RE-STARTING DISUSED INDUSTRIAL BUILDINGS

by

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RE-STARTING DISUSED INDUSTRIAL BUILDINGS

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ABSTRACT

RE-STARTING DISUSED INDUSTRIAL BUILDINGS

This thesis aims to research and analyze about practices of transformation of ordinary abandoned industrial buildings. A series of study cases on ordinary industrial buildings show how industrial infrastructures can be reused and transformed into something that suits the contemporary world and needs, without losing its value of memory for the society. The study cases demonstrate that ordinary industrial buildings, not listed as heritage can be re-used to transform and develop a city. They show how important any ordinary industrial building can be, and how they can affect cities 'urban fabrics.

Deindustrialization has brought more and more architectural and urban waste in the environment we live in. Industries played an important role in cities development during the 19th and 20th century, and the economic and production changes in the industrial field led industrial buildings to relocate out of city centers, leaving empty disused abandoned industrial buildings in the cities. Reusing them according to the contemporary design and needs adjusts the urban cycle they belong to and in some cases saves more energy and time-transforming the environment and bringing architectural, economical, ecological, and social developments in cities.

Abandoned industrial buildings are seen as waste in many cities, and the need to either destroy or keep them exactly as they were before, is mostly felt. However, restarting those industrial buildings can save from the destruction of their memory and change their status from being waste to resources.

This practice is a "scaleless" transformation process that can be applied in any project, varying from small scale to urban scale. In that process of recycling, the old and new are combined and put together but still distinguished from each other. Restarting architecture of industrial buildings implies (minimizing, reducing, re-using, infilling, maintaining, subtracting, adding etc.) changes of the environment we live in by giving it a new meaning.

ÖZET

TERK EDİLMİŞ ENDÜSTRİYEL BİNALARIN DÖNÜŞÜMÜ

Bu tez, sıradan terkedilmiş endüstriyel binaların dönüşüm uygulamalarını araştırmayı ve analiz etmeyi amaçlamaktadır. Sıradan endüstriyel yapılar üzerine yapılan bir dizi vaka çalışması, endüstriyel altyapıların, toplum hafızası değerini kaybetmeden, çağdaş dünyaya ve ihtiyaçlara uygun bir şekilde nasıl yeniden kullanılabileceğini ve dönüştürülebileceğini göstermektedir. Vaka çalışmaları, miras olarak listelenmeyen sıradan endüstriyel yapıların bir şehri dönüştürmek ve geliştirmek için yeniden kullanılabileceğini göstermektedir. Sıradan bir endüstriyel yapının ne kadar önemli olabileceğini ve şehirlerin kentsel dokusunu nasıl etkileyebileceklerini gösteriyorlar.

Sanayileşmenin azalması, içinde bulunduğumuz çevreye giderek daha fazla mimari ve kentsel atık getirdi. Sanayi, 19. ve 20. yüzyıllarda kentlerin kalkınmasında önemli bir rol oynadı ve sanayi alanındaki ekonomi ve üretim değişiklikleri, şehirlerde boş terkedilmiş endüstriyel binalar bırakarak. yenilerinin kent dışına taşımasına yol açtı. Bunların çağdaş tasarım ve ihtiyaçlara göre yeniden kullanımı, ait oldukları kentsel döngüyü düzenler, ve bazı durumlarda ise çevreyi dönüştürüp, şehirlerde mimari, ekonomik, ekolojik ve sosyal gelişmeler getirerek daha fazla enerji ve zaman kazandırır.

Terk edilmiş sanayi yapıları birçok şehirde atık olarak görülmekte ve onları yok etme ya da daha önceki halleriyle muhafaza etme ihtiyacı büyük ölçüde hissedilmektedir. Ancak, bu endüstriyel binaların yeniden başlatılması sayesinde hafızalarının tahrip edilmesi önlenebilir ve onları atık olmaktan kaynak olmaya dönüştürür.

Bu, küçük boyutlu bir projeden kentin tamamını etkileyebilecek bir boyuttaki projeye kadar her alanda uygulanabilecek “ölçeksiz” bir dönüşüm sürecidir. Bu geri dönüşüm sürecinde, eski ve yeni birleştirilmiştir, ancak yine de birbirinden ayırt edilebilir. Endüstriyel binaların mimarisini yeniden başlatmak (en aza indirgeme, azaltma, yeniden kullanma, doldurma, sürdürme, çıkarma, ekleme vb.), içinde bulunduğumuz çevreye yeni bir anlam kazandırarak yapılan değişiklikleri ifade eder.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVATIONS

ICOMOS	International Council on Monuments and Sites
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEP	United Nations Environment Programme
OAS	Organization of American States.
MONDIACULT	World Conference on Cultural Policies
CIAM	International Congres of Modern Architecture
ICCROM	International Centre for the Sudy of the Preservation and Restoration of Cultural Property
ULI	Urban Landscape Institute
TEK	Turkish Electric Institution
NDW	New Dutch Waterline
FSW	French Shipyards Workshops

1. INTRODUCTION

Industrialization and de-industrialization are some of the most important periods in the history of humanity that has affected cities, cities' economy, cities' life styles and also cities' urban fabric. The 20th century saw a great change in the production of industry in some parts of the world (de-industrialization), affecting the economy and social lives of people.

Buildings are part of the urban fabric, and sometimes they conserve the identity of cities they belong to. Historical buildings are tangible link between the present, the past and the future. The fast rapid growth of population in cities had triggered the abandonment of industrial sites and buildings, which had become very crucial to the urban development of societies. Industrialization had increased the use of automobile in the midst of the 20th century and it had also triggered the construction of many highways, which had become an alternative way of transportation compared to the old rail road transportation system. This had allowed people to live and work far away from the city centers. The demographic changes made suburbs grow in cities, relocating industries out of the city and leaving cities' industrial buildings unused. Most of those industrial buildings are left unused for so long up to these days, leaving the urban fabric with gaps.

The question is that is it important to demolish or preserve those abandoned industrial buildings?

Reuse is a practice that put together the old and the new; it's a way of preserving by keeping both the old and the new architecture distinct from each other, but without allowing any dominance from any part. It is contextual because approaches on projects depend on their own context; and it is "scaleless" because anything of any scale can be reused or recycled.

This master thesis research pursues to explore the practices of reusing ordinary industrial buildings.

The first chapter is the introduction of the research paper.

The second chapter starts by explaining the influence of the industrialization in our world, starting from the 18th century with the industrialization period and its revolution, and through the de-industrialization. It continues by explaining how industrialization and de-industrialization have influenced cities and talks about the social, economic, environmental

and architectural effects on the urban fabric and landscape of cities. The architecture and urban fabric define the identity of places, influencing the culture, the life style and the economy of cities. Are the abandoned remains of industries in our societies a waste or an asset? Industrial buildings embalm city's cultures and identities, so destroying them would be erasing the culture of cities. It goes on explaining the importance of industries in our lives, and how it once shaped our cultures and identities.

The third chapter starts by explaining the different approaches of reuse. There are many approaches on preservation. Preservation is a practice that started long time ago and its notion is still evolving nowadays. According to Rem Koolhaas, preserving is to keep and adjust to the present; it's putting the old together with the new [1]. The contemporary world we are living in has different needs from the past, and more often industrial buildings locations of the past may not be suitable for today's environment. The third chapter continues to show how reusing those industries can save us from the destruction of the past and at the same time be in accordance with the present. A re-use of those abandoned industries according to contemporary designs and needs adjusts the urban cycle of cities. This re-use is revealed to be more economic and energy sustainable. Re-using those industries in accordance with contemporary needs is developing the urban environment, and creating a sustainable environment. A disuse of industries is a waste in the city and the urban environment. Destroying them require more energy and money, and mostly it erases the identity of societies. So the dilemma in many cities is either to destroy them, which will require more money and energy and will erase a part of society's identity, or to keep them exactly as they were before, which may not suit the needs and architecture of the contemporary world we are living in. However, those industries can be seen as resources by restarting them and keeping a part of them, which is mixing them with the contemporary architecture and needs. So, this process of reusing them will save them from the destruction of their memory.

The fourth chapter is a series of case studies of ordinary abandoned industries that were transformed according to their context and needs. The fourth chapter explicit that re-use is a "scaleless" transformation practice which can be applied to any project of any size or scale, from small scales to urban scales. It's a process of mixing the void and the full, the old identity with the new one or contemporary one but still leaving a line between both of them.

The cases study analyzed in this thesis will give a guiding line to other abandoned industries.

The aim of this thesis: The aim of this thesis is to explore practices on transformation of ordinary abandoned industrial buildings.

Objective: The objective of this thesis is to create a guideline for other scholar or researchers about any ordinary industrial reuse and recycling.

Methodology: The methodology used in this thesis is firstly to research the existing literatures, then after showing some study cases of re-used ordinary industrial buildings to show that this practice is urgent nowadays. And finally preparing timelines of the literature on the topic. Figure 1.1 sums up the main ideas of chapters in this thesis.

