruction and reorganization of buildings and environmental spaces.

In the face of huge industrial land, architects must have comprehensive and overall thinking ability to coordinate various natural and man-made elements in the base, and be able to reuse and design broken elements and classify them so that the new site can avoid elements Dysfunction caused by excessive fragmentation. It is usually possible to use a grid structure to reorganize the landscape partitions, to effectively connect the theme tour flow lines, and organize the internal space of the site. Among them, the grid structure is especially good at accurately controlling the huge scale and scattered and disordered landscape in the industrial site. In addition to the establishment of grid levels and landscape levels to control the landscape elements of the industrial site, the design of the tour path throughout the site will also directly affect the actual experience of visitors to the post-industrial landscape. In the design of La Villette Park, Chumi used the two main entrance traffic points of the northwest entrance and the southeast entrance on the periphery of the site to determine the main axis, and the grid direction was consistent with this axis, and Public structures with different functions and creative public artworks are set on the grid nodes. From the perspective of post-industrial landscape design, La Villette Park adopts a rational landscape system to unify the huge-scale site, and is connected to the center of Paris through the highway and subway landscape site. Critics call on La Villette Park to be an outstanding masterpiece of the French postmodernist garden.

图2.7 拉·维莱特公园

图片来源：笔者自摄

图2.8 拉·维莱特公园节点构筑物

图片来源：笔者自摄

2.1.5 Strategies for the protection of German industrial heritage

After the reunification of the two Germanys, Germany adopted quite a wealth of historical heritage protection methods, including functional replacement methods, museum repair methods, and architectural translation methods. The reconstruction mode of coexisting styles of old German cities preserves its historical features.

The development and reuse of abandoned industrial sites in Germany is equally eye-catching and creative. Germany is not only the leader of the industrial revolution, but also the leader of international style modernism. For example, the protection projects of the Volkling steel plant and the Bauhaus school building in Dessau have provided the best examples for other European countries. In recent years, there has been a wave of sustainable "green" solutions in the field of German popular culture and historical heritage protection. In the Essen Mining League (Zollverein) coal mine group reuse project, the overall shape of the plant area, including the transportation system, spatial structure, important signs and site environment, has been fully protected. The cooling pool of the coking plant can be transformed into a skating rink in winter to provide civic activities; the original boiler room of No. 12 mine was renovated into the Red Dot Design Museum; the coal washing plant was transformed into an exhibition space; the original turbo compressor room was transformed into a tea restaurant; Interesting sculptures.

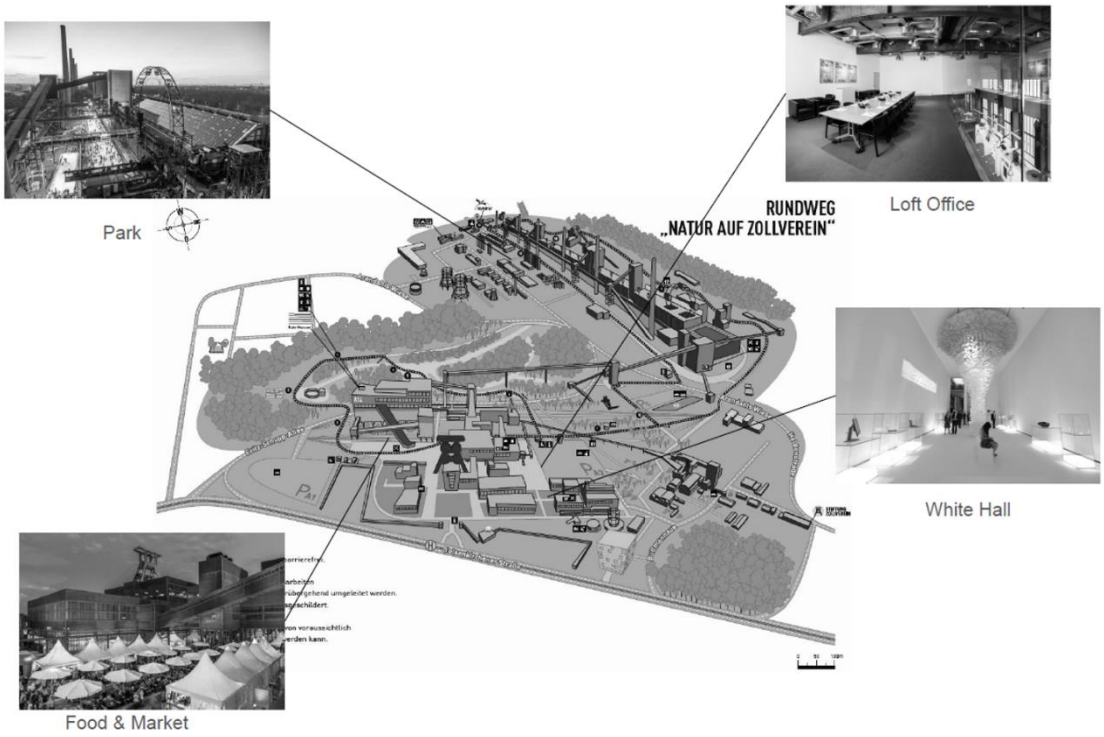


图2.9 德国矿业同盟（Zollverein）再利用区域分析

图片来源：笔者整理绘制

2.2 The history and current situation of Italian heritage protection and transformation

By consulting relevant information, we can learn that Italy has a long history of heritage protection and transformation. Since the beginning of the Renaissance, after so long of development, the protection and restoration of cultural relics has developed into a comprehensive discipline. The modern protection theory only began to develop in the middle of the 20th century. Up to now, its theory and practice have made great progress. From the protection of a single cultural relic site, it gradually developed into the protection of historical sites and related blocks, and finally expanded to the protection of historical cities. Because of the abundance of architectural cultural relics in Italy, a super-powerful architectural protection system has gradually been developed. Both technology and methods are at the leading level in the world. Therefore, most influential protection organizations and declarations are also born in This: In 1919, the "Intellectual Union" organized by experts from various countries of the International Association for the Conservation of History and Monuments was formally established in Rome; in

1964, the landmark environmental protection document for cultural relics-the "Venice Charter" was formally published. Up to now, more than 70% of the headquarters of ancient building protection agencies are located in Italy. It can be said that Italy is at the forefront of the world in terms of theoretical research and practical capabilities of ancient architecture.

2.2.1 The history of Italian heritage protection

The excellent protection cases of Italian cultural relics can even be traced back to ancient Rome. During the Renaissance, the Pope himself set up an institution of director of cultural relics and architecture in Rome. Although the protection of cultural relics and architecture began to appear as a professional discipline in the middle of the nineteenth century, and the French school and the British school took the lead in the second half of the nineteenth century. It was not until the first half of the twentieth century that the Italian school began to form and appeared relatively late, but it is more mature. The "Venice Charter" was drafted on the basis of Italian school theory.

2.2.2 The Establishment of Italy's Important Position in European Heritage Protection

The rise of the Italian school was relatively late. Since the 18th and 19th centuries, it has absorbed many effective theories about the protection of ancient buildings, and has gradually become perfect. Generally divided into the following stages:

"History restoration"

The representatives are Luc Beltrami and Camillo Boito. Beltrami opposed the French school’s requirement that maintenance personnel should use subjective "maintenance" as the original author, and the protection work should be based on a solid scientific foundation. He should collect as much relevant information as possible, conduct an in-depth analysis, and carry out the work based on adequate and still. The maintainer must be a historian and a linguist at the same time, and be able to read and truly understand all relevant documents, works, catalogs, etc., not only an architect, but also the founder of an Italian school. It not only perfects the definition of cultural relics, but also puts forward that cultural relics are not only a work of art, but also a rare material for exploring the history of civilization and folklore. There are many aspects of value. It strongly recommends that the original appearance and current situation of

cultural relics must be respected. The purpose of maintenance is only to effectively protect it. Even if they obscure their original appearance, we should protect all changes and additions in their history. Repair is first of all reinforcement, and the final intervention is necessary once and for all, and there is no need to do it after that. In order to strengthen rather than add something, we must not change the appearance of the heritage building obtained from its time and original author. All changes should be recorded in detail.

In 1883, the meeting of engineers and architects was formally held in Rome, and the idea of protecting and restoring cultural buildings was introduced for the first time. It mainly has the following two main points: 1. "Unless unavoidable, cultural relics should be strengthened rather than restored." Second, the new part must be made of "different materials" from the original part and "significantly different" from the original part to avoid even a little bit of forgery. After the Congress, Italian schools gradually got rid of the influence of French schools, and no longer paid attention to renovation and restoration, and transformed into strengthening and protection.

2. "Scientific restoration"

Its representative is G. Giovnanoni, who implemented an effective supplement to Boido's theory in 1931 and gave a more comprehensive concept of protection, that is, the ultimate goal of restoration is to protect the building itself and the environment that form a long-term historical background . The entire building restoration process should be carried out on the basis of respecting the authenticity of historical buildings, that is, "original artistic life"; we can use modern methods and materials to restore it, but it is strictly forbidden to exceed the building's ability to withstand it. In 1933, based on the relevant theories proposed by Giovanoni, the document "The Charter of Athens" was formally published. In the same year, Italy formulated the rules for the restoration of cultural relics and buildings, further improving the standards for the restoration of cultural relics and buildings. In 1939, Italy established the "Institute of Cultural Relics Restoration". The first principal, Cesare Brandi, revised the restoration rules of the historic building again in 1933 and established the Italian School.

2.2.2 The status quo and strategies of Italian industrial heritage

Due to the global economic transformation and urban planning policy factors, the

number of heavy industrial areas in Italy is still inevitably showing a downward trend, especially in the triangle of traditional industrial cities in northern Italy, such as Milan, Turin and Genoa. Take Milan as an example. The first signs of the decline of the industrial sector were already obvious in the late 1970s. Afterwards, industrial restructuring was carried out in the second half of the 1980s, which caused it to face many major challenges. However, in front of these abandoned industrial areas, reconstruction plans often prevailed and failed to save them. At first, people did not think that industrial heritage was as valuable resource as other historical heritage, and the public's interest in industrial heritage was limited. As a result of a series of urban renewals, measures have been taken to remove a large number of industrial remains. The Milan area is a good example of the abolition of important industrial heritage. In other places, similar trends are still going on, and factories are seen as obstacles to be eliminated rather than opportunities for development.

The renovation and reconstruction of Italian industrial heritage buildings are based on the following premise: the industrial heritage exhibits inadequate functions or dislocation in modern applications. Therefore, the form of renovation and expansion of industrial buildings is different from that of new buildings. Architects must first face the history and existing form of the original building, and should protect the authenticity of the architectural heritage. The "Venice Charter" has a guiding role and an important binding force on the first type of industrial buildings with a long history. The charter points out that the parts that have to be added to the historical building need to be clearly separated from the original building appearance, and it can make people realize that the added content is a contemporary new design and must be handled in harmony with its appearance to prevent new additions. The part destroys the authenticity and artistry of the original historical buildings, and causes the architectural heritage to lose the basic attributes of witnessing history. The structural characteristics of buildings and structures with different spatial structure types should be fully utilized and adapted. In the early reconstruction process of planning buildings, a so-called comprehensive assessment of the technical feasibility of expansion or reconstruction should be carried out according to the structure and space type of the original building or structure. This requires the participation and cooperation of structural engineers. This is a link that the architect must pay special attention to, and it is also the key to the success of the project.

2.3 Operating mechanism for protection and renewal of Italian heritage

Italy has the ability to become an advanced country in the field of World Heritage protection and transformation because this country has been exploring a set of mechanisms including legislation, education, publicity and fundraising for a long time to ensure the smooth progress and operation of the building renovation work. .

2.3.1 Legislative protection and policies

Italy has incorporated the protection of cultural relics into the Constitution. Its Article 9 regulations clearly stated that the Italian government should be responsible for the effective protection of the country's art, historical heritage and scenic spots. Long before the unification of Italy, there were many regulations on the protection of cultural relics. After the unification of Italy, a series of regulations were promulgated to protect cultural relics. In this country, the construction management of each city is very strict. In Italy, the external structure of buildings is under the unified control of the government. Each subject has the right to use the internal space of the house, but they do not have the right to renovate the entire building. The maintenance of the house is carried out in accordance with the laws enacted by the country, and individuals cannot make their own decisions. Although all old houses in the center of the old city are privately owned, maintenance work must be approved by a special audit department. All houses have an exclusive file that records the detailed information, renovation records and photos of the house to facilitate inspection by the relevant protection department.

2.3.2 Protection agency

In 1975, the Italian Ministry of Cultural Heritage was formally established, mainly responsible for the protection of Italian cultural relics. The main task of this organization is the protection and management of ancient cities and ancient buildings, which are carried out by provinces and cities in the region.

Many historical cities in Italy follow a complete and systematic protection mechanism for cultural relics. Different institutions have a clear division of labor and cooperate with each other to jointly complete the research, planning, design and protection of cultural relics. For example, the Cultural Bureau of the City of Rome and ICCORM are responsible for the protection and maintenance of ancient buildings in

Rome; Verona (Verona) has established a special agency to investigate and register the buildings in the center of the ancient city and give specific renovations. And utilization plan. In order to effectively protect the water city of Venice, the UNESCO Ministry of Culture moved here from Rome in the 1970s. Aims to coordinate and carry out multidisciplinary cooperative research and protection work, and at the same time cooperate with the Roma Research Center to conduct in-depth research on the protection of Venice's important building materials stone. As far as Rome is concerned, the municipal government has set up relevant offices to take reasonable planning and control measures for the entire city, ancient urban areas, development zones, cultural relics, and ancient buildings.

1. The Master Planning Office of the City of Rome. Responsible for the overall planning of the city, with commanding nature. Aims to study the city's ecological environment, traffic arteries and other content.

2. The office of the ancient city of Rome to protect the ancient buildings. This organization uses computer systems to improve neighborhood protection management, building maintenance, and public environment.

3. Rome city office. Mainly responsible for organizing and managing municipal construction projects in the suburbs, and perfecting the reconstruction plans of some key areas.

4. Ancient building protection and maintenance center. Mainly responsible for the maintenance and protection of important Italian cultural relics.

2.3.3 International support, public awareness and civil society

Actively relying on international organizations and technical forces to protect ancient cities and buildings can be said to be a significant feature of Italy's architectural protection. Although Italy attaches great importance to the protection of ancient cities and buildings, and has a strong team and advanced technology, it has very close ties with UNESCO. Some well-known conservation projects, such as "Save Venice", have won global support. Another example is the Pisa Leaning Tower Protection Project, which has also solicited extensive suggestions from the international community. Under the supervision of engineers and technicians, the protection project has achieved good social benefits and international influence.

Italians like their national culture very much, especially for those ancient buildings,

they have deep emotions and a strong sense of protection. They often use their offline time to study the architectural history of the streets or communities where they live. Sometimes they even do more detailed work than cultural relic institutions and publish their research results in journals. Throughout Italy, many formal non-governmental organizations are active and spare no effort to promote the renovation of ancient buildings. The largest of these is the organization "Our Italy". It was established in 1955 to promote the protection of historical cultural heritage and the natural environment. It has more than 100 branches and more than 100,000 members at home and abroad, including Congress and the legal profession. It is a "group that can put pressure on the government." Its internal structure is relatively complete, mainly composed of the following parts: educational institutions, publishing institutions, and information institutions, etc. Therefore, it not only has a certain degree of public opinion power, but also has a very strong academic strength. Since its establishment, it has made outstanding contributions to the protection of ancient buildings in Italy. It prevented certain factory construction projects in cultural heritage areas. Its two most influential activities: First, it frustrated a group of powerful real estate investors, and urged the country to enact laws to reserve both sides of the ancient Appia Road outside Rome as a national park and avoid this area Becoming a profitable housing land for real estate developers, the park is about 10 kilometers away from the city and about 2 kilometers wide. The other is to promote the national promulgation of laws, stipulating that all urban plans with historical value must be signed by the chief architect, chief conservator of cultural relics, and chief archaeological director. The above-mentioned victory not only greatly aroused the government's attention to cultural relics and historic sites, but also significantly improved the public's awareness of cultural heritage. Made outstanding contributions to the protection of Italian ancient buildings.

2.3.4 Sources of funds

In recent years, Italy has made a lot of efforts to build a cultural relics protection fund. The Italian central government invests a large amount of money for cultural relics protection every year, roughly maintaining an annual growth rate of ten percent. In 1999, the total amount of funds used by the central government to protect cultural relics reached a staggering 3 trillion lire, accounting for nearly 0.16% of the gross national

product. In addition, since 1996, the state has stipulated in accordance with the law that 8% of lottery revenue should be used for cultural relics protection funds. On this basis, Italy has also formulated some tax policies that are conducive to cultural undertakings.

In addition, the regional and municipal governments have also allocated special funds for the protection of cultural relics, and enterprises and individuals have also set up special funds for the protection of cultural relics. For example, under the sponsorship of the Olivetti Computer Company in Italy, Leonardo's famous painting "The Last Supper" in the church of Santa Maria Novella in Milan has been restored recently.

Because there are a large number of important sites, archaeological sites, and cultural buildings nationwide under the direct jurisdiction of the central government, and the excavation, protection and maintenance of these historical relics are all funded by the central government, the demand for related funds is very large, which has led to The problem of insufficient funds for cultural relics protection has affected the progress of related cultural relics protection projects.

In order to alleviate the contradiction between the protection of cultural relics and the shortage of funds, and to ensure the excavation and protection of cultural relics, in accordance with the decree of the central government, since 1997, the Ministry of Cultural Heritage has gradually worked in the Central Bureau of Pompeii and several departments in Rome, Florence, Pisa and other places. The implementation of reforms formed the Pompeii Central Bureau, which consists of three directors. All major decisions related to the work of the Pompeii Central Bureau need to be decided after a unified discussion and voting by the committee. The Central Bureau has greater autonomy, including self-examination and approval of site protection and archaeological excavations, and determines annual maintenance and excavation funds. In addition, the department is also responsible for the production of two travel tickets: one valid for three months with a face value of 26,000 lire; the other valid for three days with a face value of 16,000 lire. Ticket income and some operating income for tourists are no longer transferred to the central treasury, but all are managed and controlled by the Pompeii Central Bureau. The personnel management of the Pompeii Central Bureau implements "one bureau, two systems". In addition to national staff, it also recruited some people who specialize in "business" from the society. Most of them are familiar with the market, good at planning, and have strong operations and operations. Management ability, so it is mainly responsible for business activities related to public

propaganda and public services. Their participation has greatly improved the regional operating conditions and realized economic income generation.

2.4 A case study on the renovation and renewal of a giant factory building in Italy

2.4.2 Torino Lingotto Plant

First of all, this article selects the Lingotto Fiat factory in Turin, Italy as a case of industrial heritage renovation.

The Lingotto plant was once one of the main production areas of Fiat cars in Italy, and was the largest and highest level of craftsmanship in Europe at that time. The factory was designed by Matt Trucco and was built in 1923. The entire factory is 507 meters long, 24 meters wide, and 21.3 meters high, with a total of five floors. As the most advanced industrial building at the time, the Lingotto plant adopted a modular reinforced concrete structure. Not only is the modular structure related to the modular car design process, the space of the factory is also closely related to the car design process: starting from the lowest floor, cars are assembled on different floors, and finally the assembled cars are on the circular runway on the roof. To be tested. After his visit, Cobb called it "one of the most impressive landscapes in the industry", and in the subsequent Marseille apartment design, he published the concept of the roof landscape with reference to the factory roof design. The Lingotto factory can be said to have a crucial historical significance for the development of European industry. The European Industrial Heritage Organization also lists the factory as one of the most important industrial heritages in Europe.

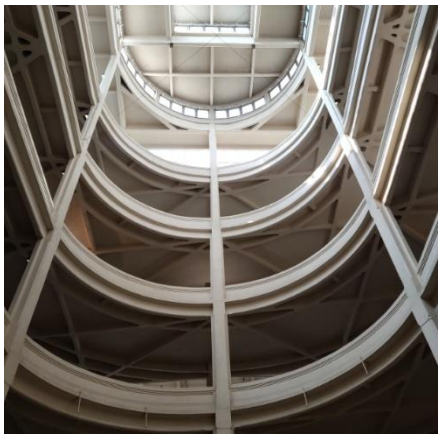


图2.11 林格托工厂

图2.12 林格托工厂螺旋形坡道

图片来源：作者自摄

In the 1970s after the war, Turin's secondary industry gradually declined, and the factory closed in 1982. The closure of the Lingotto factory caused a huge sensation at the time. On the one hand, the factory conveyed the Italians' design concept for automobile assembly, and also reflected their unique concept of industrial architecture at that time. The discussion started from the impact of such buildings on the future development of Turin, and gradually evolved into how the buildings left over from the industrial age can be transformed and have a positive effect on the urban space. Following intense discussions, Fiat held an architectural competition for the renovation of the Lingotto factory in 1984. Many famous architects such as: Renzo Piano, Cisa Perry, Hans Hollein. participated in the competition, and Piano won the victory and won the opportunity to transform. After 20 years of renovation and renovation, the Lingotto factory eventually became a leisure and shopping complex for Turin people on the urban border, which has also become a classic industrial heritage renewal case.

Piano's architectural firm RPBW regards this transformation as the creation of an urban space, changing the previous perspective, taking the economic into account, cultural, and social factors of the entire city on a larger scale. The whole building is regarded as an opportunity to improve the living space of urban residents, and the industrial building is renewed into a place that can serve the public life. Piano tried to let the architecture enter the daily life of the citizens in a daily way, so that the architecture was remembered. The Lingotto factory, which was born in the Taylor system of work, has had a certain impact on the vast majority of people in Turin: more than half of Turin’s people are related to this factory, and the factory is also a city where residents live, The Lingotto factory represents the collective memory of Turin people. To regenerate vitality in a declining area, Piano created a diverse urban public space, bringing in the flow of people and reviving the economy of the entire region.

The Lingotto factory consists of five parts: the exhibition center, the Fiat office building, the Politecnico di Torino, the shopping mall, and the civic activity space. The civic activity space and shopping center are transformed from the original production space of the factory. Visitors can step on the Olympic pedestrian bridge through the shopping center and cross the railway in the city to reach another area.

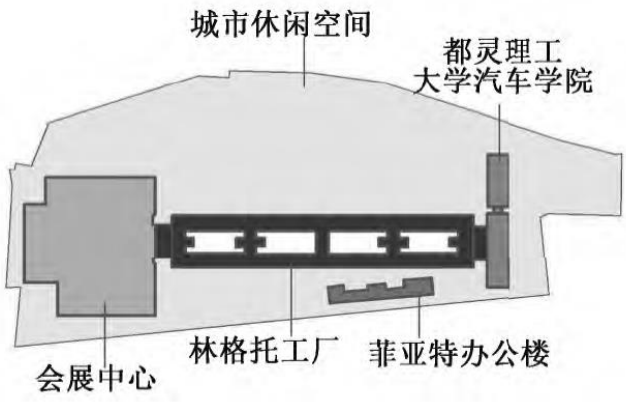


图2.13 林格托工厂区域规划示意

图片来源：*工业建筑2018 48卷（12）*

图2.14 北侧城市休闲空间

图2.15 都灵理工大学教学楼

图片来源：作者自摄

The exhibition center, office building and the space where the Politecnico di Torino are located are newly added. These areas are independent of each other and can be constructed separately. The entire project can be opened for use immediately after the completion of the project. Throughout the 20-year renovation, the Lingotto factory remained in use. Considering that the factory carries many collective memories of the citizens, Piano retains the external form and internal main structure of the factory. The transformation starts from the combination of space and the placement of business formats, and incorporates a large number of functions required by the citizens: shopping malls, Exhibition halls, hotels, conference halls and theaters, etc. Different functions are combined on the cross-section, and through the streamlined organization, the different functions are independent of each other and do not interfere with each other.

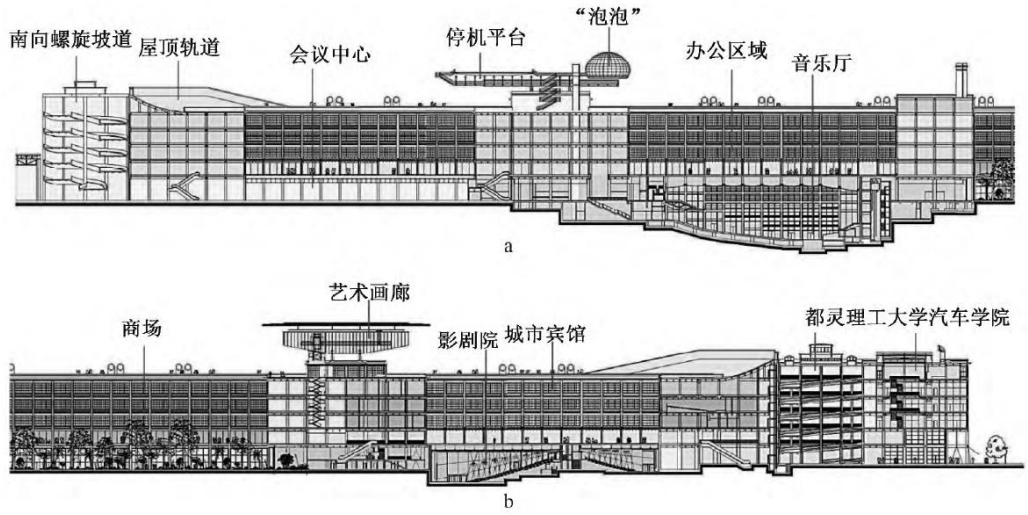


图2.16　剖面功能示意：林格托工厂改造

图片来源：RPBW(Renzo Piano Building Workshop)

The renewal and transformation of the industrial heritage forms a place for residents to inject a new flow of people into the area, thereby driving the development of the surrounding area. This is another advantage brought to the city by the Lingotto factory renovation plan. All kinds of processing plants around the factory are facing transformation problems. Due to the successful transformation of the Lingotto factory, the area has been activated. With the Lingotto factory as the center, the surrounding areas have been gradually regenerated, and the updated factory combination has become a new one. A distinctive area. For example, the Olympic pedestrian bridge built during the Winter Olympics connects the areas at both ends of the railway, greatly shortening the traffic distance between the residents of the two areas, and enabling the development of buildings in the Zenida block opposite the railway. , The city is further developed. From the urban scale to the architectural scale, to the north of the Lingotto factory, the original site was a winery. Due to the new flow of people, the development of surrounding industries was driven. The winery was transformed into a catering and cultural center, which contained Supermarkets, bars, restaurants, cooking classrooms and other spaces are good places for residents to relax daily.

The enlightenment brought to us by the renovation of the Lingotto factory is not only the diversification of functions, the diversification of space composition and other internal problems, but also the larger-scale urban reason: from its own development, it links the surroundings and forms a complete The region, the good development within

the region can eventually be fed back to the architecture, which constitutes a virtuous circle.

图2.17 奥林匹克步行桥

图片来源：笔者自摄

图2.18 “吃大利”

图片来源：笔者自摄

The evolution of architecture also heralds the development process of the city, and the replacement of industrial buildings symbolizes the development and succession of a city. Industrial heritage buildings are not only witnesses of urban development, but also an indispensable component of urban space. The collective memory produced in them is symbiotic with the city. The renewal of industrial heritage should not only start from the form of the building itself, but also from the perspective of the city. It should take into account the development history of the city, economic form and the behavior of people in the region. Only by comprehensive consideration from all aspects can the once glorious The industrial building was successfully transformed into an industrial heritage and continued to play a role in the daily lives of residents.

In addition, the citizen as the protagonist of the city, the inheritor of memory, the service object of the building, and the renewal and transformation of industrial heritage is also a question of concern about the public living space of the residents in the city to some extent. Residents use the way that such heritage buildings can be passed down for a long time, and have a positive impact on the daily lives of residents in different ways in different times. Such a human-centered transformation method is a kind of sustainable development. But in reality, the renovation of my country's industrial heritage only stays within the scope of the architect's discussion, and rarely really affects people's lives, and most of the residents have never been there. This kind of renovation design is only a discussion topic among architects, and it does not solve

social needs in the area. The overall utilization rate is low, the building is far from the daily life of residents, and there is a disconnect between urban space and residents' daily life. Therefore, in the subsequent practice of industrial heritage renewal and transformation, the focus should be placed on the needs of the public and society. Architects should consider how to improve the public space of residents through the renewal and creation of industrial heritage and expand the influence of the building. To activate the entire area.

2.4.2 Turin OGR Industrial Park

The OGR (Officine Grandi Riparazioni) Industrial Park in Turin will be renovated and updated for research. Since the 19th century, OGR has always been a magnificent industrial park, which has greatly promoted local development. After it was closed in the early 1990s, it was abandoned and unmanaged and faced with planned demolition. Fortunately, in 2013, the CRT Foundation invested in the purchase of an H-shaped flat building of 20,000 square meters and started to re-development through SocietàOGR-CRT. After 1,000 days of reconstruction, OGR has transformed into a gathering place for creative, cultural, performance and other activities. After opening to the citizens of Turin, it has injected new vitality into the city. The CRT Foundation has invested more than 100 million euros to bring this OGR, which has the status of the "Cathedral" in the industrial history of Turin, to life. High-tech solutions, environmental sustainability, historical preservation, space versatility and accessibility of people flow are the rules and requirements behind OGR's radical transformation. From the train maintenance room to the workshop of contemporary cultural innovation and business incubation, it has a broad international perspective.

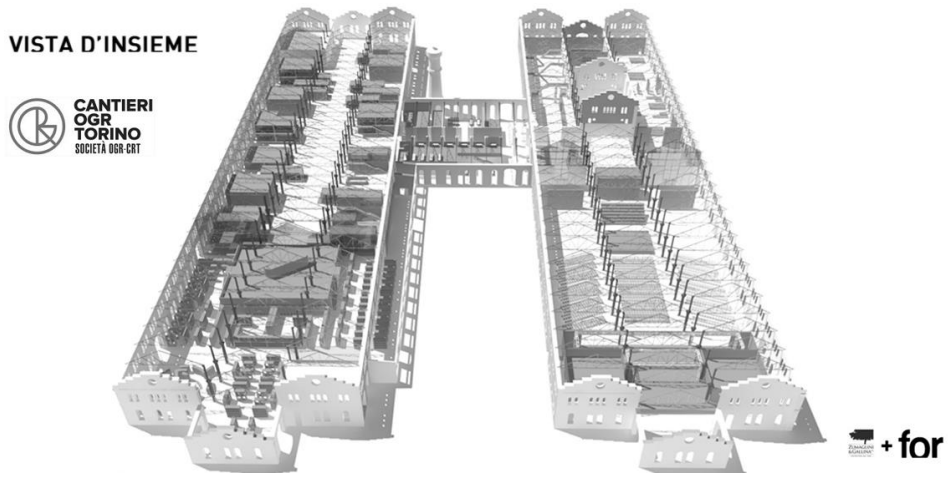
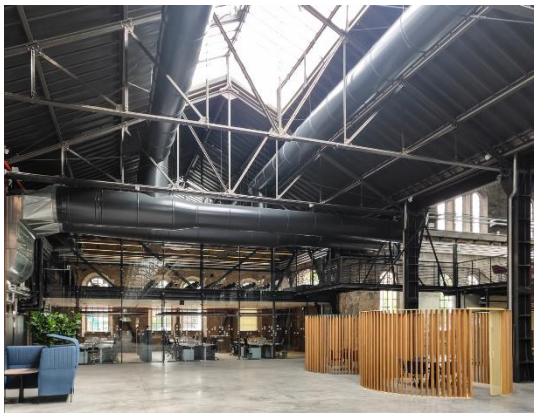


图2.19 都灵OGR工业园改造更新

图片来源： www.ogrtorino.it



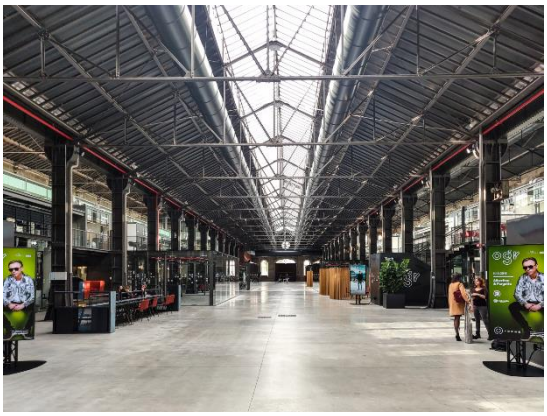


图2.20 OGR工业园内部 图2.21 OGR工业园内部

图片来源：笔者自摄

2.4.3 Turin Dora Park

Turin began its industrialization at the end of the nineteenth century, and many factories were built along the Dora River. At the beginning of the twentieth century, with the construction of the Fiat Steel Plant and the Michelin Tire Factory, industrialization reached its peak. These factories were closed in conjunction with the Great Industrial Depression of the 1980s and abandoned large tracts of dilapidated urban land in the center of the city.

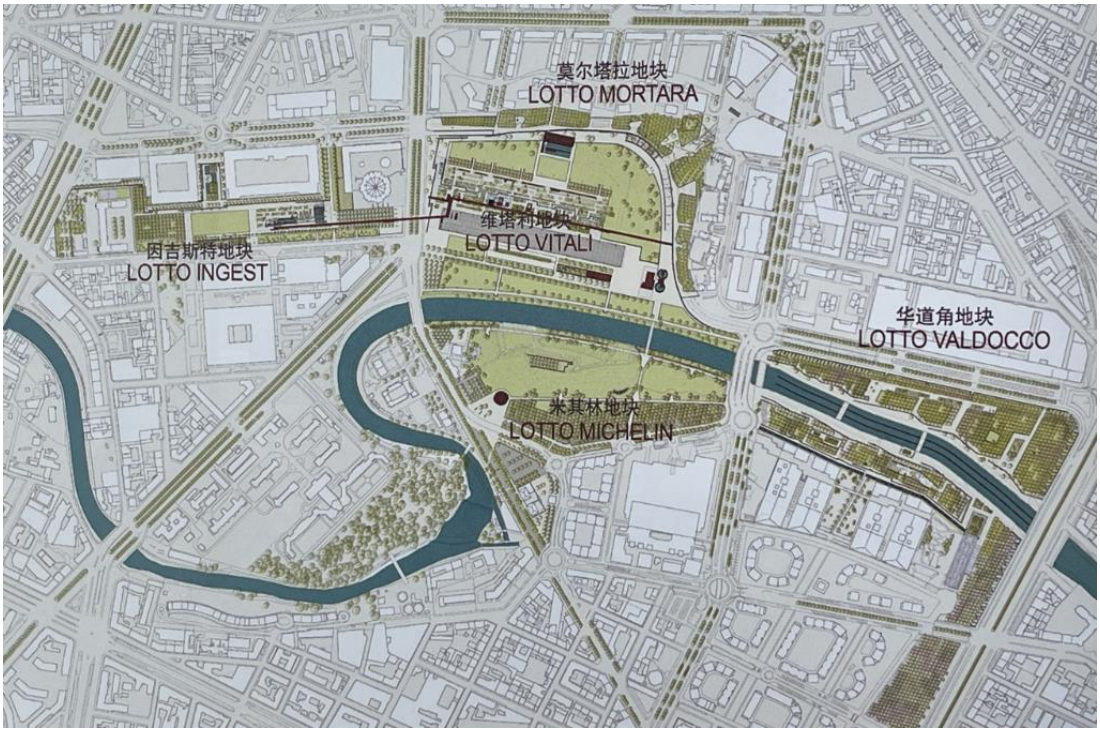


图2.22 都灵OGR 工业园改造更新总图

图片来源：*世界建筑 2013 05*

图2.23、2.24 都灵OGR 工业园改造更新

图片来源：笔者自摄

In an urban renewal plan that began in 1998, the former factory was given a new use, and the Dora skate park was born. It contains five separate areas, three of which are named after the industrial company that once occupied the area: Ingest, Vitali and Michelin. Dora Park emphasizes the connections between the five areas and their connections with the surrounding areas, retaining its unique traces of industrial history, and reflecting a new understanding of the internal urban landscape of urban social

transformation.

After removing most of the beams and coverings of the huge factory building in the Vitali Steel Plant, the 30-meter-high steel structure columns left behind are undoubtedly exposed. Under the conspicuous red painting, the steel column group reflects an extraordinary memorial Sex. The array of columns reveals the purpose of the original site, as well as the spatial scale and proportions. Like the ancient structural columns standing in the ruins of Hadrian's Palace and the ruins of the Roman Forum, it retains collective memory and the city's name card.

The open space below is re-paved, or set up as a skateboarding venue or set up as a green space for leisure walks, and is connected with the surrounding greenery on the ground level. Larger open space can hold summer concerts. The entire project was successfully urbanized and transformed into a public space integrated into the lives of citizens, forming a vibrant and fascinating "mysterious new world". The old structure acts as an "anchor", and the artificial lighting at night makes this industrial monument a landmark in the area.

2.4.4 Palma Paganini Concert Hall

The Paganini Concert Hall in Parma, Italy, used to be a factory building of a food company in the 19th century. Renzo Piano was responsible for the renovation and opened to the public in 2001. The building retains the main structure and appearance to reflect the traces of industrial architecture. The interior uses modern technology to change the key position to accommodate concerts and opera performances. The surrounding area is transformed into a park. The park can be appreciated through the glass curtain wall of the lobby. Scenery, feel the change of light and shadow.

图2.25 音乐厅外部　　2.26音乐厅内部

图片来源： www.archidiap.com

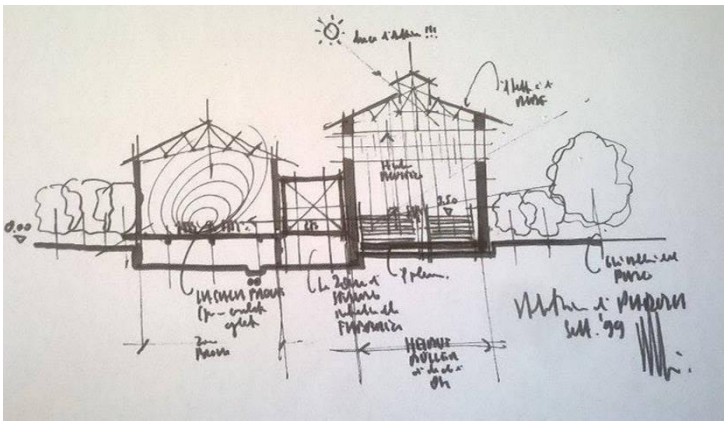


图2.27 剖面手稿

图片来源： Renzo Piano Architect

At the same time, northern Italy takes Turin, Milan and Genoa as the traditional industrial triangle. There are a large number of excellent industrial heritage renovation and renewal cases in this area, the reuse case of the original Bona wool factory in Carignano, Monferrato· The transformation of the industrial heritage of the city of Casales and the renewal of the industrial heritage of the city of Rivaro Canaves are all valuable success stories.

2.4.5 Research on the space characteristics and design of giant workshops

There are many classification methods for industrial buildings, but they can be classified into the following three types based on their spatial and structural characteristics and adaptability of transformation:

1. A bent-frame plant that expands in a single direction
2. Homogeneous workshop space with column network structure
3. Other workshops with spatial characteristics

The first type is often a single-story giant structure with a steel frame roof, including single-span and continuous-span, and the column network span often far exceeds the homogeneous column network type factory building, and the span ranges from more than ten meters to tens of meters. The form is uniform, the space is high, the column spacing is even, and there are mostly skylights on the top.

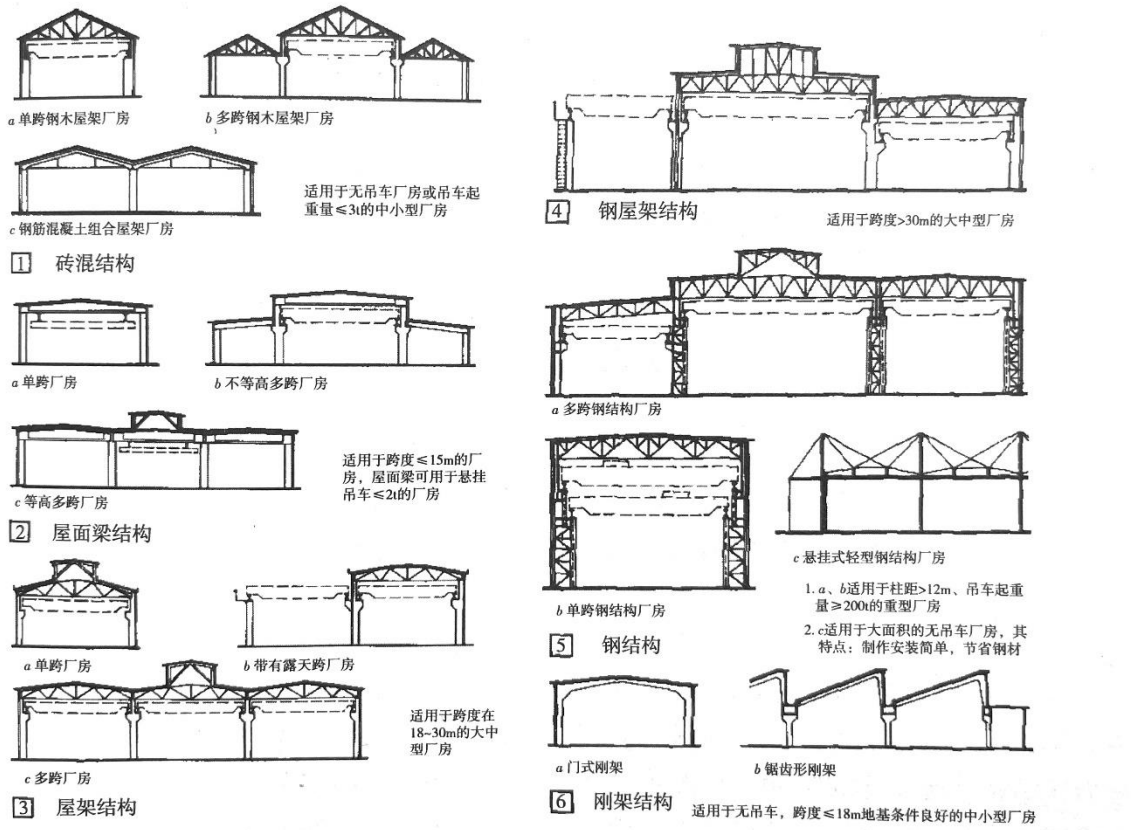


图2.28 单层厂房结构形式

图片来源： *建筑设计资料集5（第二版）*

When designing the space transformation of an industrial plant based on functional conversion, attention should be paid to the matching principle and the original space should be retained as much as possible. Among civil functions, office functions and commercial functions have their own space requirements.