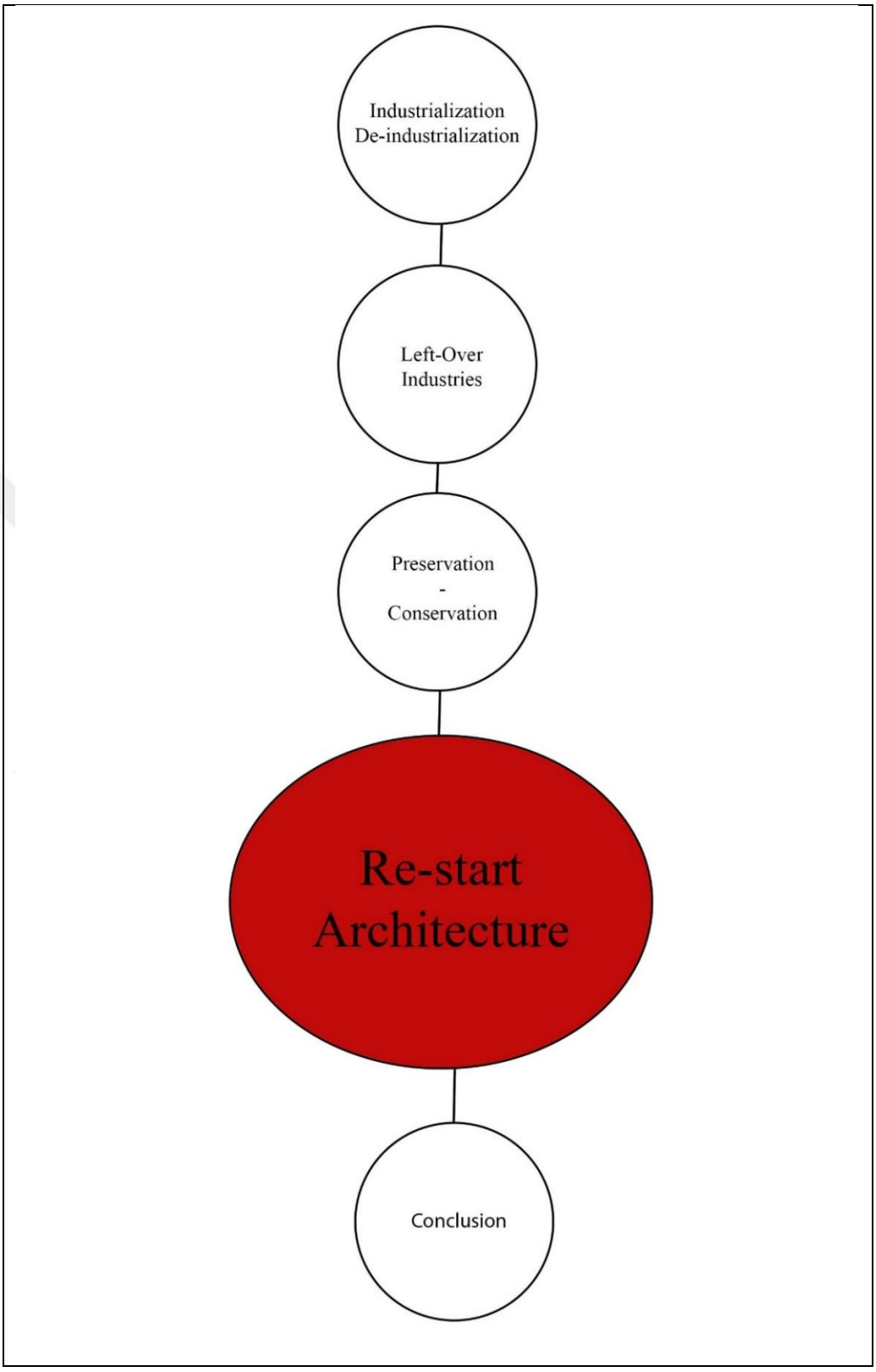


Figure 1.1. Scheme summarizing the ideas of the thesis

2. INDUSTRIALIZATION, DE-INDUSTRIALIZATION AND THE EFFECTS ON ARCHITECTURE AND THE BUILT ENVIRONMENT

The invention of machines has accelerated works in factories. Machines have lessened the efforts and energies produced by human beings and multiplied the production rates. The industrialization period was the peak of the machinery period, which was emphasized by a considerable development of machines.

It is important to define the industrialization as a process that has created huge radical changes in the architectural, social, political, economic and cultural structure of cities. Industrialization was a change in the industrial sector, which means it was a change in communication, agriculture, transportation, social production, and any other general production system. Industrialization has made many countries and cities in this world increase their productivity and their standards of life over the past 200 years. Therefore, it can be said that the economic development, a city's standard of life, the architecture and urbanization of a city have been greatly affected by the industrialization.

During the industrialization period, many workers in many countries were relocated to new places, constructing new facilities and houses [2].

Industrialization brought new style of architecture in cities. The architecture of factories had to be different from other buildings in order to allow people to easily work with machines. For instance, the openings in façades were made taking into account the fact that factories should create livable areas to people while working with machines [3].

Analyzing the industrialization process and it effects helps us understand the importance of the amount of disused and neglected industrial buildings in our cities nowadays.

2.1. DICTIONARY

Before analyzing the industrialization process, it is important to define some technical terms frequently used in this thesis.

- *Industry*: The companies and activities involved in the process of producing goods for sale, especially in a factory or special area [4]. The term Industry in general refers to creativity, work, skills, intelligence and their application [5], [3]. In general, industry means to produce. In short, industry is a production technique, and it is a historical and social fact that involves a certain relationship between nature and man-products. The history of the industry goes as far as the human history existence [6]. The word industry means activity and efficiency.
- *Factory*: A building or set of buildings where large amounts of goods are made using machines [4].
- *Industrialization*: The process of developing industries in a country [4]. It is the period of social and economic changes that transformed human groups from agrarian societies into industrial ones, involving the extensive re-organization of an economy for the purpose of manufacturing [7].
- *Industrial Revolution*: The period of time during which work began to be done more by machines in factories than by hand at home [4]. It is one of the most radical transformation of human life in history. The industrial revolution can be seen as a qualitative change that occurred at the end of a particular stage of quantitative accumulation or production. The industrial revolution does not refer to the speed of an economic growth but rather refers to the way social lives are transformed and the way the economy changes. The industrial revolution period led many societies to inventions and development.
- *Industrial society:* It is a society based on mechanical labor as opposed to manual labor to create material goods [8]. It is a society where technology, industrial and commercial activities are very developed and where mass production is allowed [3]. Over time, the industrial cities were created by factors that supplied transportation, skilled labor forces, and raw materials which attracted industries into cities. The creation of industrial societies changed the concept and meanings of small towns and villages. Cities and societies are the most important and accurate source of information concerning cities' civilization and cultural heritage.
- *Industrial archeology:* The study of buildings and places related to early types of industry [4]. It can also be defined as an area of study related to industrial heritage researches and recording, to sites identification, and also related to their preservation. The industrial archeology has the aim to assess the meaning of industrial

monuments in the social and technological history context [9]. The industrial archeology is a study of material evidence related to the past history of the industry. It is a cultural archeology [10].

- *Industrial heritage*: The physical remains of the history of industry and technology, including transportation, infrastructure, warehouses and worker housing [11]. The industrial heritage is basically that material evidence which industrial archeology studies [3]. It consists of industrial buildings, machines, infrastructures, sites, etc. and any item related to production, manufacture, construction or transportation of products. It refers to the rest of industrial materials, like industries, manufacturing sites, infrastructures, etc.

> The industrial heritage includes not only the mill and factory, but the social and engineering triumphs spawned by the new technologies: Neolithic flint mines, Roman aqueducts, company towns, canals, railways, bridges and other forms of transportation and power engineering [12].

The industrial heritage is the cultural heritage produced by the industrial society. It links the past of industrial societies to their own future while keeping their characteristics. It seems to be the subject of the industrial period, but in reality it encloses a very wide area which includes also the production-manufacturing, architecture and equipment of the pre-industrial era [13]. The industrial heritage is a part of cultural heritage, it covers the whole life and works of the industrial civilizations.

- *Industrial city*: a new concept born during the industrialization period when settlements were being formed around industrial areas, people were moving from rural areas to industrial areas. Cities contain accurate information about civilizations, and hold traces of old culture within them. Therefore, the reflect of industrial cities' civilizations can be seen in the settlement of those cities, which is the remaining form of streets, roads in those cities.

2.2. INDUSTRIALIZATION AND INDUSTRIAL REVOLUTIONS

The industrialization period has affected not only the economy of cities but also the social lives, the architectural and urban structure of many cities.

The second half of the 16th century saw an important development of technology in production, and an increase in number of experienced people in Europe. Europe during that

time became very crowded. Those experienced people were protected and supported by the states. Thus, instead of creating peasant and craftsman societies, merchant and factory-owned societies were created. United and centralized modern states were created then over the ruin of the past feudalism [14].

Industrialization has transformed societies, lifestyles, and more considerably cities' urbanization. Industrialization facilitated trade and increased economy in Europe and also in many industrialized countries. Industrial buildings and structures modified lifestyles in societies, forcing people to move from rural areas to urban centers and creating new urban fabric in cities.

For instance, the construction of bridges in London across the Thames River facilitated not only trade and economy, but also a new settlement on the southern part of London across the Thames (Figure 2.1, and Figure 2.2). Industrial buildings became then part of the city, and influencing modes of life in societies.

The period between the 17th and 19th centuries was a time of preparation for the industrial revolution. The revolution played an important role in the economic development, which affected the quality and form of the social production, the architecture and urbanization of cities, as well as large geographical discoveries. This development of technical means and production methods led to a great production and development of the social division of labor [15]. It is reported that in Europe during that period inventions in art and handcraft were also as advanced as mechanical inventions. During that period, quality was of very great importance, it was the forefront in all matters; and it had remained like that until the 18th century.

The word industrialization revolution is used to describe a qualitative change, or a leap, which happens at the end of a particular quantitative accumulation cycle [3]. It is a period of radical and structural changes in all levels of civilization. The industrial revolution reached its peak between the second half of the 18th century and the first half of the 20th century (Figure 2.3). The industrial revolution occurred first in England in the 18th century before being spread to other parts of Europe and then in the United States in the mid- 19th century and later in Japan after 1870.