The spatial organization mode of office buildings includes "corridor type" including outer corridor, inner corridor, and double corridor type. The depth of 8 meters is suitable for "outer corridor type"; the depth of 8 to 16 meters is suitable for "inner corridor type"; The "double corridor type" is suitable for 16-30 meters. The function is relatively simple and can adopt "comprehensive office style" and "patio style".

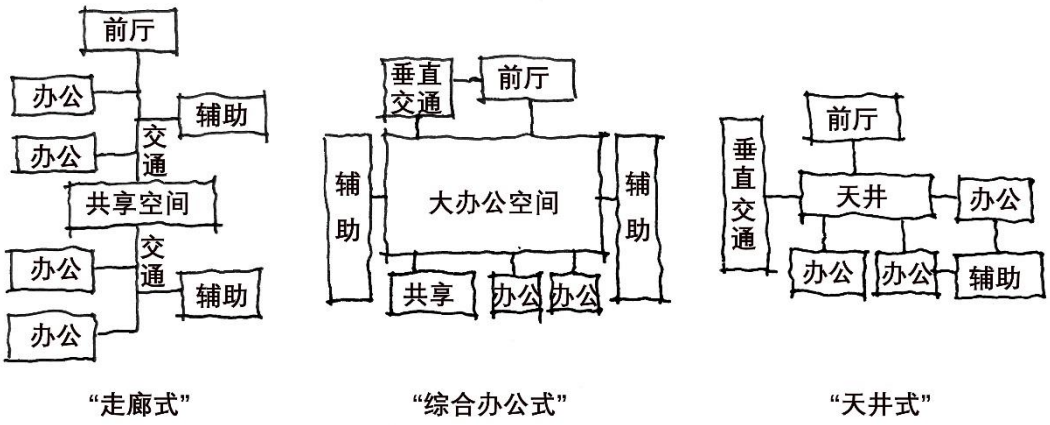


图2.29 办公类建筑的空间组织

图片来源： 笔者自绘

When transforming an industrial plant into a commercial building, the relationship between the business, storage and auxiliary areas should be organized, and the business and storage areas should be closely linked. When organizing the circulation of business districts, there are roughly "layered", "walking" and "series" types. The mega-factory is especially suitable for "walking type" and "tandem type".

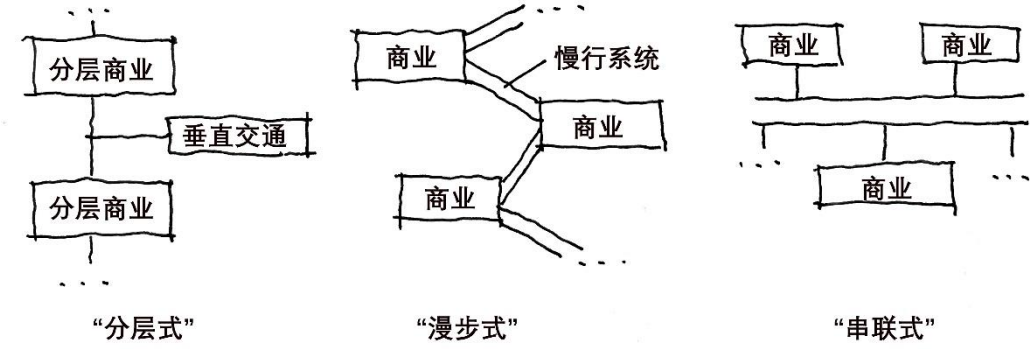


图2.30 商业类建筑的空间组织

图片来源： 笔者自绘

Chapter 3 Conditions and Evaluation-Study on the status quo of the Mirafiori plant in Turin

3.1 Turin city overview

3.1.1 Location and climate conditions

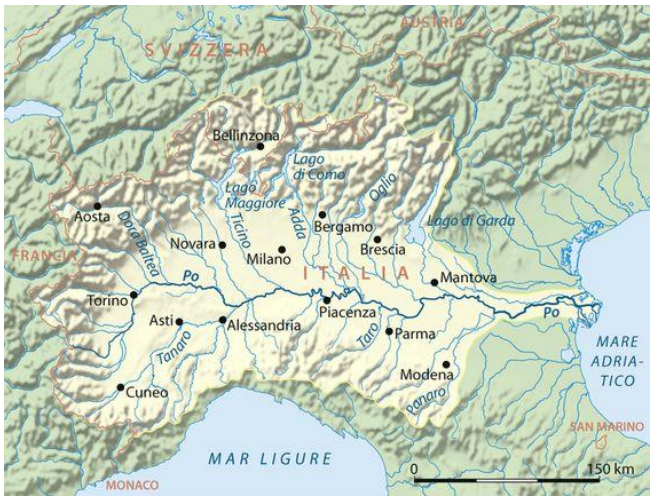


图3.1 波河流域

图片来源：en.wikipedia.org

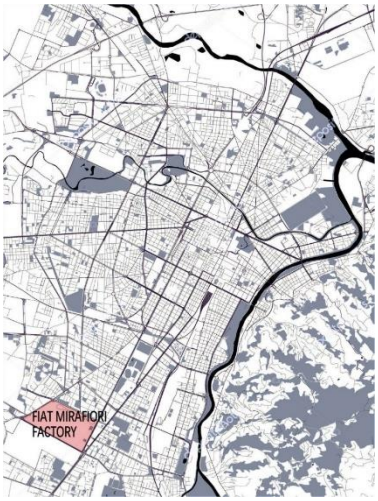


图3.2 都灵城市地图

图片来源：笔者自绘

The Po River Basin in northern Italy, especially the triangle formed by Turin, Milan and Genoa, is a traditional industrial area in Italy.

Turin is the largest car producer in Europe, producing more than 90% of the cars in Italy and owning more than 1,400 companies related to car design and manufacturing.

Turin can be said to be the birthplace of the modern Italian freedom movement, and it is the first capital of Italy. In view of this background, Turin has continued to express better publicity and citizenship in modern history. Relying on the materialization of liberalization such as equality and openness, new public projects can be used as much as possible to achieve the greatest effect in creating a positive urban meaning. In contemporary cities, openness and equality mean the effective allocation and allocation of urban public space resources, so it will bring higher resource efficiency and will also be more conducive to sustainability.

3.1.2 General Situation of Social Economy

In 2006, there were 231,645 registered companies in the province of Turin, Italy, of which 112,255 were in the urban area of Turin, accounting for almost 50% of the registered companies in Piedmont and 4% of the registered companies in Italy. In recent years, this number has been increasing, especially in the construction, tourism and service industries. Among them, 21,987 business owners are foreign immigrants, most of which are non-EU immigrants.

In recent years, Turin has undergone a long industrial transformation. On the one hand, because Fiat is in crisis, on the other hand, many domestic companies have moved their production lines to developing countries. In the 1980s, Turin experienced the pain of transition from industry to the tertiary industry, but still maintained its status as one of the major industrial centers in Italy and Europe. Due to the recovery of Fiat Group's auto exports, Italy's GDP grew very fast in 2006, which also led to support for enterprises (except Fiat, Iveco and Lancia's factories and offices, Turin also has Pininfarina and Giugiaro) and related The recovery of insurance companies. General Motors also violated its commercial and production agreements with Fiat and decided to keep an important research base in Turin to test diesel engines.

The economic reconstruction model focuses on the economic benefits of land use, emphasizing development prices, development intensity, and development utilization. The model starts from the overall economic structure of the city or the regional economic system, with high technology, information, service industry, commercial finance and communities as the leading factor, adjusts the industrial structure, accelerates the transformation of location functions, and promotes the revival of the region. Declining factories, docks and warehouses are usually located in the geographic core of the city and are often the preferred address for the development of the tertiary industry. The advantages of geographical location, less initial investment and shorter construction period make the reuse of old industrial areas a new opportunity for urban economic development.

3.1.3 Historical changes

图3.3 都灵城市改造地图2012

图片来源： www.urbancenter.to.it

In the process of urban industrial transformation, based on sustainable urban development strategies, the people of Turin have renovated most of the industrial heritage, which not only effectively activates the declining urban area, but also significantly improves the quality of the public space in Turin. It can be said that an important feature of Turin's sustainable urbanization strategy is the long-standing tradition of reusing existing houses. Whether it is a large-scale comprehensive building or a small private residence, everyone in Turin tries hard to reuse old structures.

3.2 Basic situation of the Mirafiori factory

When it comes to Turin, you cannot fail to mention Fiat. The company produced the most important mass-produced F-model in Italian history. The transfer of main production activities from the Lingotto factory to the Mirafiori factory not only marked a change in economic turnover and increased output, but also marked a new stage of industrialization. After the Second World War (1956), people witnessed the subsequent expansion of the factory, the production space expanded to more than 300 hectares, of which 60,000 workers worked. The scale of buildings, the wide range of production patterns, and the social characteristics of the population also indicate the

relationship between capital and labor in large-scale industrial production.

3.2.1 District Analysis

Fiat Chrysler (FCA)'s most important Mirafiori factory area is located in the southwest corner of the city, 6.4 kilometers from the main railway station, 15 minutes by car. It is the main plant following the suspension of production at the Fiat Lingotto plant.

The Mirafiori factory represents a model of the city that has disappeared in Turin. It represents the inevitable decline of a typical Italian company town in nature, culture, and society. However, at the Mirafiori factory, as in other places, people decided to protect and improve this precious component of the city with awareness of its intrinsic value and common value. In fact, since the 1990s, there have been several urban renewal projects aimed at establishing a new image for working-class communities, and through investing a lot of social resources, they have finally achieved considerable results. On the other hand, through the implementation of small projects, local communities have begun to slowly and silently improve local urban conditions. Therefore, the biggest challenge today is to understand whether structures that no longer belong to the previous owners can contain and identify new values of different identities.

3.2.2 Basic Information

图3.4 历史上的工厂

图片来源： *i progetti FIAT Engineering*

图3.5 都灵城市地图

图片来源：Google Map

The factory was built in 1936. After the factory was put into use in 1939, an efficiency improvement was carried out. The production line, warehouses and factory buildings were placed in a single-story building to reduce the transfer of materials. In the mid-1940s, based on the birth of the scientific management principle of "quality

tendency", the factory was born with a 20×20 m column net workshop. In the mid-1950s, technical requirements such as durability of construction, shortened construction time, cost-saving efficiency, convenient installation and maintenance, mobile scaffolding system and storage of prefabricated components appeared.

In 1967, a metal structure prefabricated system appeared in the factory. Twelve installation stations and movable platforms are used to install a 16×16-meter factory building with a complete column network. In the 1970s, space, light and comfort became the focus of design. Emphasize the dialogue with the surrounding environment and emphasize the noise reduction of the factory. In 1980, more than 50 large and small factories were built, covering a total area of 6.5 million square meters.

The main part of the construction was completed in 1972.

In 1980, more than 50 large and small factories were built, covering a total area of 6.5 million square meters.

3.2.3 Situation Analysis

With the decline in demand for automobiles, the overcapacity of the Mirafayuri plant has caused some plants to be suspended and put on hold. Among them, more than 50,000 square meters of plants in the southwest corner are facing idleness.

The westernmost section has been transformed into an information technology laboratory by the Politecnico di Torino. In the subsequent design, it is necessary to focus on the functional planning and scheme design of the part connected to the laboratory of the Politecnico di Torino.

图3.6 已改造部分与老厂房老交接处

图片来源：笔者自摄

图3.7 工厂西端鸟瞰图

图片来源：Google Earth

The factory has ample area, uniform and continuous, and the modular roof has the possibility of accommodating multiple uses. There are still temporary exhibitions

held here, because the venue is in poor condition and the factory can only obtain limited profits. Most of the building structure of the factory has been preserved intact, but there is also the problem that some building components have fallen into disrepair over the years. Broken enclosure systems and rusted structural components can be seen everywhere. Need large-scale research and repair.

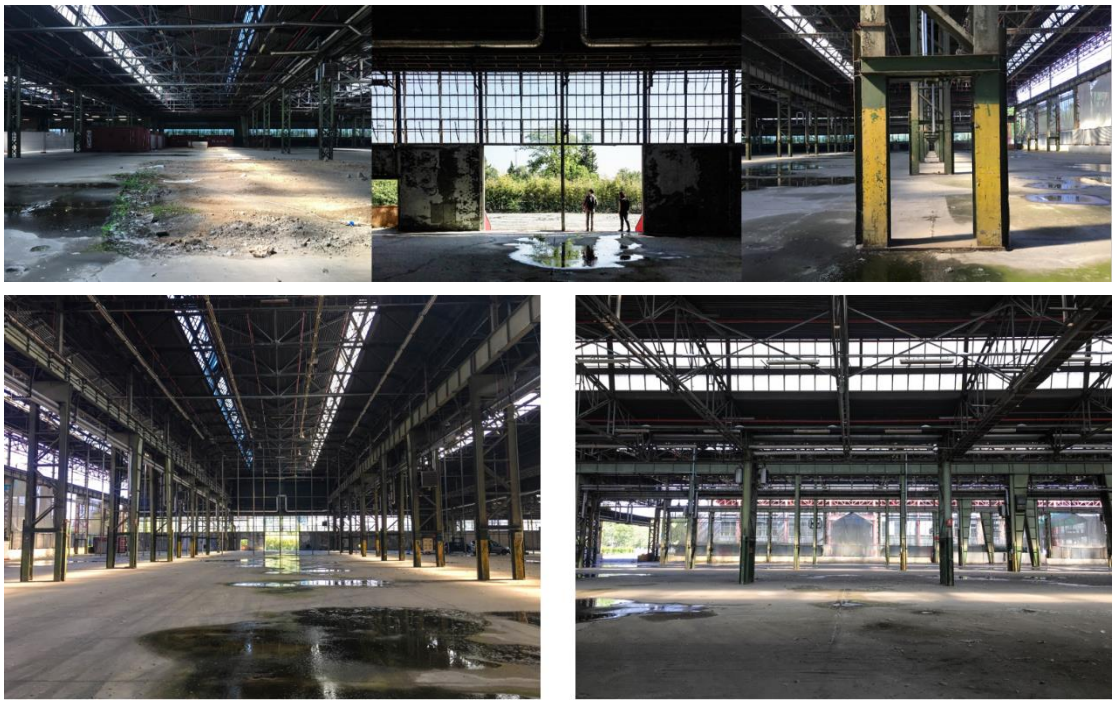


图3.8 工厂现状照片

图片来源：笔者自摄

3.3 Existing problems in the Mirafiori factory

3.3.1 Long-term social problems caused by factories in Mirafiori

In the 1970s, the construction of the social space in Mirafayuri was functioning well, just like the Fiat company. However, the transformation of the production structure in the 1980s brought a crisis to this small factory town, which was slow and painful. From that moment on, not only production activities, but also the inevitable capital divestment behaviors that underpin the urban structure model of the region.

The crisis at that time led to the "complete" abandonment of capital investment in the region, including the gradual emptying of residential buildings and factories, which have become important fixed assets in the region over time. Neighboring

communities are heavily dependent on it. Gradually, due to the lack of community services and the reduction of commercial activities, the connection between the Mirafiori factory area and other parts of the city gradually decreases, and the urban structure is sparse and discontinuous. In other words, local people have witnessed the complete collapse of the "social protection network" established in the 1970s.

Today, production activities have become scarcer, but the old land ownership structure shows a lasting inertia: the withdrawal of capital depends on the relationship established between urban space, economy and society. The original inertia of buildings and urban spaces concealed the declining inherent in the neighborhood year by year. The reasons are: on the one hand, the change of property rights, on the other hand, the collapse of the social network. The ownership of surrounding houses once belonged to the company.

With the passage of time, although the economic mechanism has been different, its non-residual symbolic and relational value makes the space for work and life missing. The Mirafiori region, which lacks Fiat production activities, has become the most obvious space for social isolation.

3.3.2 Fiat factory's own building renewal needs

Although it may seem an irresistible trend that the Mirafiori region was forgotten and passed, the region has always been regarded as an indispensable heritage by Turin. In the 1990s during the city’s revival, Mirafiori underwent a renovation project, and the municipality intervened in the area, including seven projects on the outskirts of Turin, in order to connect with the surrounding area (including the construction of a new bridge over the Sangone River). Project, strengthened public transportation), and coordinated and participated in projects that promote social inclusion. These policies are still being used in the Mirafiori Community Foundation and the strong network of local foundations, and the recently constructed buildings have never formed a gentrification project.

The worsening of the economic crisis has exacerbated Mirafiori’s long-standing isolation. Today, the proportion of the elderly population in the region is higher than the urban average, as high as 31% in the southern area of Mirafiori, while the urban average is 22%. The social and economic conditions of its residents are worrying. With the gradual decline of local real estate, it is no longer sufficient to meet the needs of the local population.

3.3.3 Underutilized construction resources

As an industrial relic, the huge factory building occupies a huge amount of urban land and space. As a part of the city's resources, it is urgent to give full play to its own value, and to bring shelter, squares and abundant types of announcement spaces to the city through urbanization.

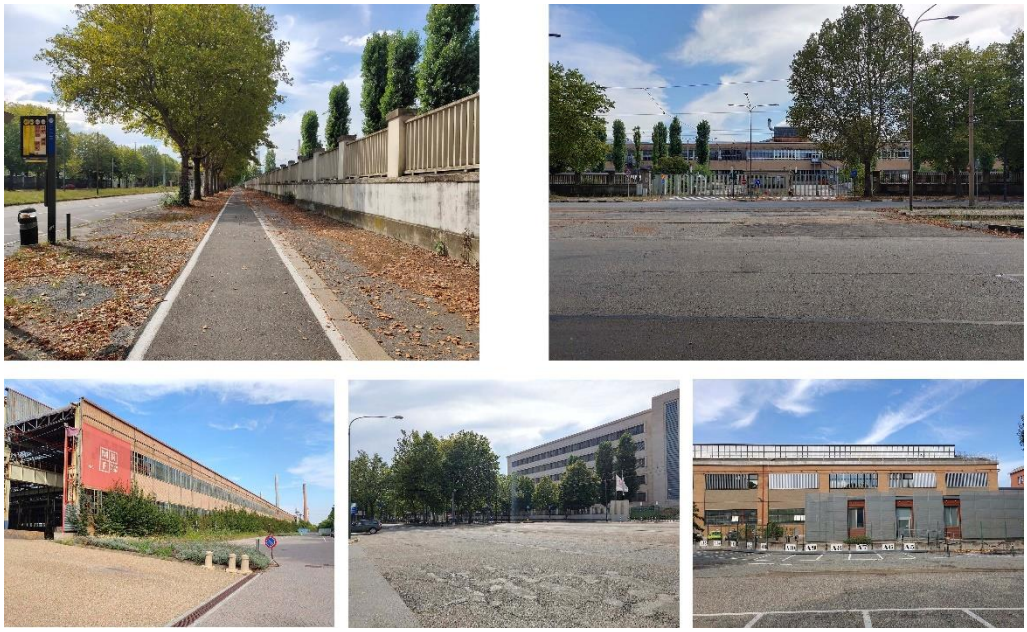


图3.9 工厂周边现状照片

图片来源：笔者自摄

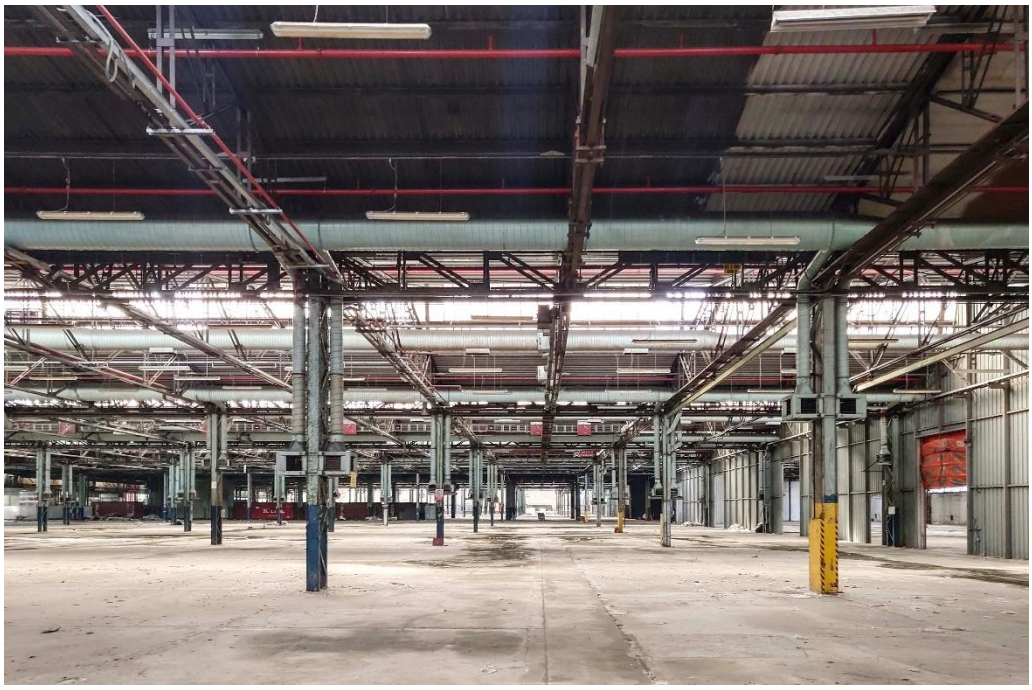


图3.10 厂房内部连续空间

图片来源：笔者自摄

3.3.4 Lack of public space and basic service facilities

At the meso and micro level that this research focuses on, especially from the perspective of the actual operation of the renovation, the Mirafiori plant has the following problems: the physical environment needs to be improved urgently. The surrounding infrastructure is imperfect and the population attractiveness is weak. The style and functionality of the factory cannot meet the needs of contemporary urban life.