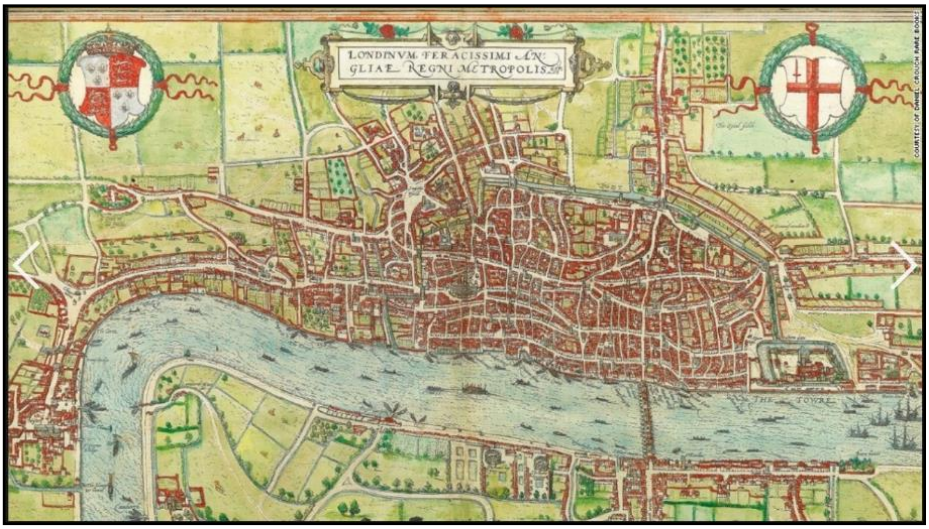


Figure 2.1. Map of London in 1575 by Georg. B. & Franz. H [16]

Figure 2.2. Map of London in 1812 by Edward. L. & William. B. of the previous figure [16]

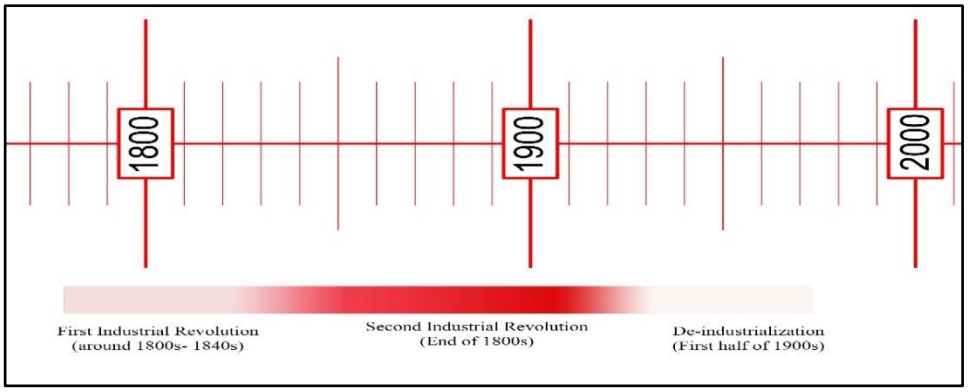


Figure 2.3. Time line of the Industrial revolution

The industrial revolution period occurred at the same time of the age of enlightenment, which was a revolution in human thought and brought rational ways of thinking. The new way of thinking turned late 18th century patrons, architects and designers of that period towards new styles. The industrialization revolution influenced many important architectural movements and style like the neoclassical.

The construction of some buildings and structures marked the end and beginning of new eras in history; for instance, in France, the Eiffel tower designed by Gustave Eiffel and built between 1887-1889; in the United States, the statue of Liberty, designed by Frederic Bartholdi and built between 1884-1886, etc. (Figure 2.4)

Many inventions and developments occurred during the industrial revolution. The first industrialization revolution was caused by the invention of steam engines and the development of mechanization. The first motor industry was the industry of cotton and silk in the textile sector between 1800 and 1840. During the first industrial revolution there was an important development in textile and steel industries, and then after an important development in railroads.

The years from 1873 through 1896 were marked by a tough transition to a second industrial revolution, which was based on the heavy industry, chemistry and then later in the 1890s on electricity and the automobile industry. That revolution influenced a series of discoveries, the production of energy, textiles, iron, steel and transportation.

Figure 2.4. Eiffel Tower in Paris (on the left) and Statue of Liberty in New York (on the right) [17]

The industrial revolution in England was that new period of industrial and technological change that influenced the economic and social life, accumulated the capital, trained the labor, developed the economy, stabilized the political system, developed the agriculture, accumulated scientific progression and discoveries, and developed the trading and commerce in England and afterwards in the rest of Europe.

There are many reasons why the Industrial revolution started in England, but the first reason is that England was considered to be richer than other European countries. The second reason is that England had a successful transition from feudal society to commercial society. The third reason is that England's works and achievements in science and engineering were a great support for the industrial revolution.

The Industrial Revolution is one of the most radical change in the history of mankind. There were many problems at the beginning of the industrial revolution, for instance there weren’t many people with specialized scientific qualifications, many people did not know how to read and write, and most of them were not used to mechanical devices. With the support of the government, the export industry incredibly developed and the cotton textile industry became the leading sector. Coal industry became the leading in mineral processing. The

advance in the steel industry became very important at the end of the first half of the 19th century, which marks the start of the railway system. The railway system helped the metallurgy industry rise, and from 1850 the expansion of iron and steel industry became significant. There was also a great development in production and transportation vehicles.

The manufacturing industry was followed by the evolution of mining, oil, and coal industries. In this period, technological developments and important discoveries were realized, strong maritime trade provided raw materials from everywhere and the profits turned into new investments [18]. During the industrial revolution, the Western society turned into a society with a fast expanding mechanization, and the population began to grow more rapidly. These inventions gradually reduced the physical effort spent on production while increasing productivity. The revolution in the industry transformed rural areas with only farms and no factories into urban centers. Works in the fields were replaced by factories and farmers were then called workers. Industrial productions started to increase and there was an exceeding agricultural production in England and also in the rest of Europe during the second half of the 19th century.

The Industrial revolution boosted the creation of urban centers with urbanized and developed neighborhoods. Before industrial revolution, suburbs were places where the conditions of living were generally poor. During this time, the working hours and conditions in factories became exceedingly abnormal. Then laws like labor laws were created to limit those abuse.

Industrial basins started to be created around places where raw materials, energy, navigation and traffic lanes were available. Industrialization needs caused immigration flows from non-developed regions and countries to industrialized regions. Manufacturing, textiles, steel and automotive industries were increasingly developing during this period and they replaced the trade corporation systems. Companies were constituted in form of stock companies, selling their shares on the stock exchange to attract business and investors. The industrial capitalism, and the advance of shareholding for savings had a great impact on industrialization. The hierarchy was created in factories: workers, skilled workers, foremen, team leaders, engineers, assistant directors, manager's hierarchies. Industrialization became then a factor of development for the middle class.

The industrialization was influenced by a persistent change in production techniques during the 19th century, and the economic productivity increased significantly which corresponded

to the development of machinery that multiplied the human power. For example, coal replaced the wood charcoal to power the machines. Production increased from manual production to the standardized mass production. Thus a mass distribution resulted from that production. Industrialization influenced the development of legal Protection of Industrial Property (Patents and Designs) to promote innovation and protection against any counterfeiting. It also influenced the development of railways, roads, motor vehicles, automotive and rail traffic. The creation of buses and subways impacted the urban transportation.

The industrialization influenced the social life of cities in many ways. Machines replaced human power in production during the industrialization revolution. The industrial revolution boosted the construction of factories, and forced people to move from suburbs to areas close to factories, and that resulted to people creating factory circles and then industrial cities. There was a movement of mass from the rural areas towards the cities. The agricultural sector started to develop and there was an increase in productivity. The mechanization of the agricultural sector reduced the human work force in factories. The excess labor force in agriculture moved to cities to meet the needs of the industry. Therefore, it is in that way that the cultural differences between the urban and rural life arose [19].

The second half of the 19th century was marked by the great influence of the industry, mostly in developed countries. The last quarter of the 19th century and the first quarter of the 20th century were marked by a drastically increase of population in industrialized countries.

The industrial revolution brought a change in production quantity and quality and thus revealed the basic principles of the modern industry.

Liverpool is an example of a city that clearly shows the social effects of the industrialization. The Figure 2.5 shows how the population of Liverpool changed before, during and after the industrial revolution.

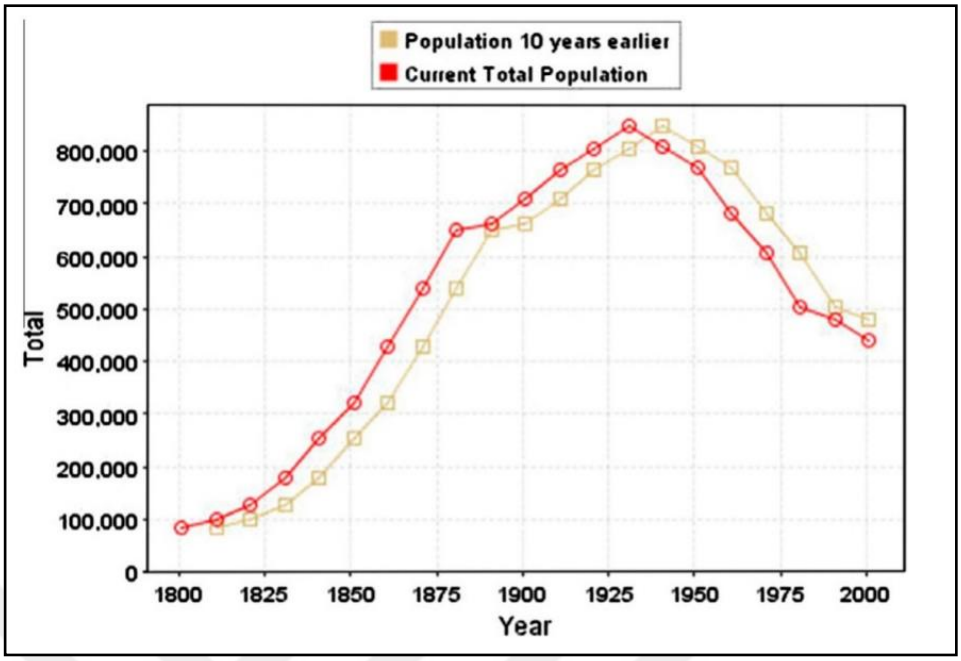


Figure 2.5. Liverpool population growth and decline in the 18th and 20th centuries

2.3. THE EFFECTS ON ARCHITECTURE

The early period of the industrial Revolution saw an innovation in technology, scientific discoveries, and industry thanks to the replacement of hydraulic energy by the steam energy. The first blast furnaces of the metallurgical developments were upgraded to steel production by Bessemer (1856), providing great opportunities for railway construction. The Western European countries became the center of all these developments, and countries rich in minerals attracted many people. For instance, England and Germany.