3.3.5 Preservation of collective memory and historical status symbols

The industrial assembly in Mirafiori is undoubtedly the collective memory of the entire Turin. Whether it is the collective strike in the 1960s to the unemployment wave of the industrial recession in the 1980s, the memory of the factory does not only exist in Mirafeiu. In the minds of the family members of the workers' dormitories around the factory, they even exist in the hearts of people in Piedmont. The picture below clearly shows the process of continuous renewal and expansion of the region for more than 100 years, and the symbolic significance of preserving its historical identity is beyond doubt.

1880-1908

1908-1936

图3.9 米拉费尤里工厂区域的不同历史时期

图片来源：笔者整理

3.4 chapter summary

From a macro point of view, the Mirafiori factory, like many industrial heritage renovations, is faced with the problem that the former location makes the area difficult to adapt to the urban development. As factories are gradually incorporated into the city's territory, phenomena such as road networks, landscapes, and supporting facilities gradually appear incompatible with the old city. These large-scale construction projects inevitably become "fortresses" that are separated from the city when dealing with urban texture problems. In addition, with the decline in the proportion of the Italian automobile industry in the international position, the gradual saturation of the automobile market and the decline in output demand caused by the weak economic downturn is an irreversible trend. The Mirafayuri region, which used to rely on automobile production as the leading model, is now unsustainable, and the region has not yet integrated into the urban economic cycle organically. As a result, the Mirafiori factory was gradually isolated or even abandoned.

Chapter 4 Strategy and Design-Mirafiori's Urbanization Renewal and Renewal

4.1 Overview of the retrofit design of the Mirafiori plant

4.1.1 Project planning

Planning to transform the factory into a competence center, a comprehensive technology center, compared to the traditional homogenization approach of transforming to a cultural and creative industrial park. In the context of Industry 4.0, smart factories, network entity systems, the Internet of Things, self-organized production models, and the integration of production, education and research are more suitable for the renewal and transformation of this industrial heritage.

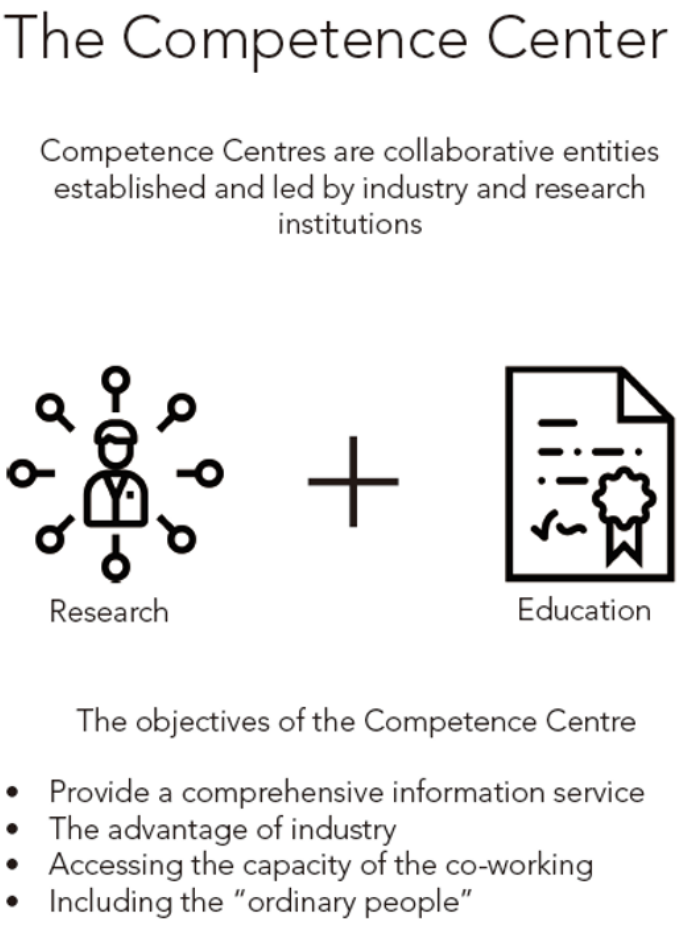


图4.1 策划本体

图片来源：笔者自绘

The comprehensive technology center is led by the city's industrial departments and research institutions, and aims to provide complex information services, take advantage of the position of the industrial zone, accommodate the working mode of exchanges and cooperation, and cover the daily activities of ordinary citizens.

图4.2 目标人群

图片来源：笔者自绘

4.1.2 Industry 4.0 as a development background

The previous article and the background of the era of "Industry 4.0" have been explained. Here, I clarify the requirements of "Industry 4.0" as the development background of the factory renovation project. Industrialization is the process of improving production efficiency led by technological progress. Therefore, the design of the integrated technology center should meet the high efficiency of the

modularization and internal manufacturing system.

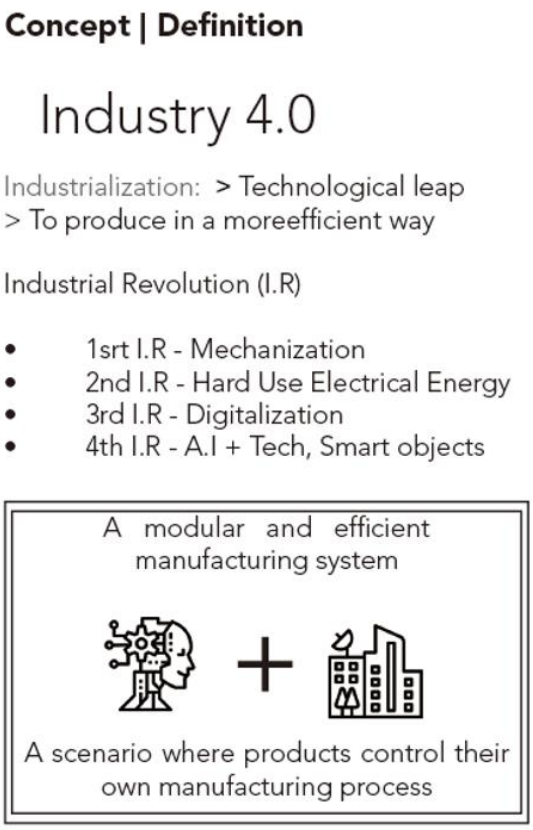


图4.3 策划背景分析

图片来源：笔者自绘

4.1.3 Operation management system setting

Through field research, there have been successful cases of successful transformation and operation of the Torino OGR Park, and through interviews with relevant persons in charge, it can be set that the park operation and management system should be adopted in this case, and the government will take the lead in granting certain financial subsidies and low-interest loans. Non-governmental non-profit organizations (NGOs) give certain financial support. For example, the CRT Foundation invested more than 100 million euros in the OGR Park, accounting for more than 50% of the total investment. And through profitable project funds such as renting shared office land, light laboratories, and heavy laboratories collected in the later operation, the bank loans will be gradually repaid until it becomes profitable.

4.2 Renovation design for site activation

4.2.1 Current conditions and strategies

1. Protection and continuation of industrial culture. The various equipment and structures left on the abandoned site have special historical value, and the author believes that they should be retained as a landscape element to participate in site activation. Through the design as an outdoor exhibition and children's entertainment venue, the status quo can be preserved and continued.

图4.3、图4.4 场地遗留的混凝土梁和钢梁

图片来源：笔者自摄

2. The overall layout of the plant is fully protected. In addition to the broken enclosure structure, the main structure is selected for comprehensive protection. The overall spatial scale and spatial characteristics of the original factory building are thus preserved. The biggest feature of the old structure of the factory is that it is homogeneous and continuous, with ample area, and the modular roof has the possibility of accommodating multiple uses. The evenly spaced grid of 10 meters by 20 meters, similar to the grid structure in La Villette Park, provides a coordinate system for the "urbanization" of the factory.

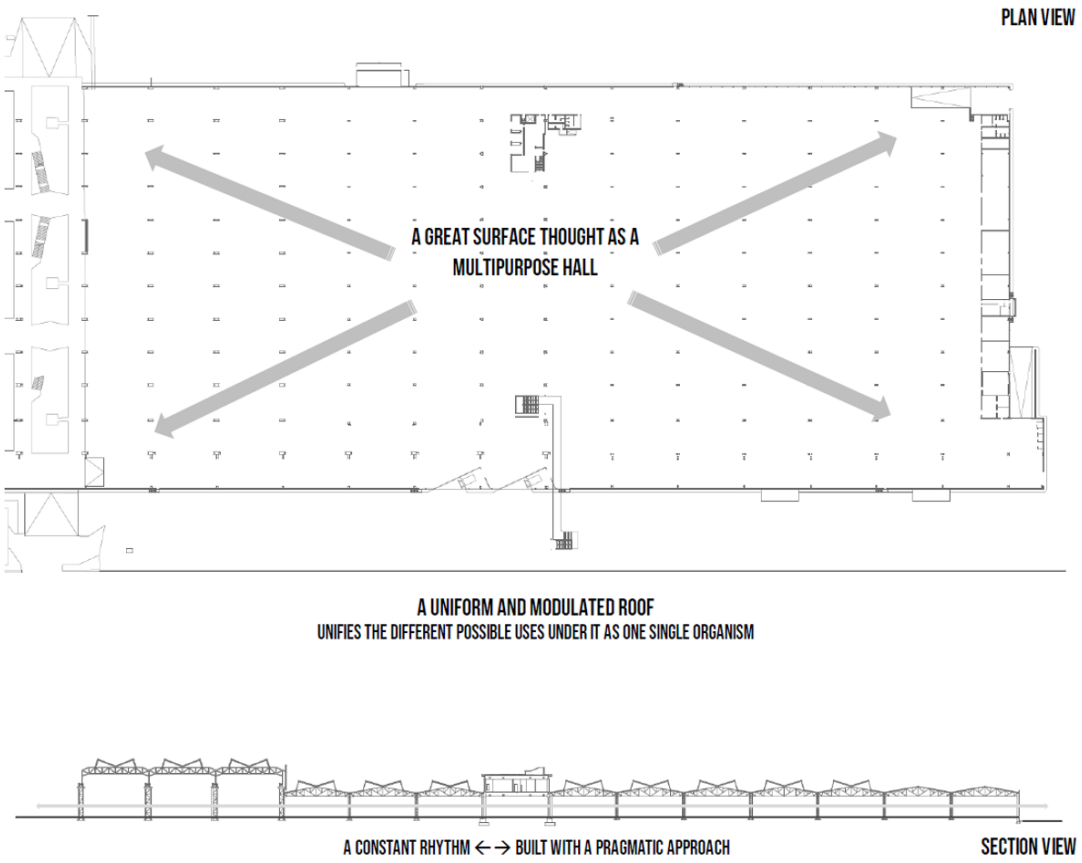


图4.3 工厂平面及剖面

图片来源：笔者基于资料自绘

4.2.2 Function planning

The project hopes to form a new industrial complex integrating urban space, basic services, office, research and development, laboratories, and business incubation. Among them, the smart factory part needs to set up a light laboratory and a heavy laboratory to meet the space needs of different uses, and form a functional complement to the information center of the Politecnico di Torino that has been transformed on the west side.

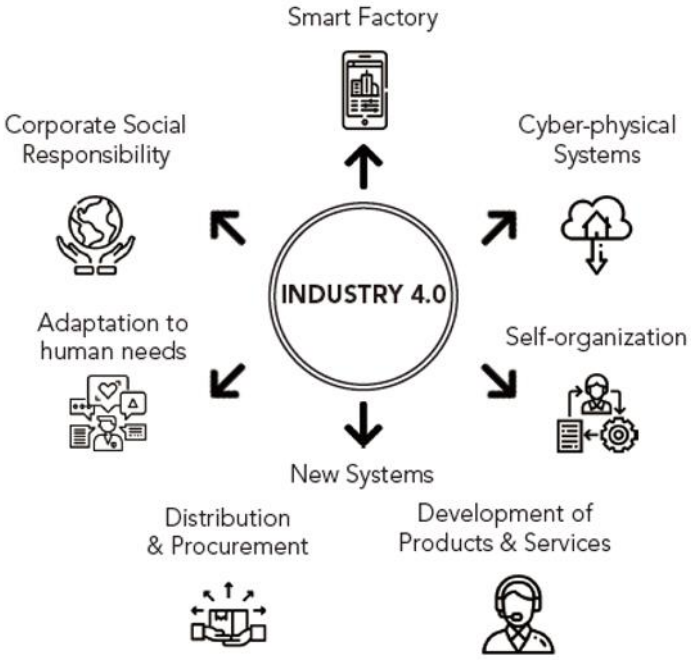


图4.4 工业4.0下的功能策划

图片来源： 笔者自绘

4.2.3 Remediation of the external environment

The first task facing the remediation of the external environment is the design and processing of the "border zone". While demolishing the original partition wall of the factory, the boundary between the factory and the main urban road is softened. Design landscape greening and exhibition installations. The landscape adopts a grid module closely related to the 20m horizontal span of the factory, or sinks or rises, and part of it is set with landscape pools. Here, the checkerboard design is closely related to the internal design of the factory, as shown below.

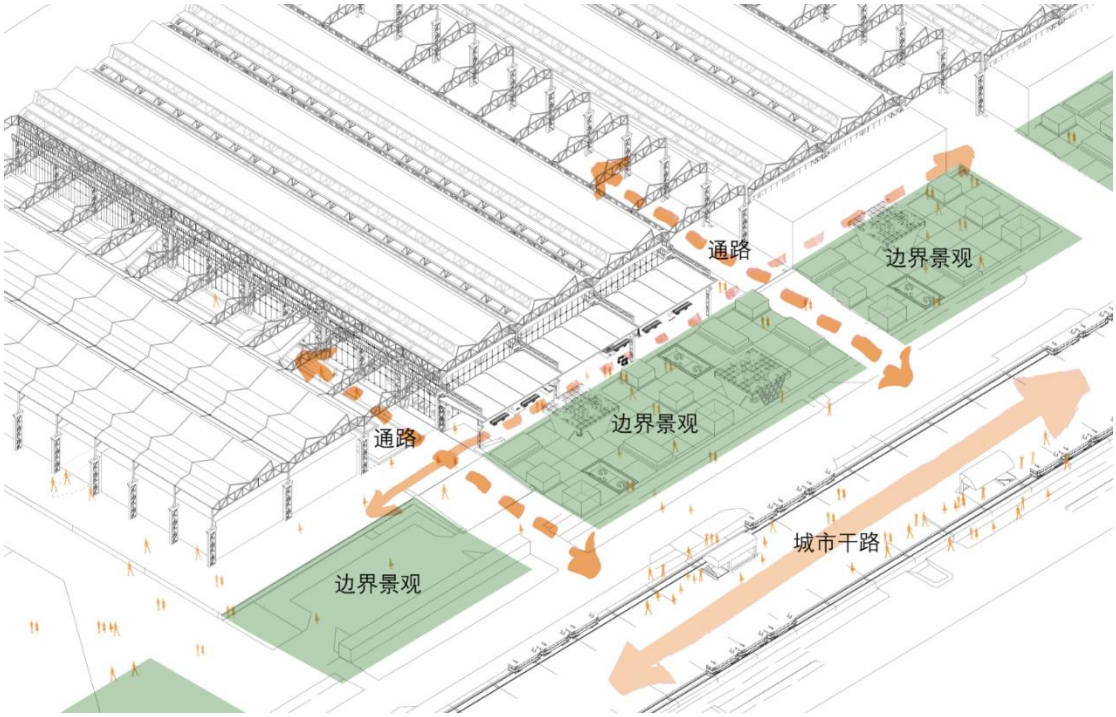


图4.5　工厂用地边界承载城市活动

图片来源：　笔者自绘

图4.7　边界环境设计鸟瞰

图片来源：　笔者自绘

图4.8　效果图 城市道路看向建筑主体

图片来源：　笔者自绘

4.3 Retrofit design for function replacement

4.3.1 Current conditions and strategies

After combing and thinking about the known problems, the solution I gave is to open up a layer of space to the city, especially the side close to the city road. The internal space is subdivided and functionally reorganized and managed to hang up.

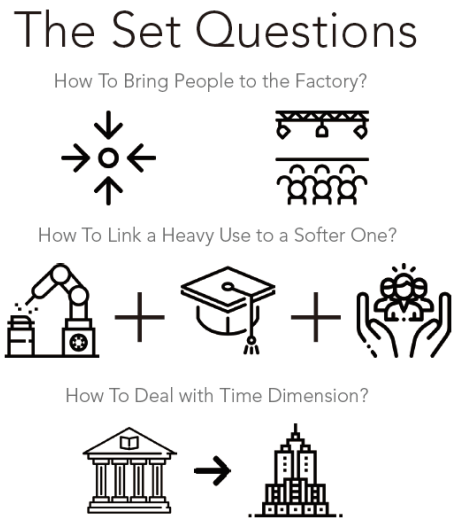


图4.7　问题思考梳理

图片来源：　笔者自绘

The original structure is retained, and the new structure bears all the new loads,

and it is juxtaposed and compared with the old structure. As shown in Figure 4.7, the newly implanted volume is based on the essential difference of the planning laboratory. The light laboratory is suspended on the new structure, and the heavy laboratory falls on the ground.

图4.7　结合功能的空间策略

图片来源：　笔者自绘

4.3.2 "Hanging mezzanine" as a vertical expansion of space

The transformation and renewal of Torino OGR analyzed above and many historical successful cases show that adding mezzanine is a feasible way to expand the space capacity of the giant factory in the vertical direction. The mezzanine in this design adopts the "suspension" method, as one of the innovations, not only logically self-consistent, but also feasible at the structural level.

As shown in Figure 4.8, there is still a 2.65 to 3.30-meter-high headroom between the top of the suspension beam and the roof truss beam in the original old structure. Enough to accommodate the newly added structure. As shown in Figure 4.9, the newly added structure is delicately separated from the old structure without adding any new load to the old frame.

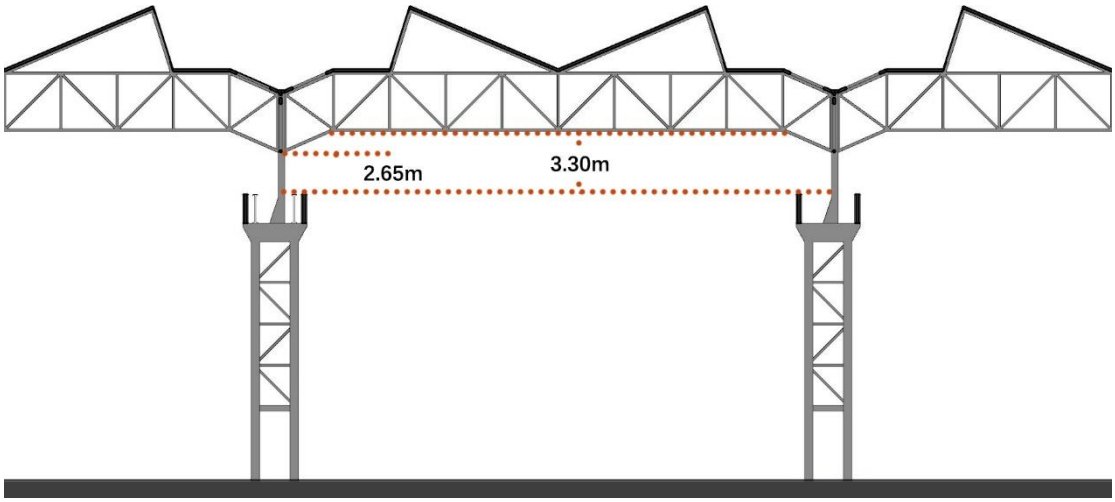


图4.8　结合可行性

图片来源：　笔者自绘

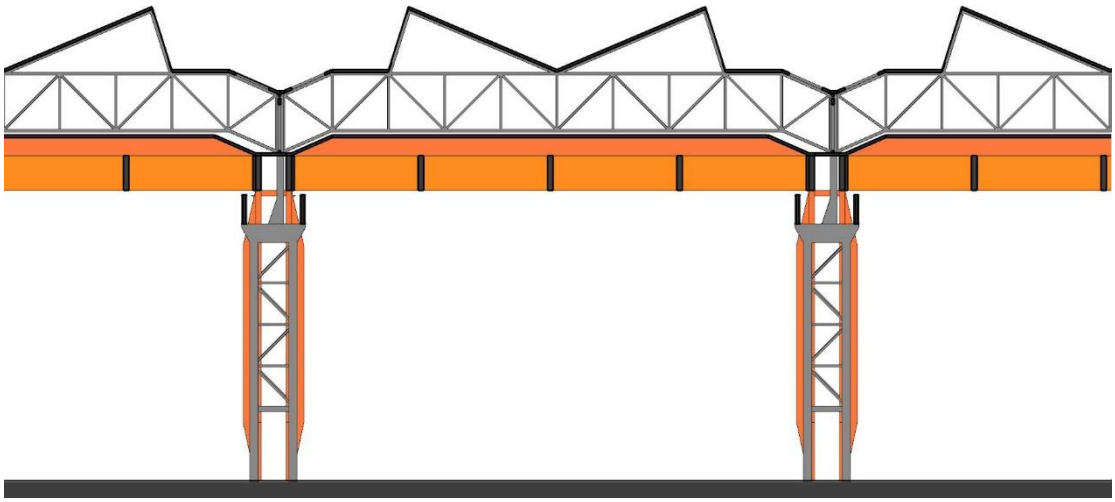


图4.9　新增结构示意

图片来源：　笔者自绘

So far, the design has made a preliminary answer on the publicity of the ground floor, the feasibility of the structure and the matching of new functions with the old structure, and strives to create two "off-hook space" (off-hook space) and floor-standing "showcase" . These concepts, one on top of the other, contrast in light and heavy, and complement each other.

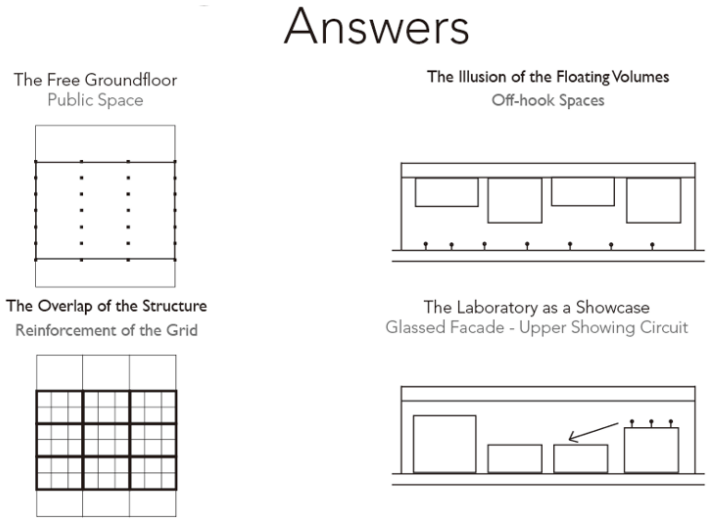


图4.10　问题回答整理

图片来源：　笔者自绘

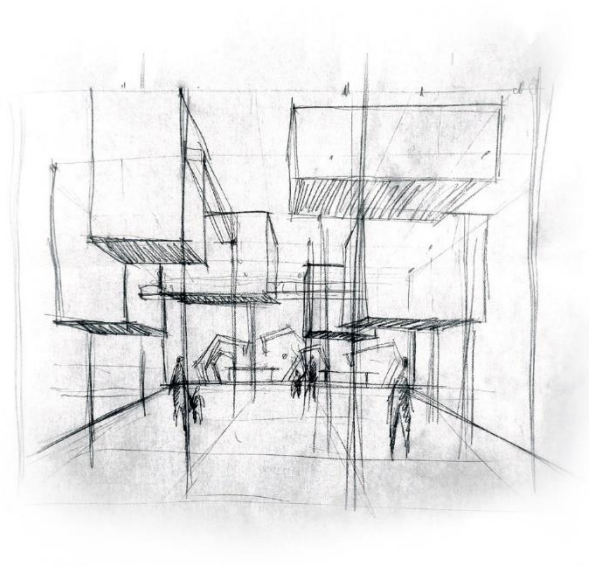


图4.11 概念意向图

图片来源： 笔者自绘

The new tic-tac-toe beams form a huge braided beam to hang the volume that will be placed next.

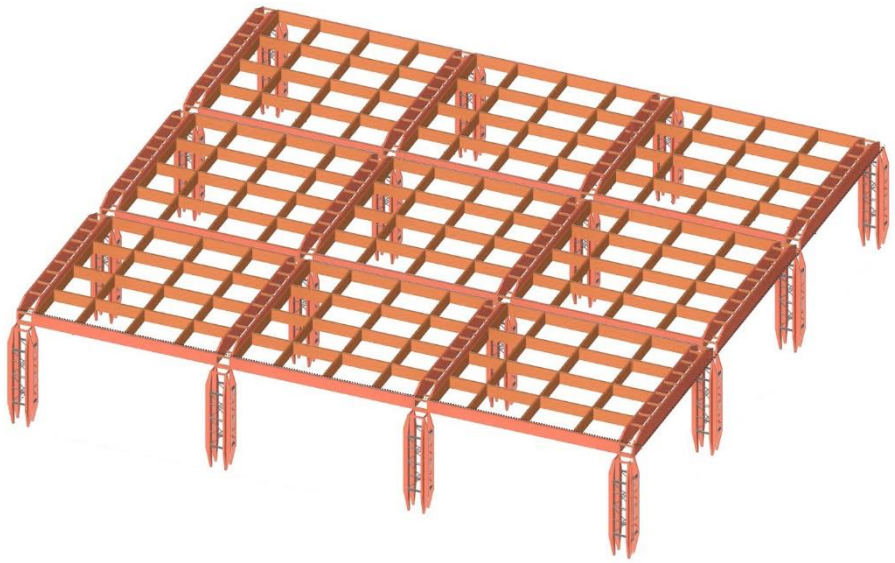


图4.12 新井字梁体系

图片来源： 笔者自绘

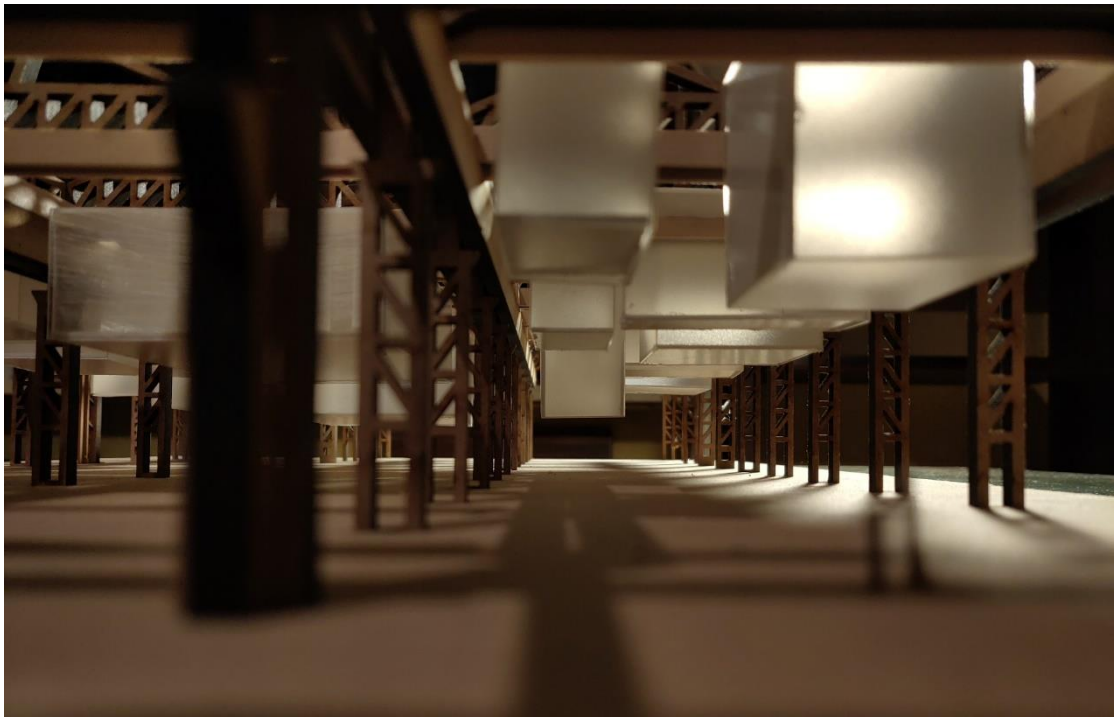


图4.13 概念模型照片

图片来源： 笔者自制自摄

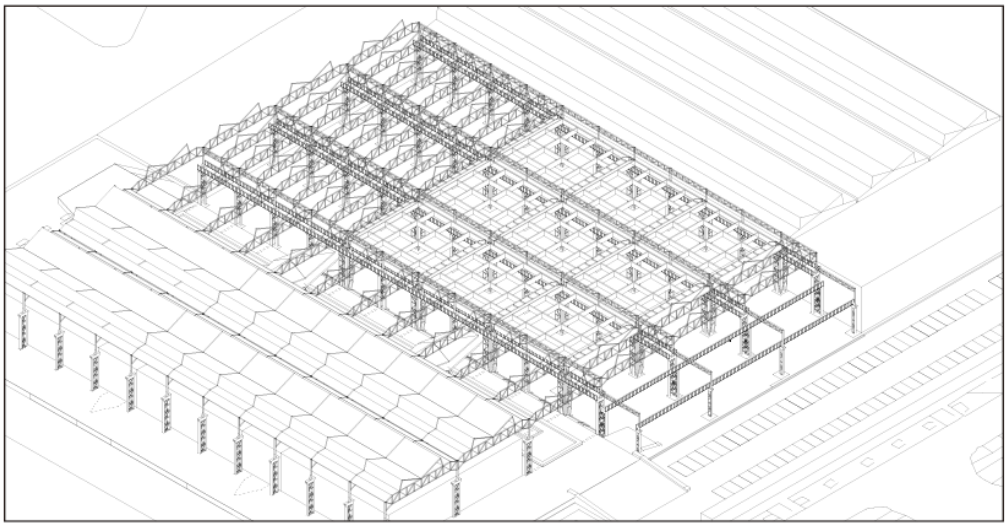


图4.14 新旧屋架并置共存

图片来源： 笔者自绘

4.4 Reconstruction design of juxtaposition of new and old

4.4.1 The old structure as the "anchor" of the city

Refer to the successful case of the Dora Skate Park in Turin with regard to the retention strategy of the structure as a marker. This case intends to retain as many original structural columns as possible, and in the final presentation, they will be painted with red anti-rust paint and orange bright color paint. The new structure of the painting is distinguished visually. It achieves the role of an urban "anchor" similar to the red structures in La Villette Park.

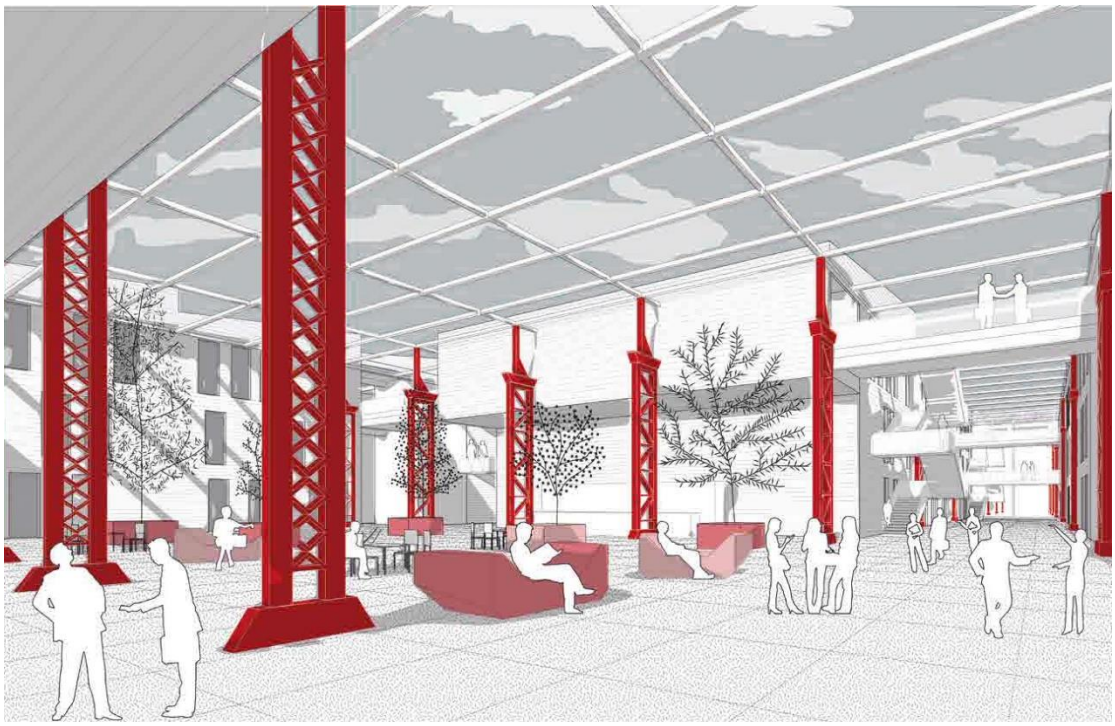


图4.15 室外老结构的红色涂装

图片来源：MRF项目组共享资料

4.4.2 Structural design of new and old handover

Designing a structural column that can support the new volume became the beginning of the design. Keep the original representative long-span steel structure, set up new lattice columns around the old columns and completely separate from the old structure in the depth direction, set up a new column every other old column, so that the original 20*10 column network is enlarged. 20*20. The four-in-one lattice column weakens the size of each member and the overall new column has a larger cross-sectional size. The new column net is enough to hold the new Tic Tac Toe beam, the

beam height is close to 2 meters, using the original clear height between the column top of the old structure and the roof. At the same time, the shape of the new structural column conforms to the deformation of the frame structure under the action of vertical force.

图4.16 新旧结构柱构造模型

图片来源： 笔者自制自摄

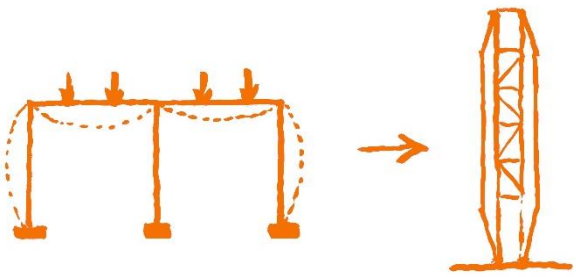


图4.17 框架结构受竖向力作用下的变形

图片来源： 笔者自绘

4.4.3 Matching new and old space

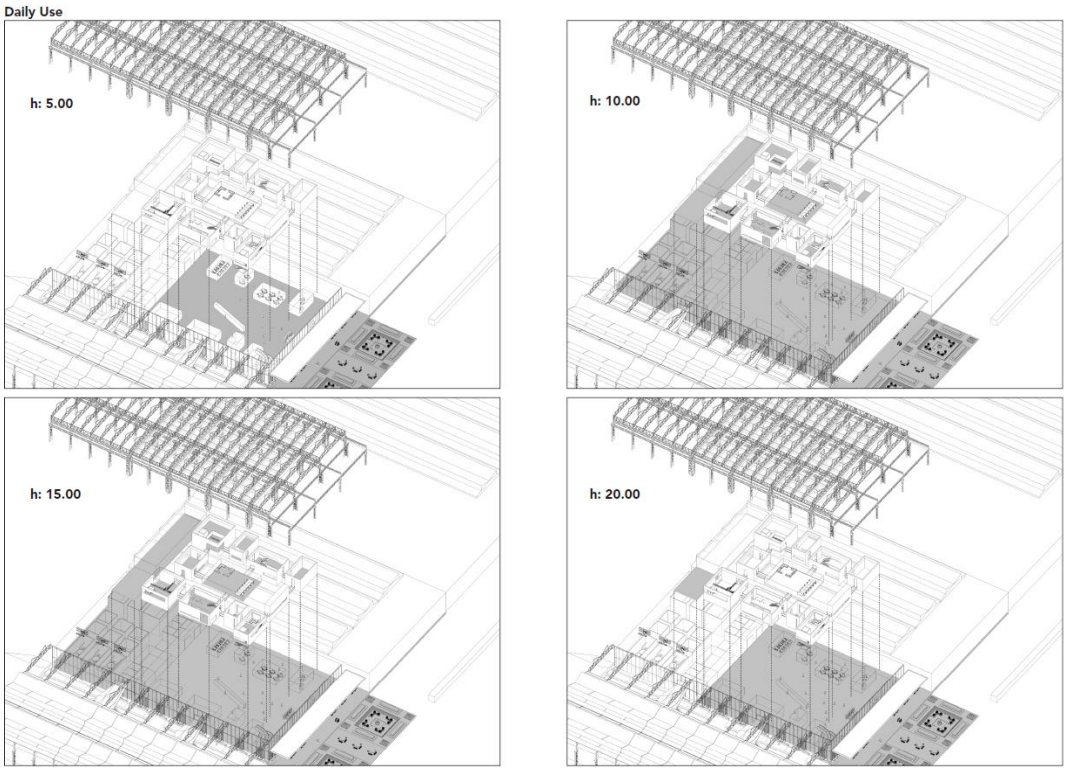


图4.18 分时使用的适应性策略

图片来源： 笔者自绘

Function blocks of different sizes are placed, and the possibility of using it in different periods is designed. As shown in Figure 4.18, at different moments, the comprehensive technology center can be opened in districts to implement effective management in the face of different users. In addition to the light laboratory, the suspended volume also includes functions such as renting a maker office and other functions that require flexible use of time periods.

4.4.4 "Large office model" as a reintegration of space

In section 2.4.5 of this article, we have discussed the spatial model of office reuse in the mega-factory. In this design, the spatial structure of "comprehensive large office mode" is adopted. Design a dominant public staircase in the center, which has a

tea break function and meets the needs of temporary reports and performances. From the organizational relationship on the second floor in Figure 4.19, it can be seen that the small office and other auxiliary and traffic spaces are centered on the large central space, which is relatively independent and can achieve close contact and efficient traffic. This model has proven spatial organization capabilities and reintegration capabilities.