In the 1860s, societies were affected by the invention of some new products like the appearance of the phone, the radio, the light bulb, and the automobile. The urban lifestyle and cities were then modified by the appearance of new sources of energy like oil, electricity, gas, and electric lighting in cities. A real urbanization started in England right after the industrial revolution with the development of coal, iron, and electrical industries. Therefore, it can be said that industrialization is a factor that fostered urbanization and directed cities towards a developing economy [19].

The industrialization era brought new innovations, techniques, varieties listed below:

- *Textile industry:* The textile industry is one of the first mechanized industry in the world, a part from the printing or typography industry. The first mechanization and factory establishment was in the silk industry, but the cotton weaving industry became one of the major industry in the modern time. Many machines were invented for the textile industry, for instance the spinning machine and the steam-powered weaving loom [20].
- *Electrical industry:* During 1870-1880, the urban lifestyle of cities was transformed by the appearance of new sources of energy like oil, gas, and electricity in cities. This is a transition to the strong lighting power technique. In this period, factories started to use electrically powered motor and dynamo generating electricity. This kind of industry completely changed the previous one established before the industrialization.
- *Iron-steel industry*: The metal industry developed depending on the coal and iron industry. The iron and coal industries became mutually dependent. Iron manufactures were moved near to coal deposits. During the industrialization period, the iron industry affected many other industries [20]. The construction of railways, roads, motor vehicles, automotive and rail traffic, and the creation of buses and subways are the consequences of the development of the iron-steel industry.
- *Transportation era*: Influenced by the iron-steel industry, the first works on transportation started around 1820s. The transportation of manufactured products accelerated the railway transportation system. The first train processing started about the 1830s [20].
- *The locomotive era*: This era is marked by the invention of sources of power, engine and vehicles. The first gasoline engine with internal combustion was built in 1883, and the first locomotive was manufactured four years later in 1887 [21].
- *Scientific era*: The period of scientific development and discoveries. Scientific researches accelerated. Inventions based on modern industrial nutrients and artificial fertilization methods were developed during that era.

The industrialization period brought a new spirit and technical understanding of the industry in societies. The industrial revolution also brought many changes in construction and industrial structures with the introduction of new materials. Cast iron, forged iron and steel iron materials were first introduced in the structural industry during the industrial revolution. Cast iron was first used in structures of bridges. For instance, Coalbrookdale Bridge

(constructed in 1779) built over the Sevem River in England; it is the first bridge built with cast iron [6], see Figure 2.6. The Clifton Bridge (Figure 2.7), built in 1836 is one of the good examples of the first iron structure in architecture [3]. Cheap forged iron has helped the development and construction of suspended bridges, stations and buildings. Cast iron started to be used in the structure (bearing system) of buildings dome. Iron columns was then introduced in factories due to the increase in the need for large spaces and rooms. The first structural system constructed only with an iron skeleton was first built in the United States of America. The first five-story factory built with an iron skeleton was built in New York in 1848; in Europe the iron skeleton was first used in factories about 1871-72; the Menier Chocolate factory near Paris (Figure 2.8) is a good example of factory built with an iron skeleton [22].

The first examples of building structures using the iron new materials in good harmony are recorded in exhibition palaces. Exhibition buildings are planned to be installed and dismantled quickly. Later on, exhibitions started to be opened also in Paris and other European countries. For instance, the Eiffel tower (1887-89) (Figure 2.9) was shown in the "Exposition Universelle" exhibition in the "Hall of Machines" in Paris.

The Eiffel Tower, built in 1887-89 (Figure 2.9) and designed by Gustave Eiffel, was constructed to be the entrance for Paris' World fair. With a height of 1063 feet and 81 floors, its shape was designed in order to withstand the wind's force [23].

The Wainwright State Office building (1890-91) (Figure 2.10) in St. Louis in Missouri in the United States, designed by Louis Sullivan, it is one of the first skyscrapers in the United States with 41 meters high and 11 floors. Also known as the red brick office building, the building is a combination of red brick and steel frame. The steel enabled the building to be raised with 11 floors. The architect in this building rejected traditional architecture, allowing new materials that required new designs which reflects the function of the building. Hence the principle: "Form follows function" [24]. The terra cotta used for molding and carving on the façade of the building is a local material of the city St. Louis, and it's chosen because of its ease for molding; the red brick being also a local material is used for water insulation [25].

In the United States, the invention of new materials has triggered the construction of skyscrapers. Another example is the Chrysler building (1928-30) in New York (Figure 2.11).

Designed by William Van Alen, it's raised at a height of 1047 feet with 77 floors. It was the tallest building in the world until the Empire State building was built [26]. The Chrysler building is an Art Deco style skyscraper with the Deco geometric forms on its façade, and is decorated with the Chrysler automobile features. The architect used stainless steel on the top of the building as sunburst design (Figure 2.11).

The construction of the Empire State building (1929-31), in New York is also one of the result of the industrial revolution with the invention of new materials and steel. The Empire State building, designed by Shreve, Lamb and Harmon, it is an example of the Deco art, with a height of 1472 feet with 102 floors (Figure 2.12). The Empire State was the world's tallest building until 1974 before the completion of the twin towers, the world trade centers.

Figure 2.6. Coalbrookdale Cast Iron Bridge, England, 1777-1779 [27]

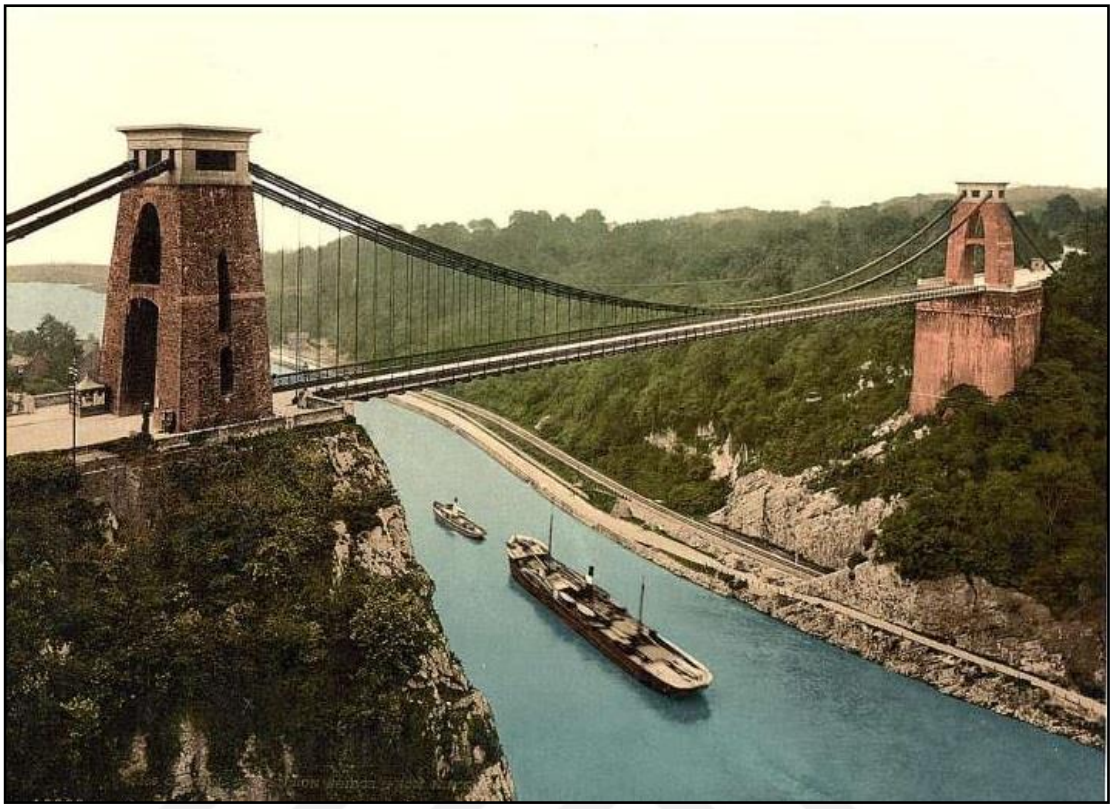


Figure 2.7. Clifton Bridge, England, 1836 [28]

Figure 2.8. Menier chocolate factory in Noisiel, near Paris, 1911.

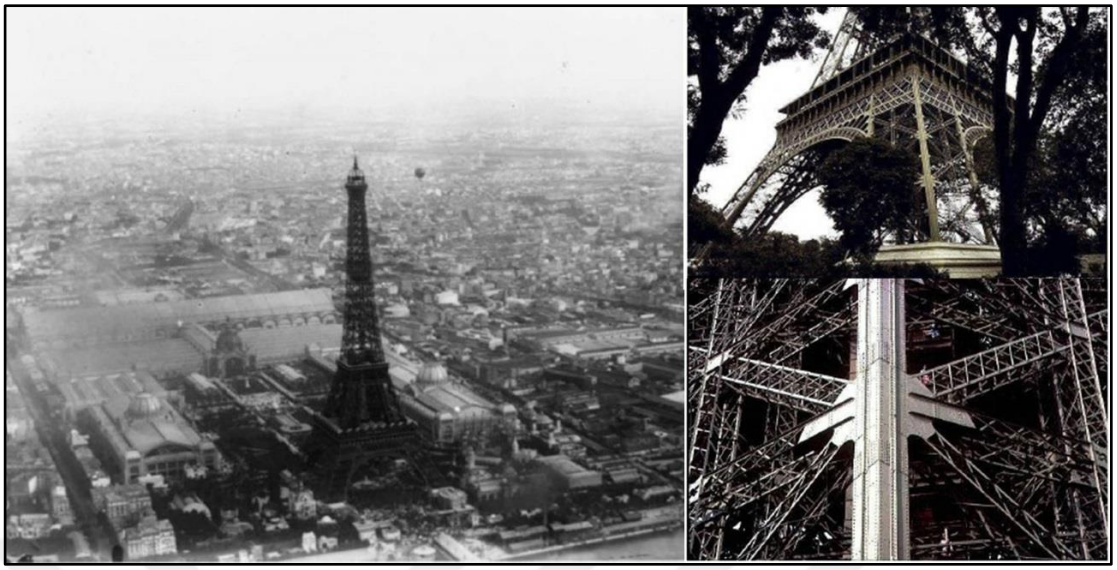


Figure 2.9. Eiffel Tower, Paris, 1887-89 [17]