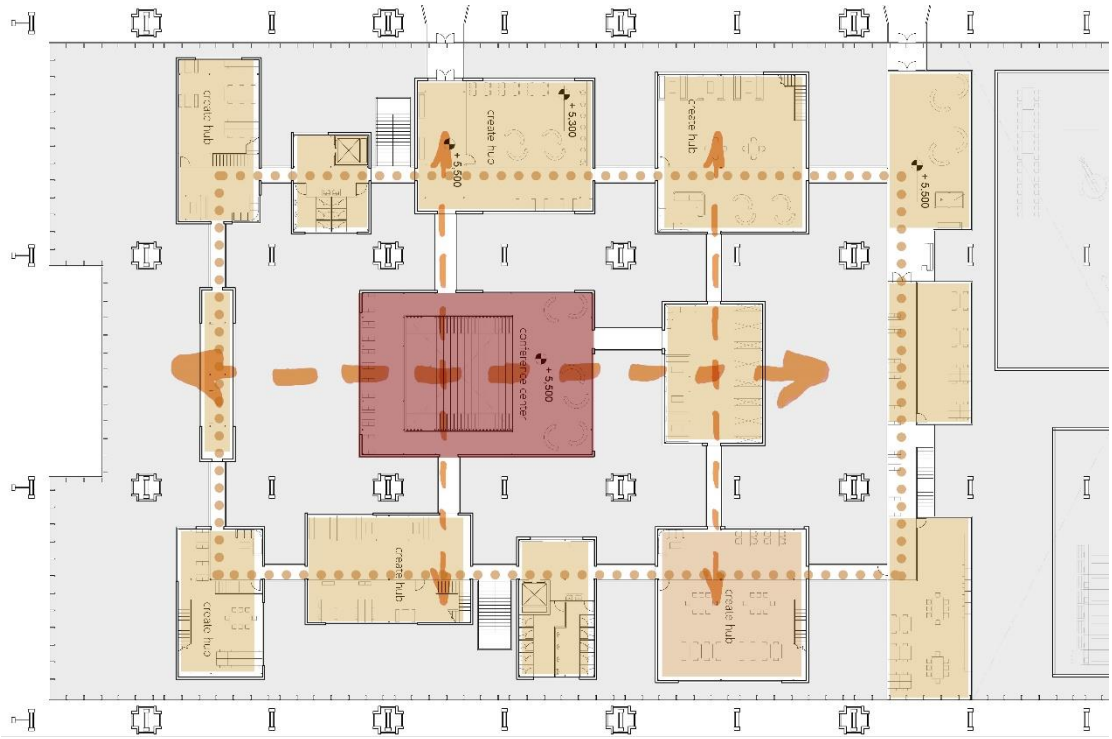


图4.19 二层平面组织关系

图片来源： 笔者自绘

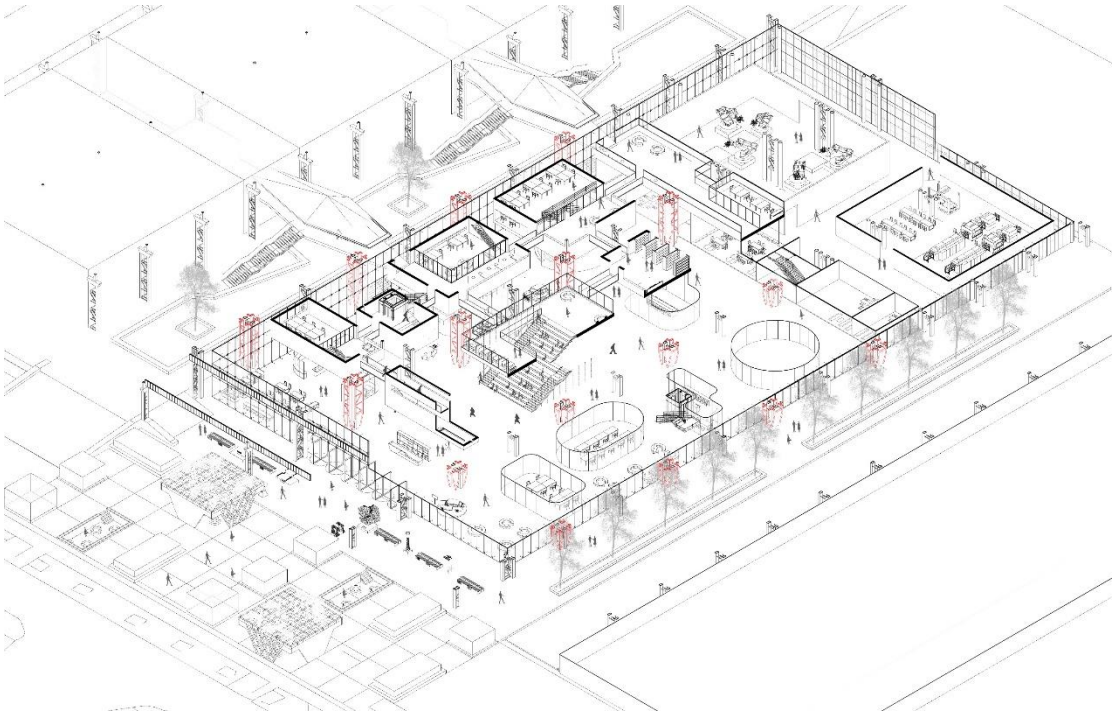


图4.20 轴测图

图片来源： 笔者自绘

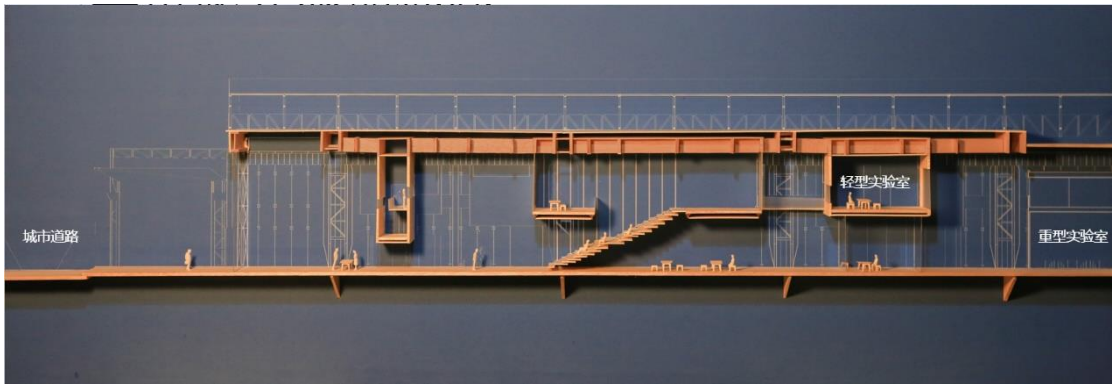


图4.21 典型剖面模型

图片来源：笔者自制自摄

Figure 4.21 shows the unique organization of this spatial structure. The ground is open to the city, and the upper functions are relatively independent and can be managed and operated independently. The heavy laboratory is the most private and in the deepest place, but at the same time it has the possibility of being visited on the second floor as a showcase.

4.4.5 Technical points

1. New lattice column shape design. The vertical force of the reference column adopts the overall shape of a spindle with thin ends and thick middle.
The new lattice column cannot apply any new load on the old structure. The bearing capacity of the pile foundation under the original column needs to be recalculated. During the actual civil construction, it is not ruled out that the old structure is numbered and temporarily demolished, the piles are re-driving and the original steel columns are "assembled back".
2. Glass curtain wall design.
In order to achieve the lightest visual effect, the structural curtain wall has become the first choice in this design, as shown in Figure 4.22. The author also carried out specific calculations of wind load and snow load (mainly considering accumulation side thrust) based on the parameters of Piedmont, Italy, including wind internal pressure and surface static wind pressure.

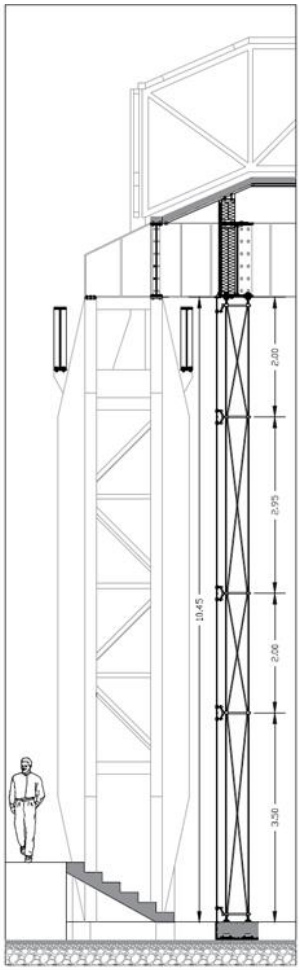


图4.22 幕墙剖面图
图片来源：笔者自绘

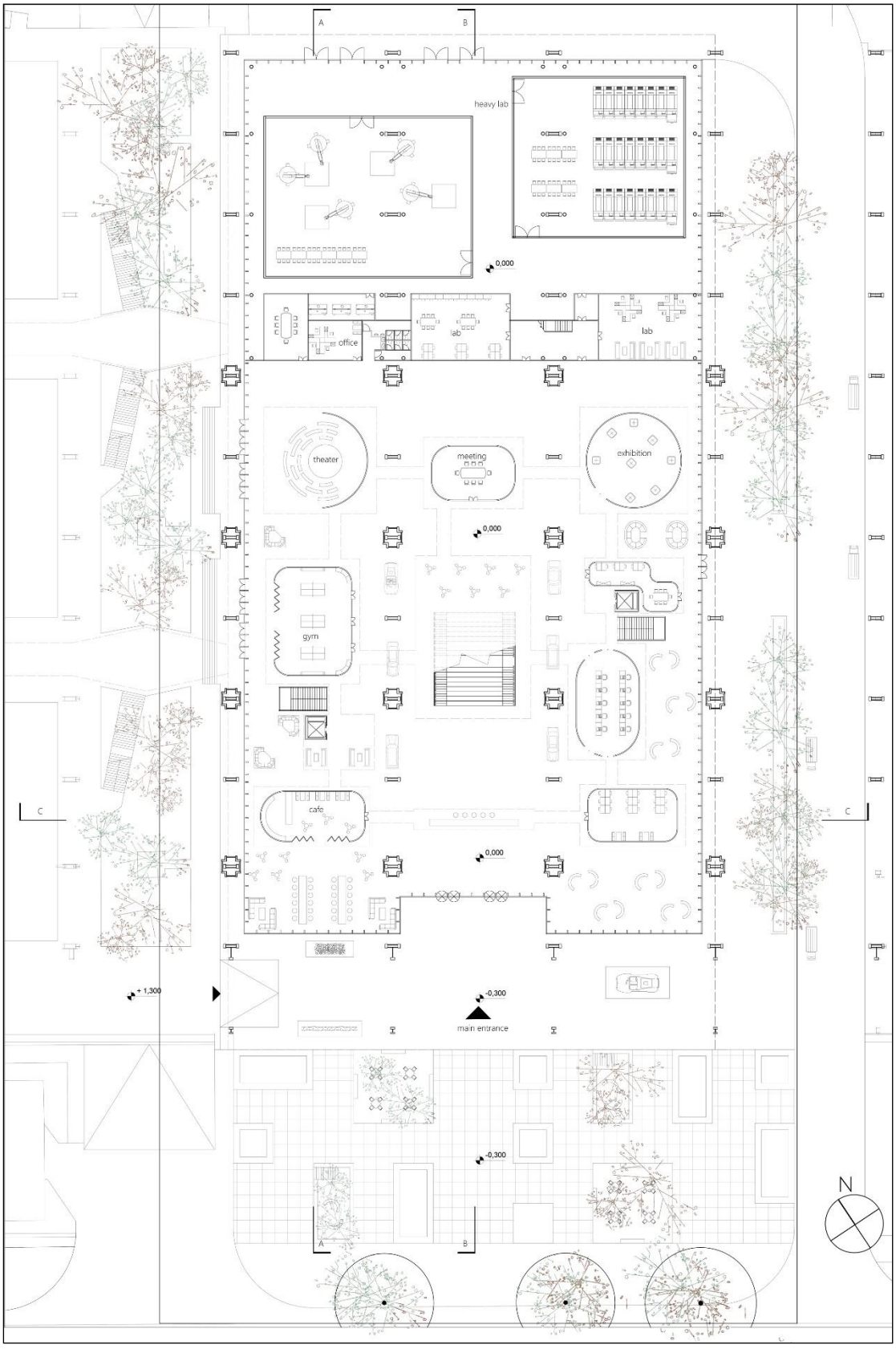

A
B
heavy lab
0,000
office
lab
lab
theater
meeting
exhibition
0,000
gym
C
C
cafe
0,000
+1,300
-0,300
main entrance
-0,300
N
A
B

图4.23 一层平面图

图片来源：笔者自绘

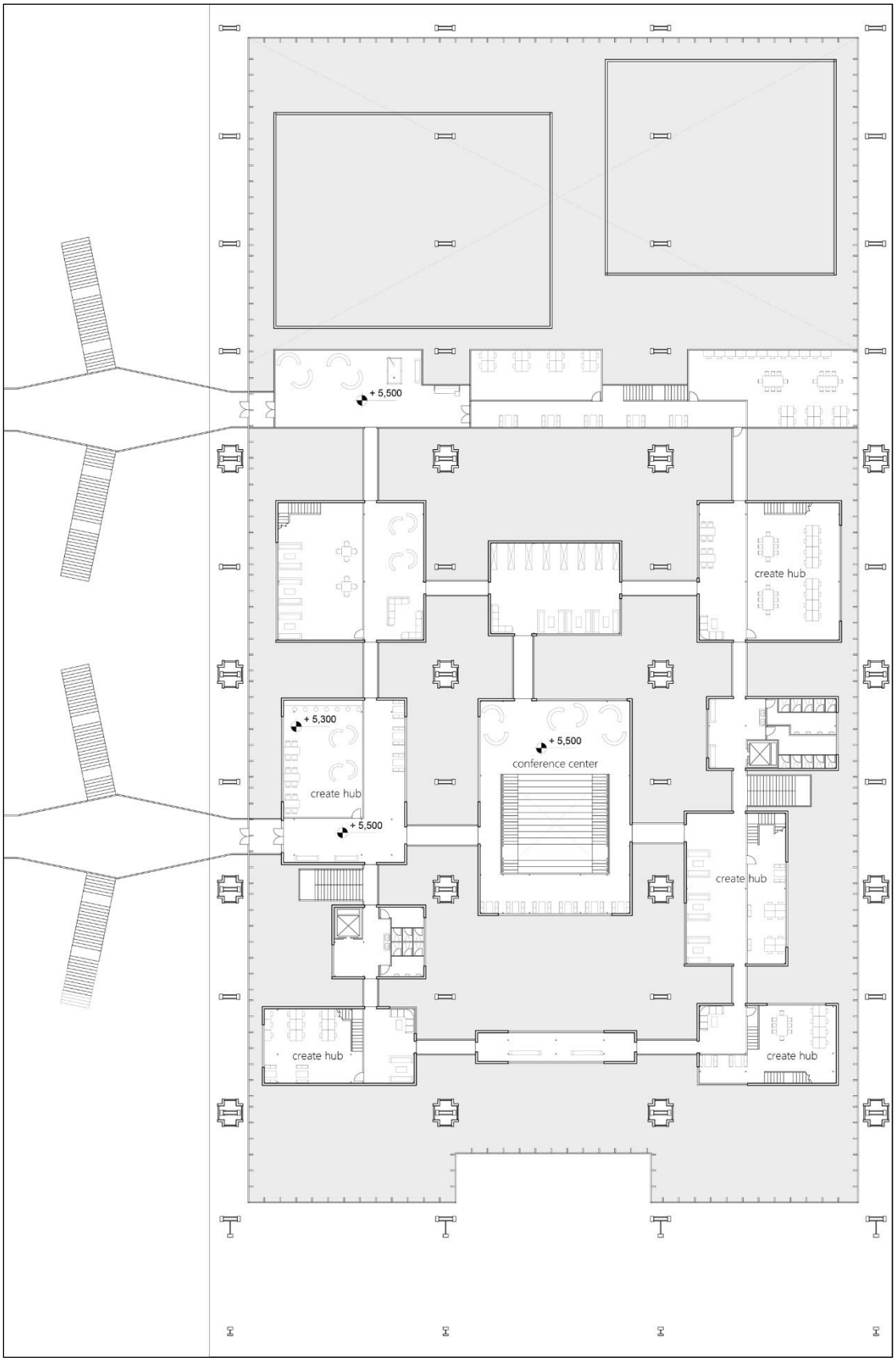


图4.23 二层平面图

图片来源：笔者自绘

4.5 Design summary

The renovation of the Fiat Mirafiori plant in Turin has its own particularities and the universality of the problems faced by the renovation and renovation of contemporary urban industrial heritage. The special study hopes to use the experience and reflection of the project design process, based on the current situation of the Mirafiori factory, to summarize the characteristics of the project transformation: starting from activating the site, giving the site public space and connecting to urban life, making full use of the factory The structural characteristics of factory buildings, the inherent advantages of large spans, multiple spans, high headroom and high space capacity, fully retain the unique architectural elements of industrial buildings. Preserve people's collective memory and historical status symbols. The new functions conferred provide the city with new activities. At the same time, the location and role of the project in urban renewal are clarified. On this basis, a typical strategy for the renovation and renewal of industrial heritage in contemporary cities is extracted to provide a reference for the renewal and renovation of similar industrial heritage in the future.

Chapter 5 Rethinking and Summary of the Urbanization of Factory Buildings

5.1 The representativeness and universality of this type of single-story and multi-span factory buildings

The key research object in this article-the Mirafiori plant of Fiat Chrysler in Turin, is extremely representative. The renewal and transformation design of the single-story, continuous multi-span giant factory building meets the domestic demand for major industrial development and transformation from the founding of the People's Republic of China in the last century to the 21st century. Countless domestic industrial remains with similar structures can be used as a reference.

5.2 Rationalization of the operation management process in the project

Renewal projects initiated by asset owners often have more autonomy, and those who dare to challenge are often more inclined to choose to renew and reuse instead of discarding and overthrowing and rebuilding. However, considering the nature of private development, these projects are more likely to face over-tourism and commercialization. Become a shopping mall with shopping as its main purpose. Therefore, the reuse project of industrial heritage is complicated, especially related to the impact of the neighborhood, which requires more public participation.

From the perspective of development and operation models, public-private partnership development is obviously more worthy of reference. Usually the government strengthens direct intervention in the industrial heritage area, adopting the model of direct government purchase of land to construct the site infrastructure, and then sell it to the developer for construction by private capital. The advantage of this model is not only the effective use of social funds, the development and reuse of industrial heritage, but also, because this is the entire transfer of the entire region, the builders will plan from the perspective of the entire region, which is beneficial to the overall site Improve the success rate of transformation with the continuation of style.

At the same time, industry support is particularly important for the sustainable

development of a region. The endurance of an industry is inseparable from several complete industrial chains. We can start with the knowledge industry chain, combine the concept of smart factory in "Industry 4.0", and combine production, education and research. Provide complete knowledge industry services such as complete supply of raw materials, design and production, and transactions. It will not only prosper the regional economy and attract popularity, but more importantly, it will form a scale with many domestic knowledge and creative industrial parks and form a differentiation strategy.

5.3 The Status Quo and Problem Analysis of the Renewal and Transformation of Industrial Heritage in China

After years of development, the renewal and reuse of China's industrial heritage has gradually formed the following relatively fixed chaebol models, mainly: cultural and creative business models, tourist attractions, urban landscape park models, museums, and exhibition halls. However, as the number of industrial heritage continues to rise, the types of industries that need to be transformed continue to increase, subverting the inherent model, and adding diversified architectural functions to effectively meet the urban development and renewal, so as to achieve the real purpose. In this research, in view of the huge old factory building in the current urban construction and development process, in-depth exploration and explanation of the development process, theoretical achievements, implementation strategies and other content of the reuse of old industrial buildings, and borrowing from the relevant Italian Practical cases are used to summarize the strategies of reuse of old industrial buildings in foreign countries, and analyze the operability and popularization of the reuse of old industrial buildings in the development of urban construction in my country. Based on the actual operation of Fiat’s old factory in Mirafiori, Turin, Italy, explore the renewal strategy of mining resources-sorting out problems-proposing a vision-planning strategy-point implementation, and exploring the goal of "urbanization" The renewal and development strategy of the factory-type industrial heritage.

However, the renewal and reuse of my country's current industrial heritage usually has a very common phenomenon: that is, the reconstructed site has a small visitor flow or the overall utilization rate is very low. This means that the reused building space has not truly been "urbanized" into the public life, or the role of the reconstruction of the building has not been fully utilized. There is a serious disconnect between the life of

urban residents and the urban space in this area, and it has not evolved into an urban public space and has not played the role of serving the public. Therefore, in the future renewal and transformation of industrial heritage, it is very necessary to combine social needs and the awareness of serving the public, so as to truly inject new vitality into the declining urban industrial zone and the city.

5.4 Enlightenment on the renovation and renewal of similar industrial heritage in China

In the process of urban industrial transformation, Turin, Italy has formulated a sustainable development strategy, so that the old industrial area that was on the verge of decline will once again be integrated into the urban economic development in the form of "urbanization", injecting strength into it. power. The successful renovation and renovation of many huge factories in Turin has given us very good guidance: how to revive the declining industrial area, how to effectively renew and renovate the industrial heritage from the perspective of urban design, How to take the public interest of urban residents as the core, all the above-mentioned contents need to be used for reference and learning.

Regarding the renewal and transformation of industrial heritage, in fact, the issue of public life in the city should be paid attention to. Since the service object of the building is only one, that is, people, which can be said to be the core of the city. Therefore, when renewing and transforming industrial heritage, we must first strictly follow the principle of "people-oriented", which is also a requirement for sustainable development at the soft level of the city.

At the spatial level, there is a mutual interaction between the internal environment of the area. "Relevance" can reflect the "layeredness" of a city's evolution in the course of time. Therefore, the formation, development, rise and fall of an industrial heritage are closely related to the development of the city in which it is located, which is characterized by "symbiosis". Therefore, when renewing and transforming the industrial heritage, we must start from the perspective of overall urban design and combine the local historical background, natural environment, economic conditions, and human factors to realize the "urbanization" transformation that promotes the development of the entire region. Update.

References

[1] 王建国. 后工业时代产业建筑遗产保护更新[M]. 中国建筑工业出版社,2007：80-110

[2] 庄简狄. 旧工业建筑再利用若干问题研究[D]. 清华大学,2004.

[3] 孟璠磊. 论" 工业建筑" 到" 工业建筑遗产" 的四个发展阶段[J]. 工业建筑, 2019 (05).

[4] 孟璠磊. 荷兰工业遗产保护与再利用概述[J]. 国际城市规划, 2017, 32(2): 108-113.