Figure 2.10. The Wainwright State Building, Missouri, 1890-91 [25]

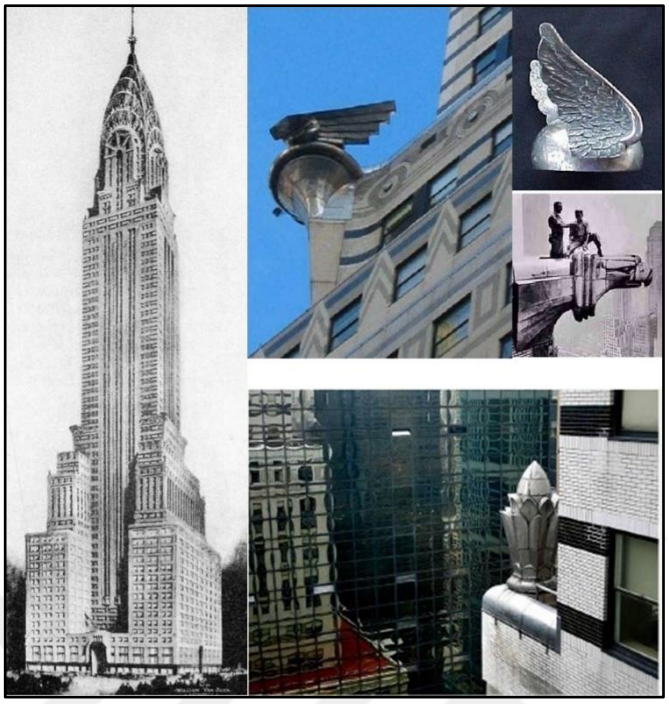


Figure 2.11. The Chrysler building and the Art deco style on the façade, New York, 1928-30 [26]

Figure 2.12. The Empire State building, New York, 1929-31 [26].

Iron materials have also begun to be used in large constructions like market, large stores, bazaar, Churches, etc. The “Marché de la Madeleine” (1824-1832) in Paris is one of the examples. In that time, new produced construction materials were first used in old formal molds, bridges, aqueducts, etc. During that time, although new construction materials were discovered, transportation and technology were not really developed. Thus, most of industrial structures were built near the supplying sources, and generally out of the city center. Industries were built close to mineral sources or on the river banks due to water supply in the city. For instance, in the beginning of the 19th century one of the main characteristics of the first produced structures in England is that the materials were made in tight spaces, with inadequate and natural lighting, and with wood materials with narrow span. The development of mechanization has brought the need of increasing the span of materials, thus, this has influenced the beginning of using cast iron and glass in industrial structures in the 19th century [29].

Cast iron and glass are one of the oldest materials in the world. They were already used even before the middle of the 19th century in gardens, greenhouses and conservatories. The first time cast iron and glass were used in industry was in 1851 in London for large industrial exhibitions. Joseph Paxton designed the Crystal Palace, which was a huge modular cast iron and glass structure built in London to house the Great Exhibition of 1851 (Figure 2.13). The first international exhibition occurred in 1851 in the "Great Exhibition" exhibition in Hyde Park, London as "Crystal Palace" [6]. It was built with a cast iron skeleton system and covered by glazed panels, its geometry with repetition of simple panels was a good example of the concept “form follows the function”. The building, deprived of an optical center, was designed to appear as if its length was unlimited. The size and shape of the Crystal Palace was determined by the size of the standard glass panels provided by the supplier at that time. The outer surface of the building was glazed using many identical glass panels, thereby reducing both the time of construction and the production cost. The long open gallery along the main axis was extended by wings on either sides. Both the arched transept and the flat roofed were built using the patented ridge and furrow roofing system of Joseph Paxton which were considered as his key elements [30].

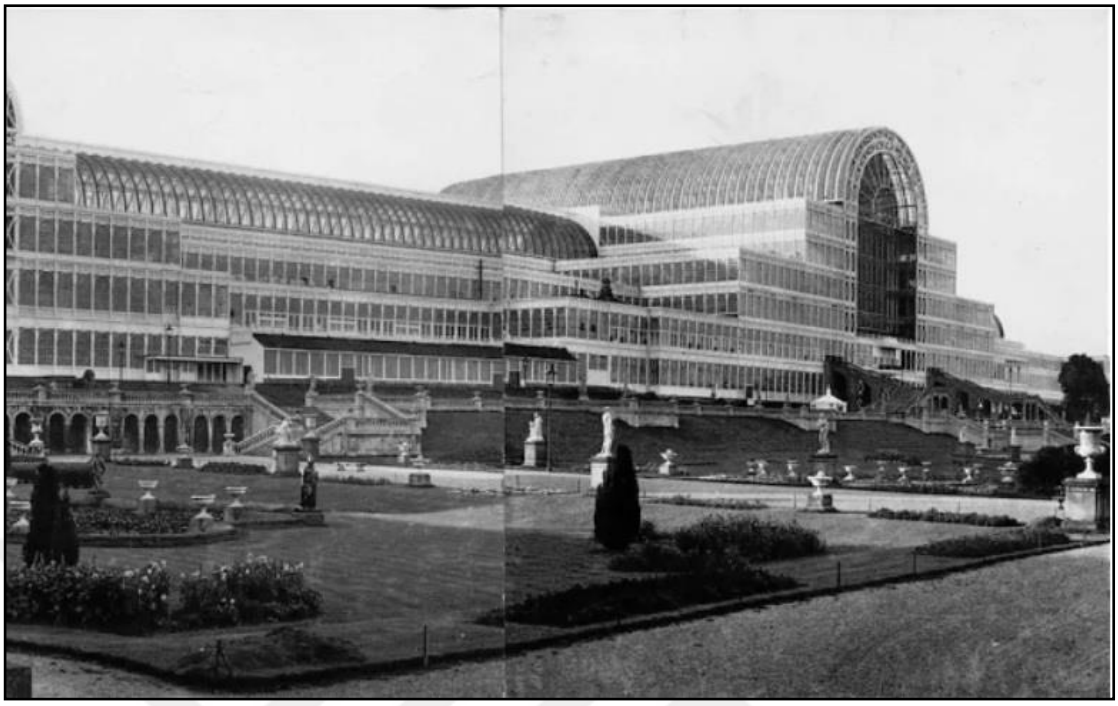


Figure 2.13. Crystal Palace in London, by Joseph Paxton 1851 [30]

The second half of the 19th century saw a development in steel construction and accordingly the construction of large structures with wide span. The process of obtaining steel in construction evolved from the 1850s through the Bessemer converter process, then switched to the open hearth furnace system process in the 1860s and then finally to the current steel production system process in the late 1870s.

For instance, the Galerie des machines (Hall of Machines) (Figure 2.14), designed by Charles Louis Ferdinand Dutert, with Victor Contamin as the structural engineer was one of the best example of structures built with steel in that time. The Hall of Machines was the largest vaulted structure to have yet been built at that time. The structure of the Hall of Machine was free of any internal supports, and was formed by a Steel cage and three pin hinged arch, usually used for bridge. It is reported that static calculations based on scientific formulas were made for the first time on this building. At that time people were used to heavy stone arches, and the proportions of light, narrow and small trusses at the base and larger trusses at the top were not very familiar to people. St Pancras railway station is another example where iron and glass are used in wide span. The original St Pancras railway station was built in 1868 in London and designed by the engineer W.H. Barlow. It was the largest

vaulted structure during the Victorian times. It was a masterpiece constructed in iron and glass; and the glass roof 240 feet (75 meters) wide and 82 feet (25 meters) high seemed to float without support and spanned five platforms (Figure 2.15).

The "Duetscher Werkbund" (a German Association of Craftsmen, curators, architects, artists, designers, and industrialists) was founded by Peter Behrens, Olbrich, Richard Riemerschmid, Bruno Paul and other artists and architects in 1907 in Munich. This association played an important role in the development of the modern industrial architecture, and later in the creation of the Bauhaus school.

Peter Behrens built the AEG Turbine factory in Munich in 1908, a revolutionary industrial structure free of old forms. A structure of 100m long and 15m tall with glass floors and natural lighting provided by a roof window with a steel structure. A wide opening and large interior spaces volume are achieved in that structure. The function of materials, raw materials and the construction process used in that building have brought a pure and strong order to the building. It is considered as the first modern industrial building because of its design and the characteristic of its building elements (Figure 2.16) [19].

Steel and glass have played an important role in the evolution of industrial structure's construction. The technology of glass and steel influenced the designs of industrial structures in the beginning of 1900s with the construction of structures with large span, thinner and transparent walls and roofs, and the use of thin columns.

The industrialization has influenced the development of technology and favored the growth of investments. The use of advanced technology like pre-cast concrete, new structural system and frameworks, and various forms of modern structures have begun to be used in constructions and these are the base of the modern industrial design. The Industrial revolution accelerated production, but also reduced the number of workers in working places. Industrial revolution has transformed cities and their urbanizations. The modern understanding of urbanization came from the result of the industrialization during the period between 1830 and 1850 [3].

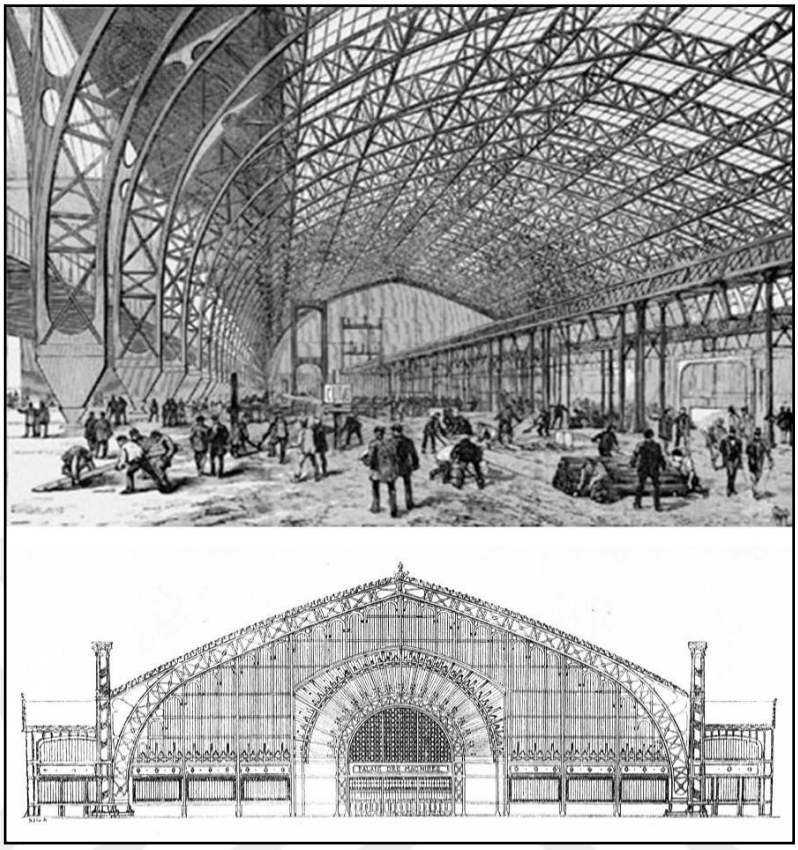


Figure 2.14. Hall of Machines in Paris, 1889, interior view and section [30]

Although, the industrial revolution led cities settlement and urbanization to develop, it also created many negative consequences like death, unhealthy social environment and brought many negative social and economic problems in cities that started to become critical after 1830 firstly in England [3]. An increase in production crumbled the structure of cities in England, and that has affected the urbanization and environment of cities. Areas where industrial workers settled became polluted and, utterly neglected and unhealthy. The coal burning polluted the atmosphere a lot, and death and misery started to occur in England. The lack of water distribution network and services, and the bad quality of houses favored epidemic diseases. The development of industry led people to settle in cities, and created a new lifestyle, and new social and economic environment in cities. These changes had later affected other European countries and America as well [3]. There were many death cases in England due to the air pollution by factories that polluted the environment in English cities during the industrialization revolution (Figure 2.17) [3].

Industrialization is one of the most striking period in human history which has affected lives in many ways. The industrialization changed the standard of life of cities, their economy, architecture, urbanism, social life and also environment. The industrialization was a period of massive production, inventions, discoveries, and technological development. A shift in the production changed all those standards brought by the industrialization. That change in production triggered the de-industrialization period. Many buildings were left obsolete. Industries were abandoned forcing a mass movement of people to other locations. The de-industrialization changed the urbanism and demography of many industrialized cities.

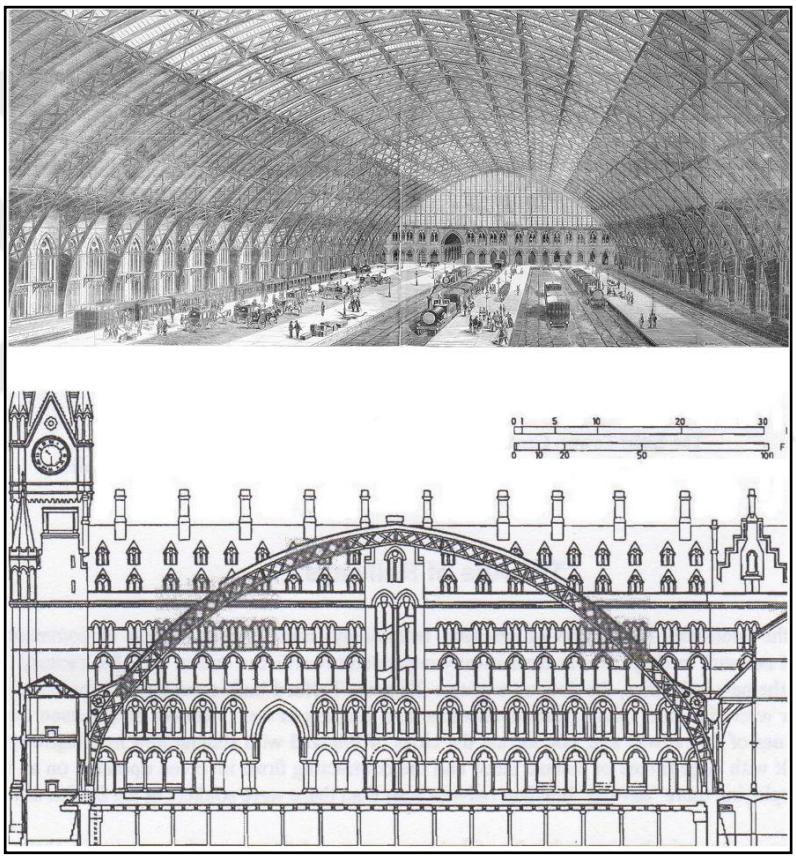


Figure 2.15. St Pancreas railway station in London, 1868, interior view and section [31]

Figure 2.16. AEG Turbine Factory, Peter Behrens, Germany, 1908 [32]

Figure 2.17. Picture of a city polluted by industry in the 19th century [3]

2.4. THE EFFECTS ON URBANISM

Industrialization has affected cities population growth and their urbanization for almost two centuries. The development of modern industry from 18th century led to a great urbanization and boosted new cities in Europe, in the America and then also in other countries. These favorable circumstances brought many immigrants to move from rural communities into urbanized areas. The change in production led many industries to relocate to other places, and forcing people to relocate to other places too. The change in production affected many cities.

Statistics show that around 1800s about 2% of a billion worldwide population lived in city centers; and around the year 2000, it had increased to around 50 % of about 6.5 billion worldwide populations. Estimations go on saying that in 2050 about 75% of about 8.5 billion of worldwide population will live in cities [33].

Statistics show that between 1950 and 2000, more than 350 big cities saw their population decline temporarily, and around the 1990s more than a quarter of worldwide big cities population dwindled. Although statistics show that the worldwide large cities population started increasing from late 1800s and will keep increasing till the next coming decades, there are also a good number of large cities where the population keep dwindling progressively [33].

Statistics show that the worldwide population will reach its climax between 2070 and 2100, and the worldwide urbanization process will eventually come to an end [33]. After the worldwide population has reached its climax, the urban shrinkage will come to the stage it was before industrialization started. In the overall, growth processes have had more influences so far. After all, this growth is not really uniformly distributed geographically and many worldwide large cities are facing serious population decrement. Moreover, in a sequence of countries, the urban population is generally decreasing. The United States gives a nice example of this process; the invention of railroads between late 1800s and the beginning of 1900s diminished the costs of transportation and during the same time large manufacturing centers started to increase allowing population to move from rural areas to urban ones. After industrialization had started, human activities began to cause so many

problems like climatic warming, increasing prices of raw materials and oil which show economic limits on growth.

De-industrialization occurred due to the change in the economy and production in the industry. Industrial buildings and infrastructures were left disused in some cities like in Detroit and Manchester, causing the population and workers move to other part of the countries. This led to crucial bumps, with the occurrence changes in models, modes of action, and methods which brought about a social relocation.

Detroit is an example of urban cities affected by de-industrialization. De-industrialization in Detroit caused many consequences, and population shrinkage is one of them. Detroit, called "the Motor City"[1], and Manchester (in Great Britain) are typical examples for suburbanization through de-industrialization as cause of de-industrialization transformation.

Detroit which was once the core of industry in the United State, saw it population dwindle between 1950 and 2004 of -51%. Located in the northern Midwest of the United States of America, Detroit is an industrial city that became the core of the automobile industry in the United States during the 1900s. Detroit is one of the first American cities with infrastructures, asphalted streets and urban freeways. It was a typical figure of remarkable economic growth. Construction of infrastructures arising in the beginning of 1900s such as stores, skyscrapers, theaters, railways, and the population growth between 1900 and 1950 from 285,700 to 1.85 million are facts that show the economic growth and urbanization development of the city in the first half of the 1900s. Nevertheless, after the 1950s, the shrinkage of the city started occurring, allowing a movement of population from the inner city to the suburbs (Figure 2.19).

Suburbanization in Detroit was partly induced by the increase of automobile industry and also by racial conflict. African American population growth occurred between 1940 and 1960. During that period, the African American population increased up to one third of the whole city's population, this led the white middle class to leave the inner city and settle in surrounding areas. This movement from the inner city to the suburban led also to the

[1] The term shrinking cities by Oswalt Philipp in his book Shrinking Cities and To mean a drastically change of demography of cities affected by the change in production and economy (Deindustrialization)

impoverishment of the inner city. Statistics show that in 1998, 78 % of Detroit suburban inhabitants were white Americans where as 79 % of the inner city inhabitants were African Americans. Detroit is then seen as a figure of the modern downtown, where a reckless discard of a third of the total urban area occurred. About 108,000 buildings were allowed to be destroyed in Detroit between 1978 and 1998, and only about 9,000 buildings were constructed or converted (Figure 2.19.b). More than thousands of buildings, offices, theaters or movies in Detroit are still abandoned, and many department stores have closed. By the second half of the 20th century, deindustrialization had led the city of Detroit into a process of decentralization, where production was then relocated outside of the city. Many industries, residences and public places were then abandoned, leaving gaps in the urban fabric of the city (Figure 2.18).

Manchester, being also one of the examples of social effect of deindustrialization, its population dwindled between 1930 and 2002 of -44.9 %. Manchester and Liverpool are the first pioneer of industrialization in the Great Britain. The first passenger train in the UK connected Manchester to Liverpool, and the first ship canal which connect Manchester and Liverpool was built in 1855. Manchester is considered as the center of the world trade, and Liverpool's docks hearten the city to be the logistical center of the region's textile mills.

The collapse of the textile industry as well as the revolution in container cargo that occurred after the 1950s led the city Manchester to a slump.

Statistics show that in 1930, Manchester had about 766,000 residents; but nowadays, it has half of what it had in 1930. A decreasing impoverished working class population and a high unemployment rate in that city was mostly caused by the deindustrialization and suburbanization of the city. The Figure 2.21 shows a double tabula rasa in the Hulme district of Manchester, which is a good example of planned demolition and failed planning.