[5] 孟璠磊. 从 “域” 迈向 “场”: 城市设计视角下的工业遗产地边界改造研究[J]. 规划 60 年: 成就与挑战——2016 中国城市规划年会论文集 (06 城市设计与详细规划), 2016.

[6] 寇怀云, 章思初. 工业遗产的核心价值及其保护思路研究[J]. 东南文化, 2010, 20(1).

[7] 王建国,戎俊强.城市产业类历史建筑及地段的改造再利用[J]. 世界建筑,2001(6).

[8] 王路. 德国当代博物馆建筑[M]. 清华大学出版社有限公司, 2002.

[9] 李爱芳, 叶俊丰, 孙颖. 国内外工业遗产管理体制的比较研究[J]. 工业建筑, 2011, 1.

[10] 曾锐, 李早, 于立. 以实践为导向的国外工业遗产保护研究综述[J]. 工业建筑, 2017, 47(8).

[11] 李杨. 城市更新背景下的工业遗产保护与开发问题研究——以西安市为例[D]. 西北大学,2010.

[12] 彭飞. 我国工业遗产再利用现状及发展研究[D]. 天津大学,2015.

[13] 辛慧琴. 意大利古旧建筑保护及改造再利用浅析[D]. 天津大学,2005.

[14] 石克辉,薛冰洁,胡雪松. 结构美学视角下的旧工业建筑空间改造策略研究[J]. 世界建筑,2013.

[15] 刘抚英,崔力. 旧工业建筑空间更新模式[J]. 华中建筑,2009(03).

[16] 吴唯佳. 对旧工业地区进行社会、生态和经济更新的策略[J]. 国外城市规划研究,1999.

[17] 陈卓. 从单体建筑保护到老工业区保护与振兴——简析意大利老工业建筑及地段保护与再利用模式[J]. 规划师论坛,2007(05).

[18] 叶瀛舟, 厉双燕. 国内外工业遗产保护与再利用经验及其借鉴[J]. 上海城市规划, 2007, 3: 50-53.

[19] Michele Bonino. Parco Dora, Torino, Italy, 2004-2013[J]. WORLD ARCHITECTURE, 2013 (05).

[20] Ronchetta Chiara, Trisciuoglio, Marco. Progettare per il patrimonio industrial[M]. Torino: Celid, 2008.

[21] Comba M . Maire Tecnimont : i progetti FIAT Engineering 1931-1979 = FIAT Engineering projects 1931-1979[J]. 2011.

[22] Dansero E, Emanuel C, Governa F. I patrimoni industriali[J]. Una geografia per lo sviluppo locale, Franco Angeli, Milano, 2003.

[23] Ciuffetti A. L'archeologia industriale in Italia: storie e storiografia (1978-2008)[M]. FrancoAngeli, 2012.

[24] Palmer M. Industrial archaeology: principles and practice[M]. Routledge, 2012.

[25] Hudson K. Industrial archaeology: an introduction[M]. Routledge, 2014.

[26] Docci M. Oltre l'abbandono: il patrimonio industriale fra conoscenza e progetto[J]. 2010.

[27] Francesca De Filippi, Ianira Vassallo. Mirafiori sud: la città fordista oltre la Fabbrica, Scenari e progetti per (la costruzione di)una nuova identità[J]. Politecnico di Torino,2016(2)

[28] Colombo M. Riutilizzare gli edifici industriali dismessi: residenze universitarie a Mirafiori Sud[D]. Politecnico di Torino, 2015.

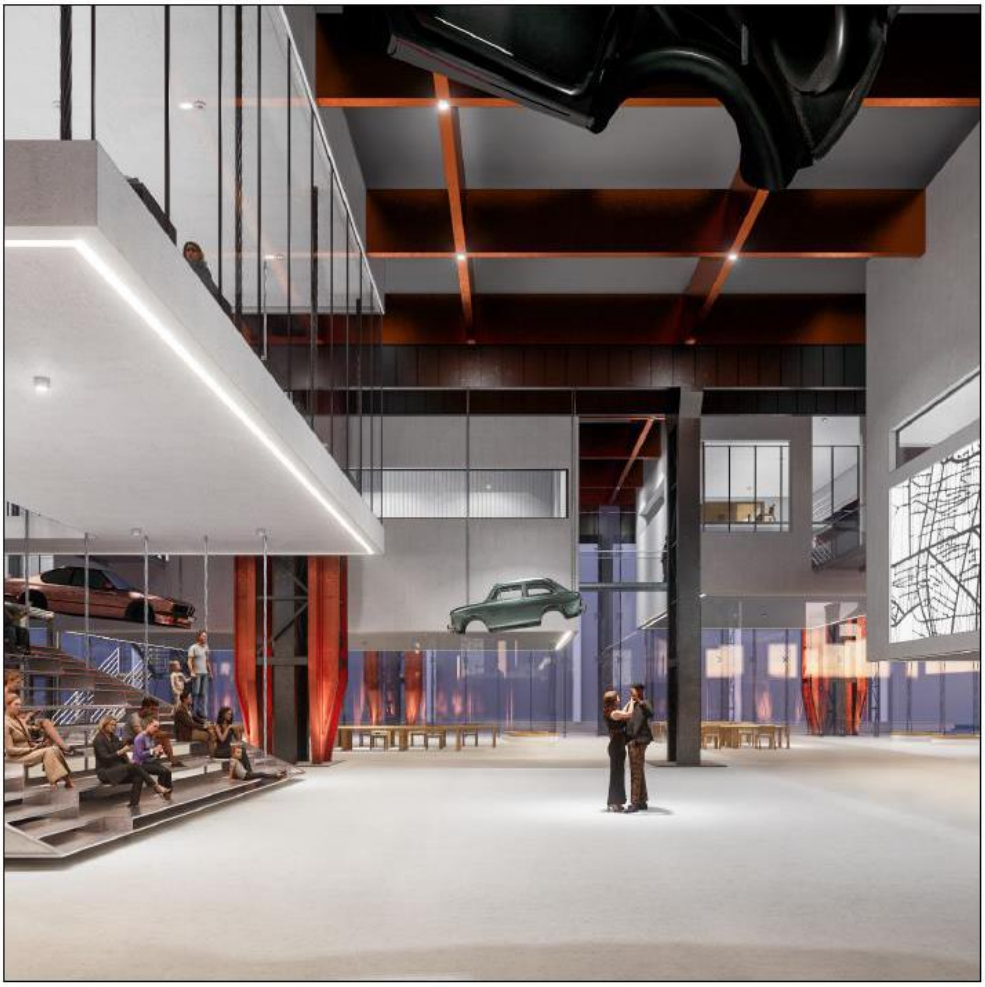
[29] Chierici P, Palmucci L. Per una storia del patrimonio industriale in Piemonte: il periodo napoleonico[J]. Publications de l'École Française de Rome, 1987, 96(1): 133-160.

[30] Battaglia A. Aree industriali dismesse: da patrimonio della storia industriale, a occasione di rinnovo urbano per le città odierne: un viaggio attraverso importanti interventi di rilievo nazionale, fino alla realtà delle dimissioni nella città di Rivarolo Canavese[D]. Politecnico di Torino, 2010.

[31] De Blasi M. Strumenti e metodi per la trasformazione valorizzazione di un patrimonio industriale nel Monferrato Casalese: il caso della ex Palli Alta Italia[D]. Politecnico di Torino, 2009.

[32] Gallo M, Lorenzino M. Problemi di recupero del patrimonio industriale: ipotesi di riuso dell'ex lanificio Bona di Via Salotto a Carignano[D]. Politecnico di Torino, 2005.

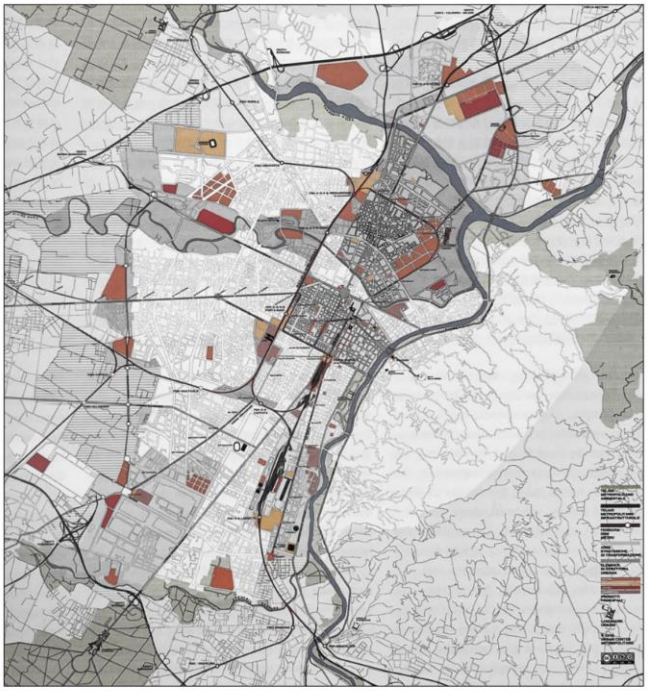
Appendix A Design drawings



巨构厂房的城市化改造策略——米拉费尤里工厂改造更新

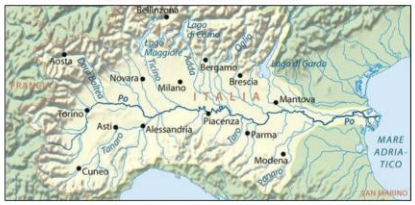
Urbanized Strategy of Factory Buildings Renovation——Conservation and Reuse of Fiat Mirafiori

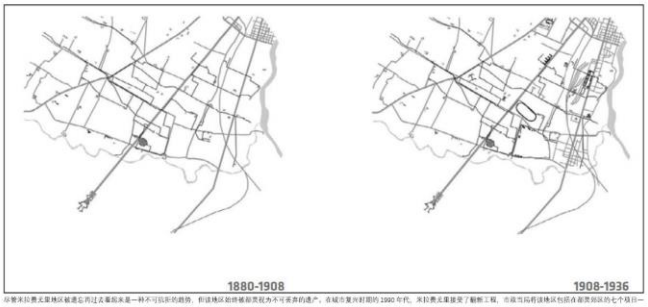
区位与资源 **01**

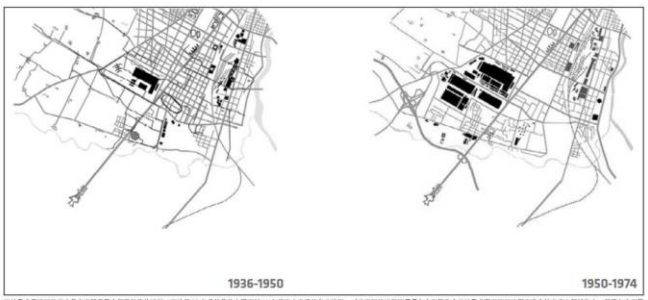


本项目研究为真实背景下的自选研究性设计任务，由菲亚特米拉费尤里工厂为平方主导的更新计划。

项目位置位于意大利皮埃蒙特大区都灵省都灵市区，设计范围包括原工厂的部分停产废弃部分，涉及规模 48800 平米，本研究将选取一个废弃工厂中的典型单层多跨厂房建筑进行改造的建筑设计研究，重点设计部分面积 12000 平方米。







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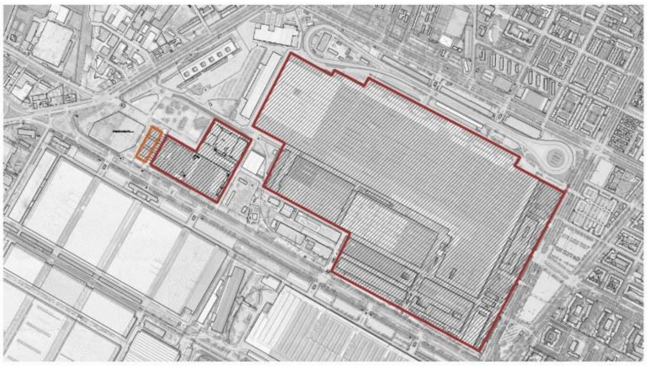
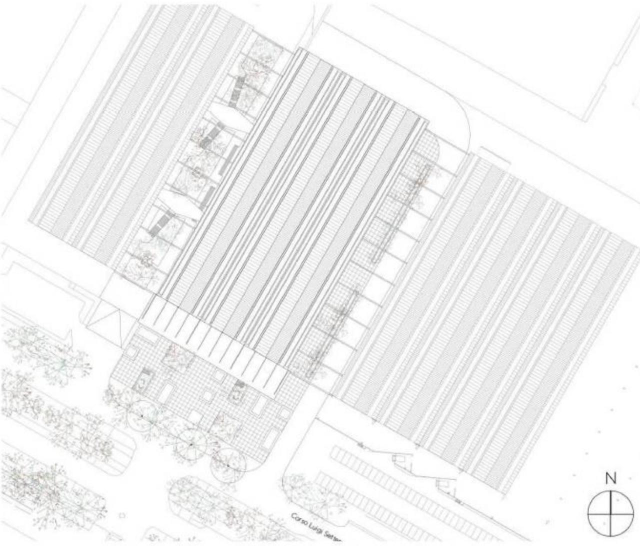
条件与评估 **02**



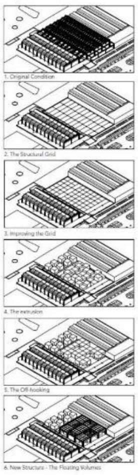
七十年代的米拉费尤里地区的社会空间建设良好运转，正如菲亚特公司的如日中天。然而八十年代的生产结构转型给这座工厂小城带来了危机，缓慢而令人痛苦。从那一刻起，不仅是生产活动，支撑该地区城市结构模型的经历了不可避免的资本撤资行为。

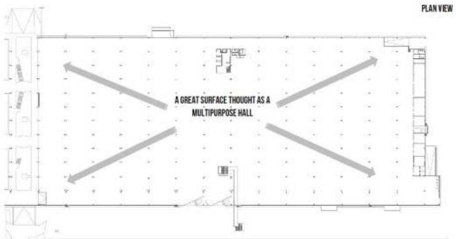
当时的危机导致了资本对该地区投资的"彻底化"放弃，包括逐步清空居民楼和厂房，这些居民楼和场所随着时间的推移已经早就成为了该地区重要的固定资产。邻近社区对其依赖严重，逐渐由于社区服务的缺乏，商业活动的减少，米拉费尤里工厂地区与城市其他地区的联系逐渐减少，城市结构稀疏且不连续。换句话说，当地人们目睹了七十年代建立的"社会保护网"的全面崩溃。

今天，生产活动已经更稀少了，但旧的土地所有结构却表现出持久的惯性：资本的撤离取决于城市空间、经济与社会之间建立的关系。建筑物和城市空间的原有连惯性掩盖了邻域间内在的逐年衰败。其原因有：一方面是产权的变化，另一方面是社会网络的崩溃。同意住房所属权曾属于公司。



Project Schemes





A UNIFORM AND MODULATED ROOF
UNIFIES THE DIFFERENT POSSIBLE USES UNDER IT AS ONE SINGLE ORGANISM

A CONSTANT RHYTHM ←→ BUILT WITH A PRAGMATIC APPROACH

SECTION VIEW

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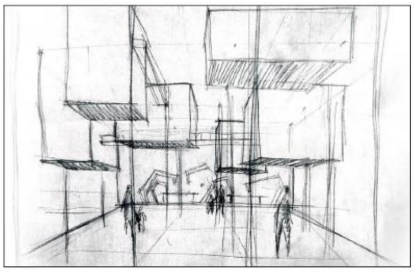

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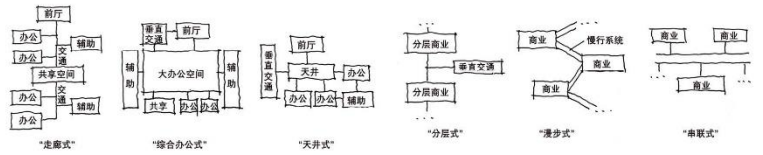
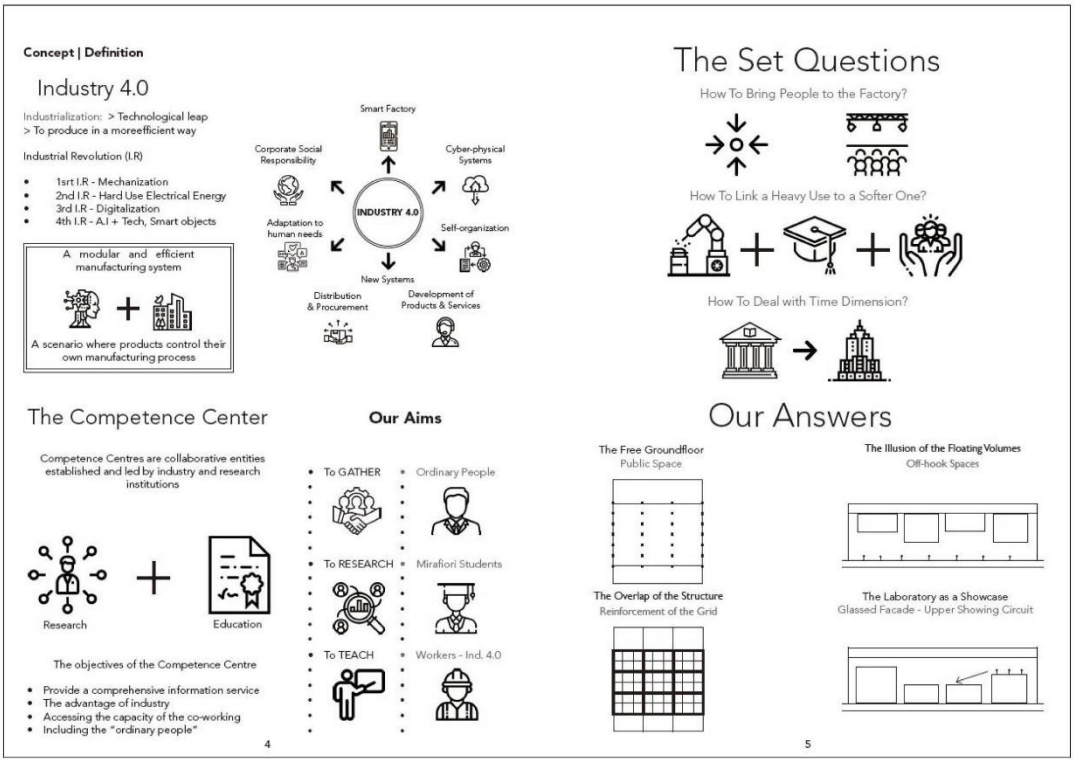
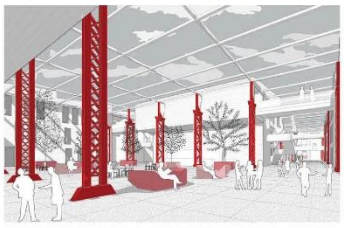
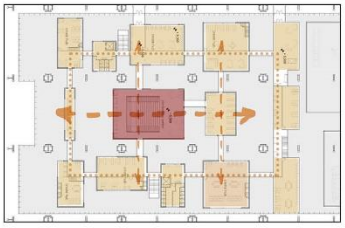
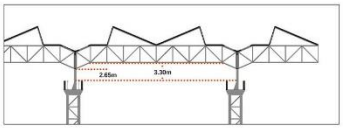
规划与策略 **03**