Most of the structures have been destroyed, and nowadays the district is a figure of vacant lots of postmodern buildings plots.

Industrialization is a process that started centuries ago, and it was marked by the development of machinery in the eighteenth century. That period is the mechanization era which promoted the first and second industrial revolutions. Industrial revolutions led to the creation of urban cities, deeply modifying the built environment and people's lifestyle. Former farmers became workers and started moving to cities. The production increased and

social classes were created. The change in economy and production in the mid of twentieth century led to the de-industrialization. The de-industrialization caused a change in big cities leaving them with unused and abandoned industrial buildings and factories for many decades. Over time, those abandoned and disused buildings, infrastructures became a threat to the development of urban cities. They became obsolete, thus the problem of demolition or conserving them arose. Deindustrialization has affected the urban fabric of many cities, their economy and social lives; leaving unused buildings in cities. The change in production has created gaps in the urban fabric, and that left scholars, architects, economists, urban developers and citizen of cities with the question of how to cover those gaps created by the abandonment of buildings. Private houses, industrial facilities, offices, and many other kinds of buildings were left unused.

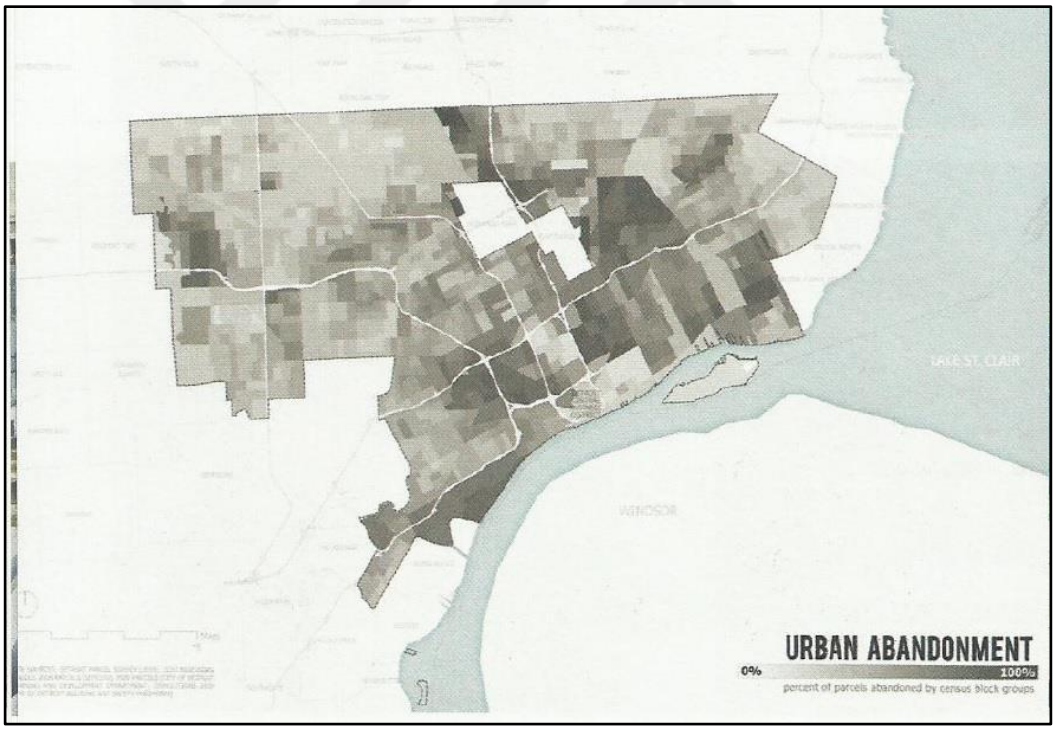
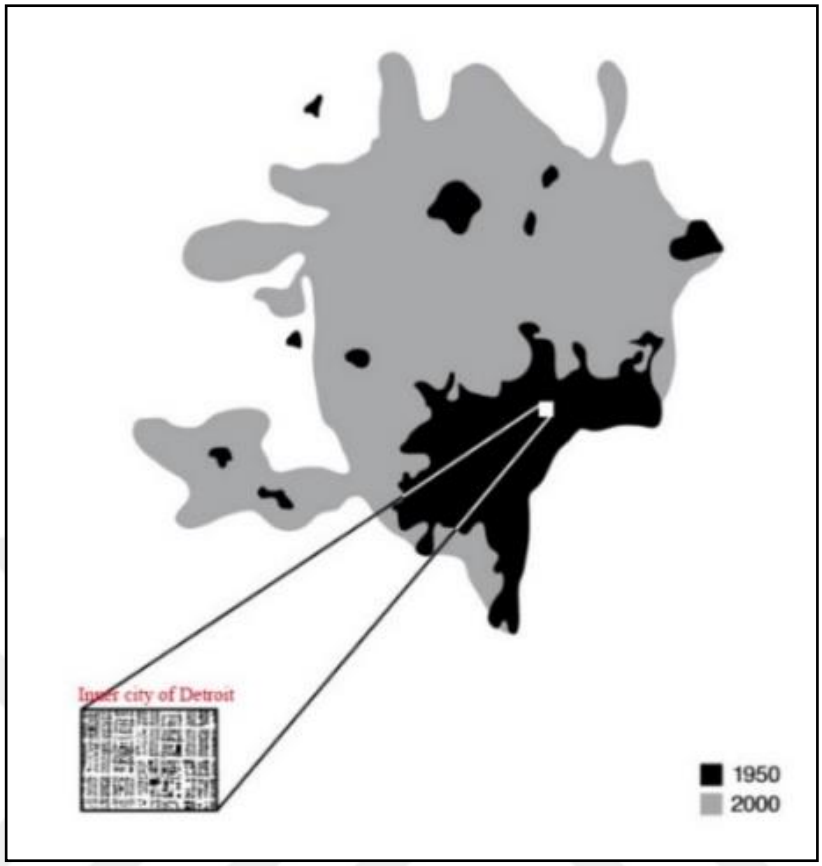
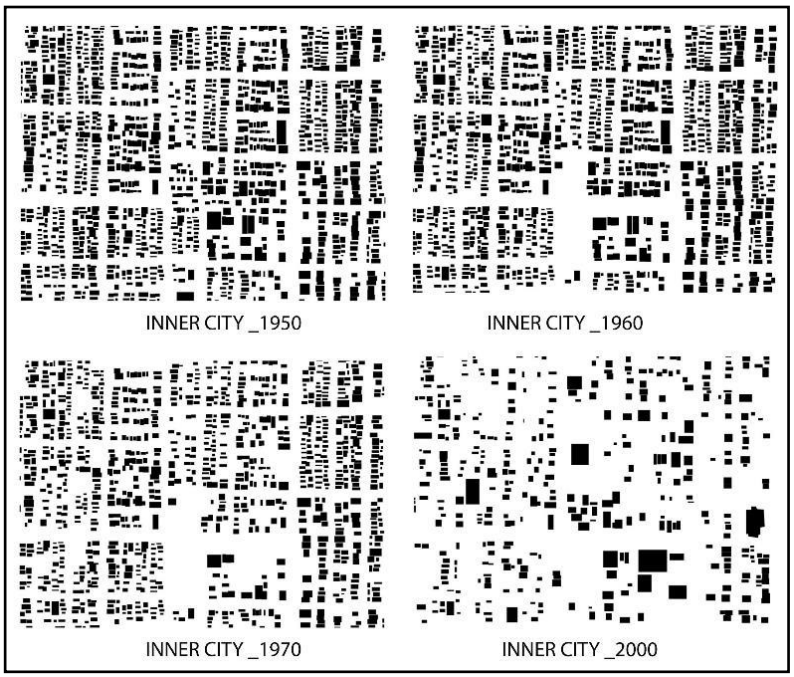


Figure 2.18. Urban abandonment of Detroit in the second half of the 20th century [34]



(a)



(b)

Figure 2.19. (a) & (b) Settlement map of Detroit between 1950 and 2000 [33]

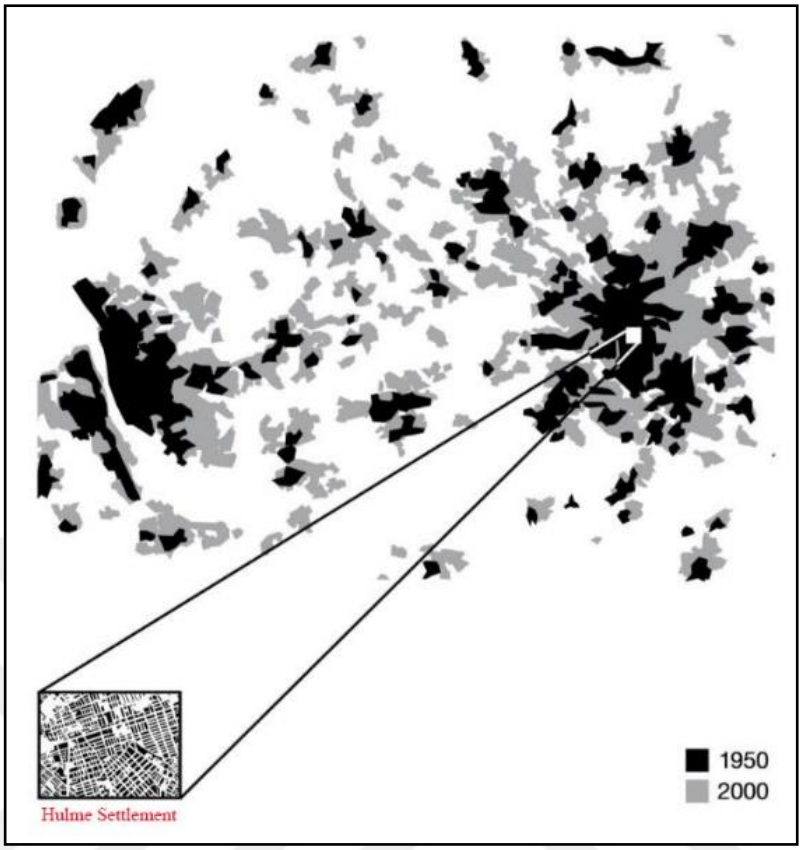


Figure 2.20. Map of Manchester between 1950 and 2000 [33]