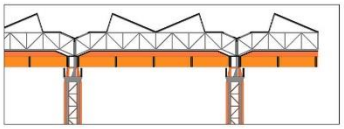


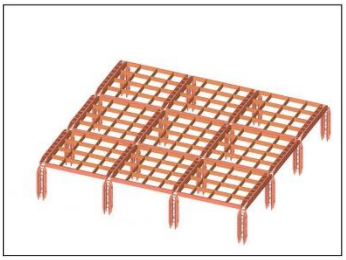


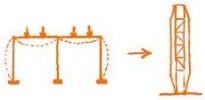


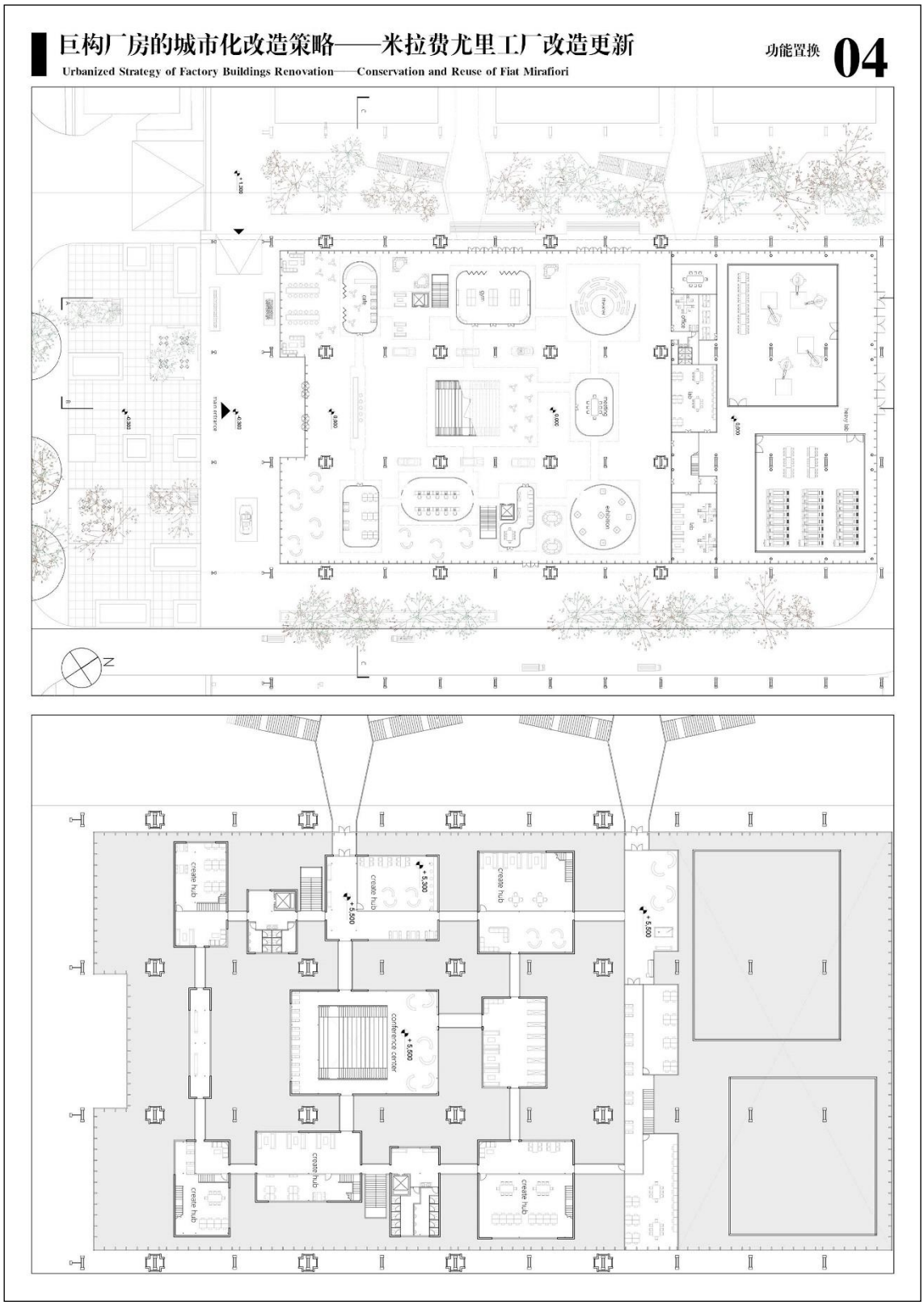








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Urbanized Strategy of Factory Buildings Renovation——Conservation and Reuse of Fiat Mirafiori
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conference center
+5.500
+0.000

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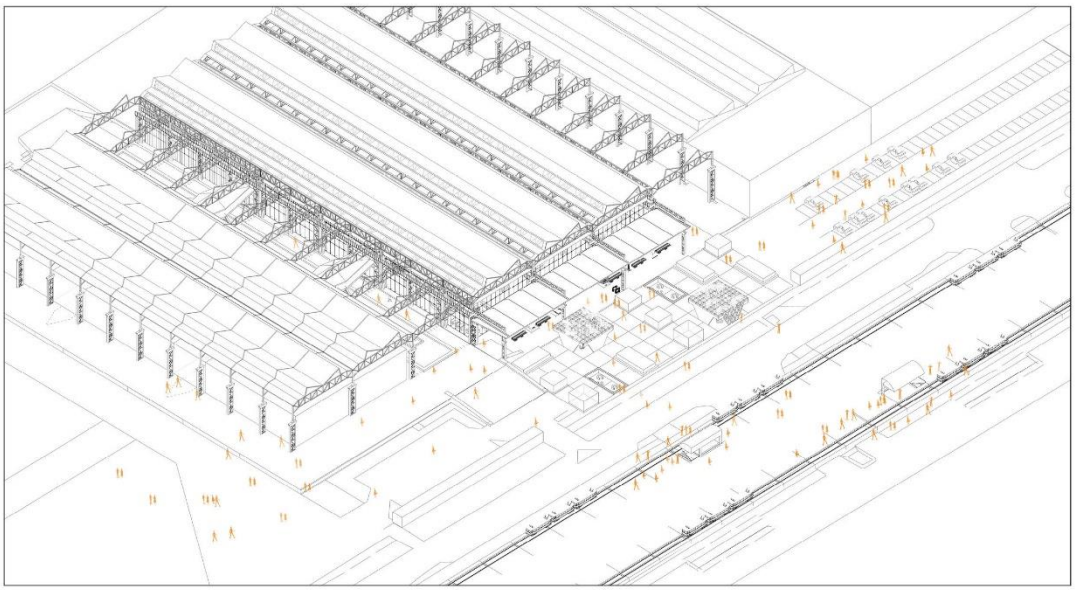
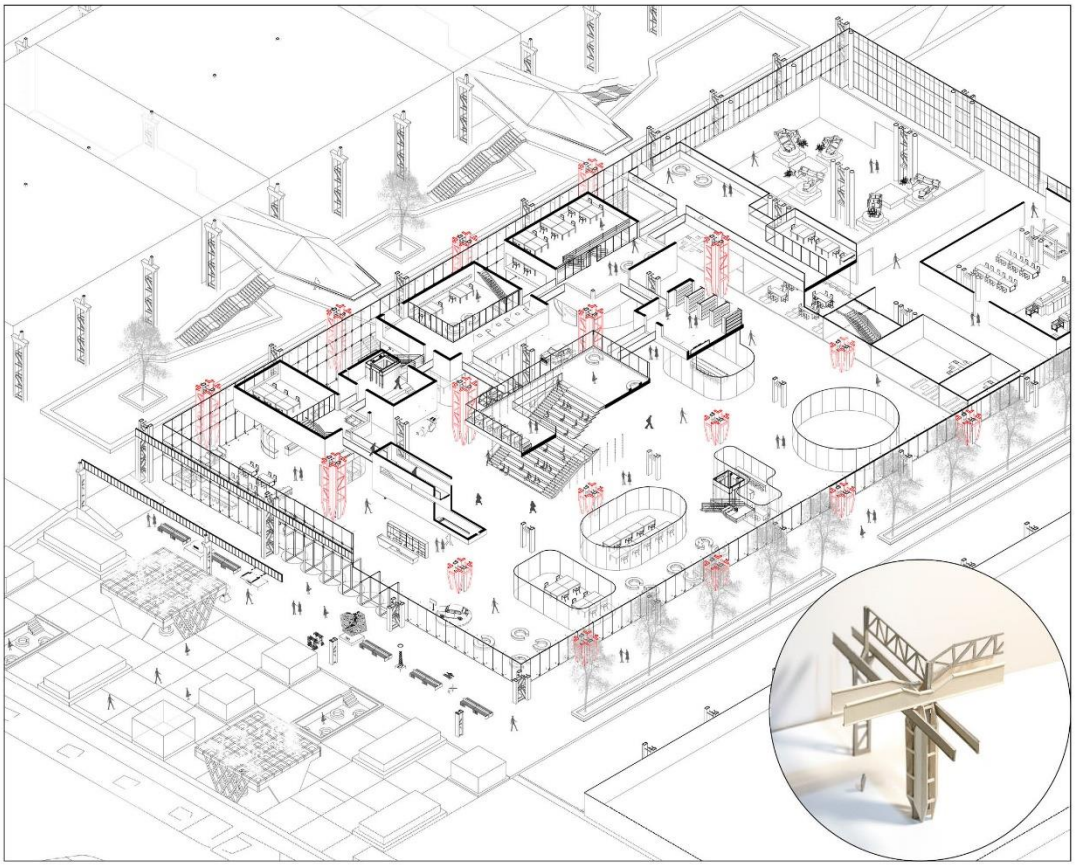
新旧并置 05





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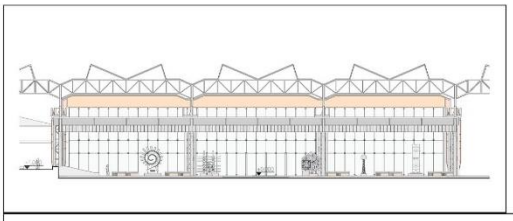
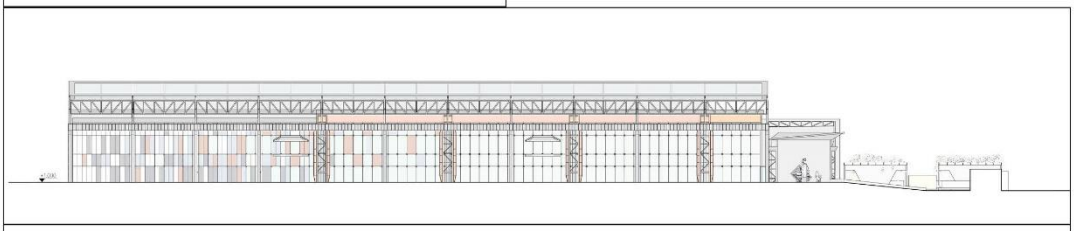
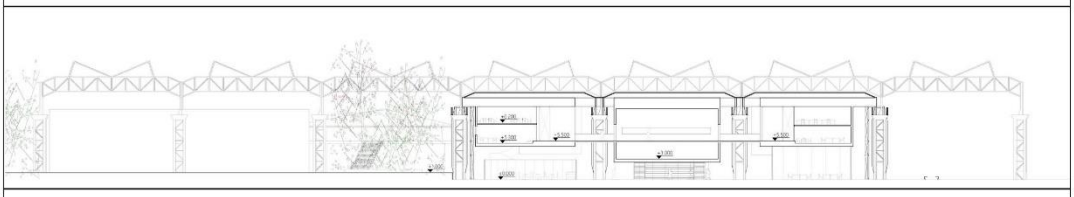
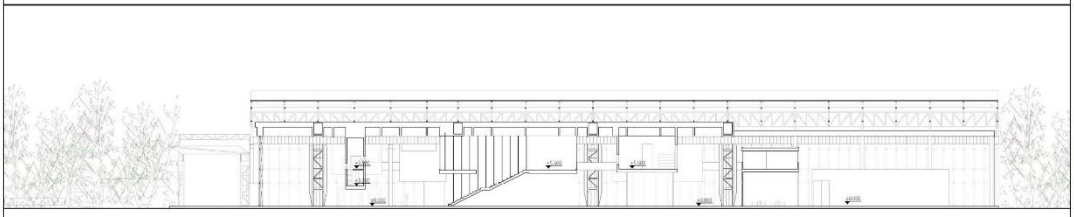
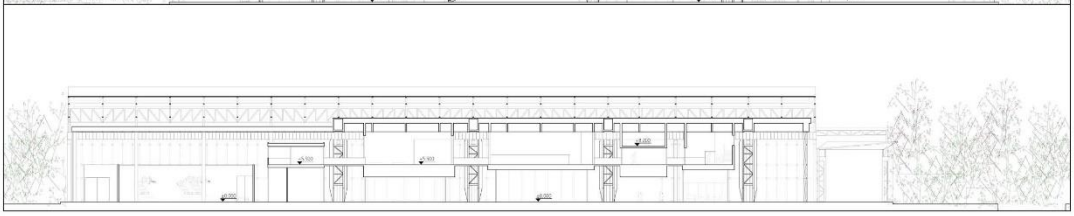
区位与资源 **06**











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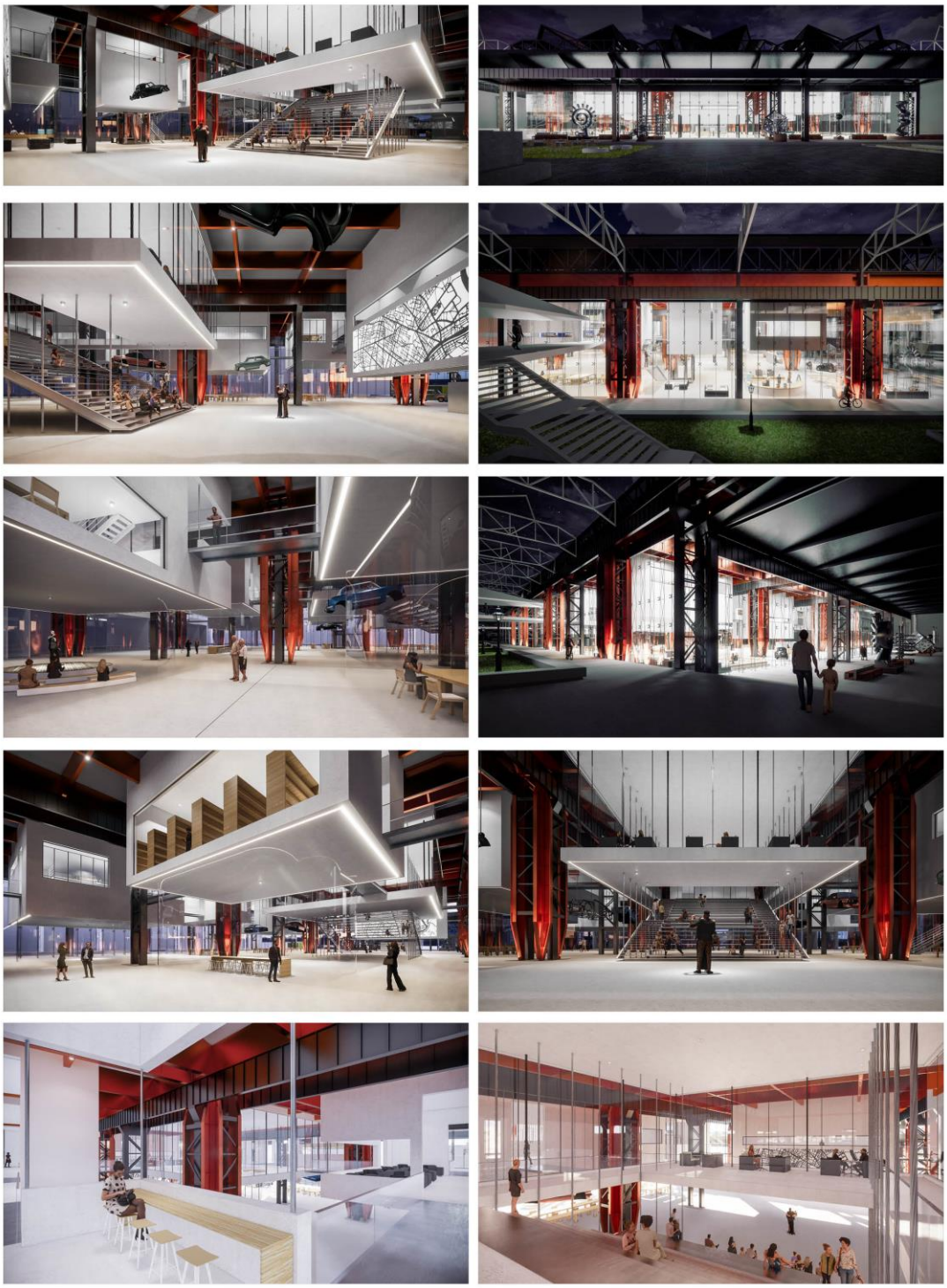
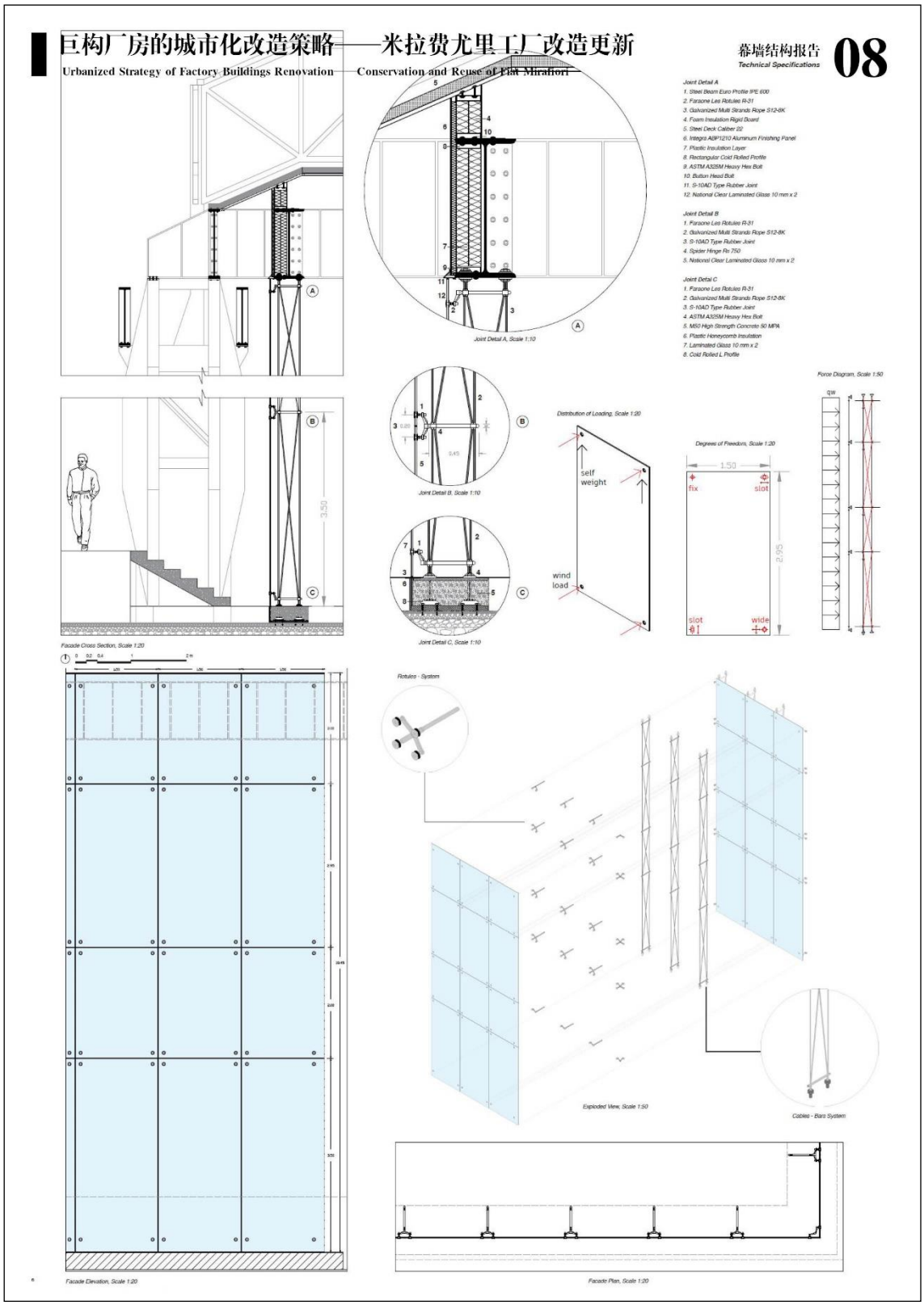
效果与表现 07

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幕墙结构报告
Technical Specifications
08
Joint Detail A
1. Steel Beam Euro Profile IPE 600
2. Faraone Lea Rotules R-31
3. Galvanized Multi Strands Rope S12-8K
4. Foam Insulation Rigid Board
5. Steel Deck Caliber 22
6. Integra AB*1210 Aluminum Finishing Panel
7. Plastic Insulation Layer
8. Rectangular Cold Rolled Profile
9. ASTM A325M Heavy Hex Bolt
10. Button Head Bolt
11. S-10AD Type Rubber Joint
12. National Clear Laminated Glass 10 mm x 2
Joint Detail B
1. Faraone Lea Rotules R-31
2. Galvanized Multi Strands Rope S12-8K
3. S-10AD Type Rubber Joint
4. Spider Hinge Rx 750
5. National Clear Laminated Glass 10 mm x 2
Joint Detail C
1. Faraone Lea Rotules R-31
2. Galvanized Multi Strands Rope S12-8K
3. S-10AD Type Rubber Joint
4. ASTM A325M Heavy Hex Bolt
5. M50 High Strength Concrete 50 MPA
6. Plastic Honeycomb Insulation
7. Laminated Glass 10 mm x 2
8. Cold Rolled L Profile
Joint Detail A, Scale 1:10
Joint Detail B, Scale 1:10
Joint Detail C, Scale 1:10
Distribution of Loading, Scale 1:20
self weight
wind load
Degrees of Freedom, Scale 1:20
1.50
fix
slot
slot
wide
2.95
Force Diagram, Scale 1:50
qw
Facade Cross Section, Scale 1:20
3.50
Facade Elevation, Scale 1:20
Rotules - System
Exploded View, Scale 1:50
Cables - Bars System
Facade Plan, Scale 1:20