Figure 2.21. Hulme settlement (in Manchester) throughout the 20th century [33]

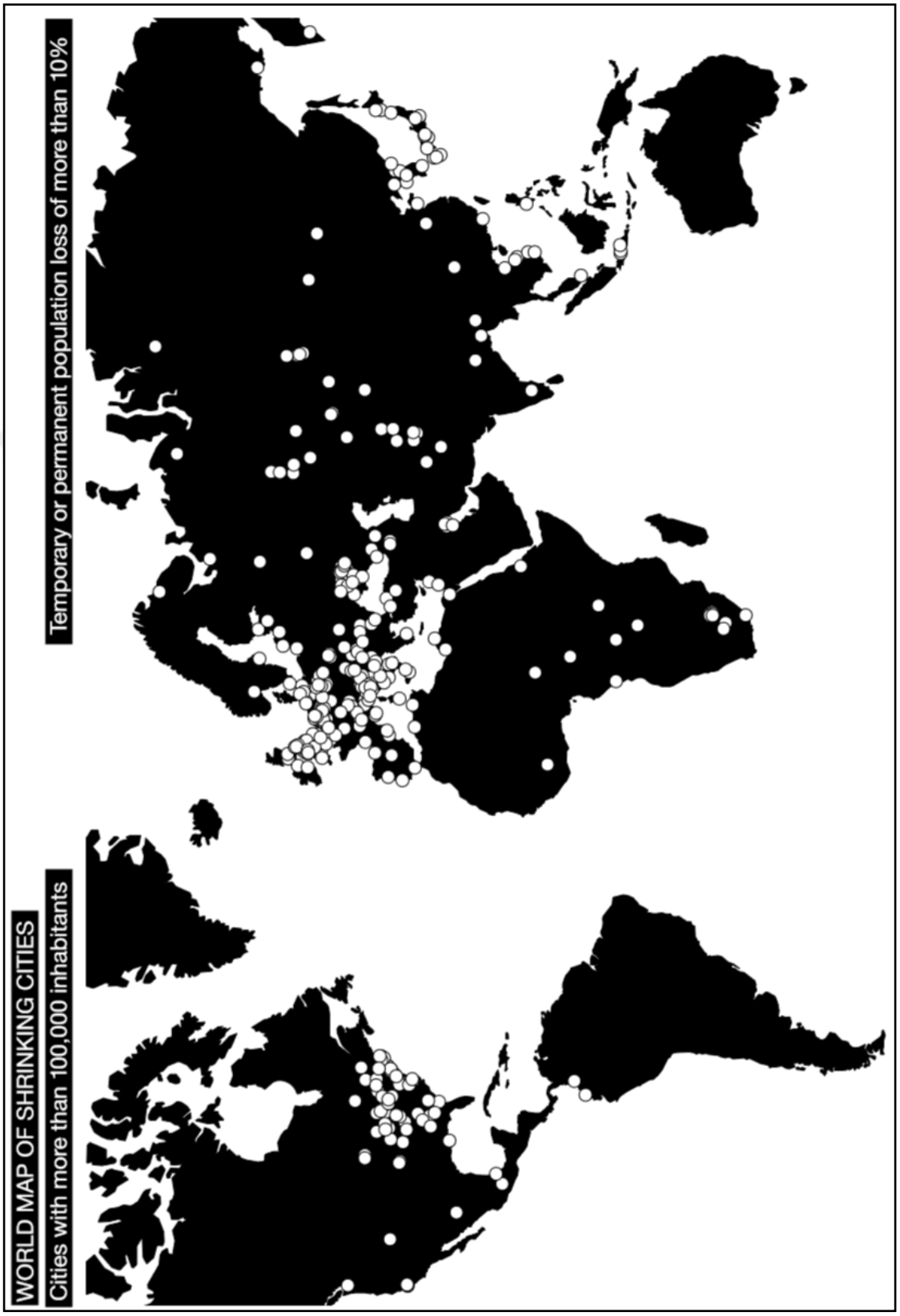


Figure 2.22. World map of shrinking cities [33]

3. RE-STARTING DISUSED INDUSTRIAL BUILDINGS

The architecture and the urban fabric of cities determine somehow the culture and identity of people living there. The abandoned buildings are also part of the urban fabric and architecture of cities.

The change in production has led to the de-industrialization, and this later has also led to the abandonment of many industrial buildings. Deindustrialization has created many changes in cities urbanization, cities economy, and life style. This fact happened in many cities and countries in the world, and especially in the second half of the 20th century. Buildings were left unused creating blanks in the urban fabrics. The buildings left unused in cities were of many types; residential, industrial, private, public, small, big, etc.

In some cities like Detroit and Manchester, de-industrialization has forced people move from neighborhoods to other neighborhoods, leaving buildings obsolete. There were many types of buildings left unused after the de-industrialization, but this chapter will focus on the industrial buildings and structures. Since buildings are parts of the urban fabric, they constitute the identity and parts of the cities cultures. Leaving industrial buildings unused is affecting the identity and culture of cities. In order to not lose the identity of cities; scholars, designers, archeologist, and scientists have started to consider preservation of old and mostly unused industrial buildings. Therefore, to preserve industrial buildings, archeologists and scientists have created a concept of "industrial world heritage", to refer to the most important industrial buildings left that have to be preserved.

3.1. PRESERVED INDUSTRIES AND ORDINARY INDUSTRIAL BUILDINGS

3.1.1. Approaches on Preserved Industrial Buildings

Living in a world full of traces of the past and heterogeneous historical materials that are gathered and accumulated in the present world, the remaining of the past cover identities and histories of lands, cities and societies.

Preserved industrial buildings are considered to be the world industrial heritage. The word Heritage is a complex word to define. Many words, definitions and organizations have influenced and shaped the perception we have of Heritage in our contemporary world.

Nowadays, there are various ways of defining the word Heritage. The word heritage can include anything from concrete such as monuments, buildings, and memorials to exquisite songs, lyrics and languages, etc. It circumscribe many things varying from big to tiny, from extravagant to meek, from natural to built ones, from a whole landscape to a small fragment of bone, stones and dusts in archeological sites; from public big areas to small ordinary dwelling areas, from wasteland or forest to modern areas.

The management, listing, and categorization of the past have become so complex that we become blind to this fast and pervading remains of the past in our contemporary world. Our societies perceive heritage as a social, political and economic phenomenon of the late contemporary world, which particularly focus on many changes that have happened as an effect of globalization of heritage during the end of the twentieth and the beginning of the twenty-first centuries.

These various ways of perceiving heritage depend partially on the influence of knowledge of heritage spread through the Work of World heritage Committee since the 1970s, and on a sequence of global extensive economic and social switches in our late contemporary societies including procedures of globalization, deindustrialization, and the contemporary economical advance [35]. Heritage is essentially about our interaction with the present and the future rather than being about a simple history or recognition of the past.

> Heritage is not a passive process of simply preserving things from the past that remain, but an active process of assembling a series of objects, places and practices that we choose to hold up as a mirror to the present, associated with a particular set of values that we wish to take with us into the future [36]

Heritage can be seen as a creative arrangement containing the past in the present, which directs us to consider our ability of taking any positive and active position in the production of a good future.

Understanding preservation of heritage, which is one of our era's obsession, allows not only heritage researchers, but also informed persons to exercise better organizations in the resolutions that NGOs, governments, individuals, private communities, public communities,

make about in creating the past in the present that we are living. However, despite the fact that some of the remaining from the past have been preserved for many years, we live in an era in which the definition of heritage have been influenced by many things in such a way that now nearly anything can be considered as “heritage”.

Industrial heritage is about culture; it is an identity of a site or city, it’s a memory, or tradition too. It belongs to countries, places, cities and their all transformation processes; it is an issue of planning. The term industrial heritage doesn’t only describe the relationship of a nation with its past, but also describes to a great extend the ways in which a wide range of other people are concerned to create the past in the present. Heritage engages many different scales of various fields. Industrial heritage is part of the urban fabric which represent the story and culture of a society, hence the need of preserving heritages aroused [37].

Preservation is one of the oldest method of keeping heritages alive, it’s a way of protecting one’s identity or a culture of a society. Authenticity seeing as the embodiment of history and the aspect of reversibility and respective treatment of art was first recorded in the 18th century in art, painting and sculpture repairs by Johann Winckelmann and Giovanni P. Bellori [38]. These concepts are considered as one of the first approaches to restauration of monuments. Preservation was then seen as a recovering from the past, preserving was seen as a way of maintaining history and time, and reminding us of the intact past in the present and future days. Since many centuries ago, people were trying to preserve their identities, lands, buildings, and environment etc. preservation have been of a very importance for keeping the history and identity of societies.

History shows that the laws of preservations were first applied centuries ago. For example, it is recorded for the first time in history that in 1790, right after the French Revolution, the issue of preserving monuments was first recorded in France. The laws of preservation was secondly recorded in 1877 in Victorian England. Starting from the beginning of the 1900s, international and non-governmental organizations became aware of the importance of culture and societies, and urged to preserve heritages.

International organizations and architects have stood and gathered to decide the regulations of preservations during time. Besides the European countries, the USA, and other industrialized countries have also stood to decide the preservation regulations for their states during time.

Some of those organizations are: ICOMOS, UNESCO, UNEP, etc.

Some International Institutions for Preservation:

- *ICOMOS:* It is a global non-government organization that focus on the conservation and preservation of cultural heritage places. It advocates the application of theories, methodology, and scientific techniques to the preservation of archeological and architectural heritage. The work of ICOMOS is built upon the rules cherished in the Venice Charter (the 1964 International Charter on the Conservation and Restoration of Monuments and Sites).
- *UNESCO:* The United Nations Educational, Scientific and Cultural Organization (UNESCO), is an autonomous organization of the United Nations (UN). UNESCO adopted on 16 November 1972 in a general conference the instructions concerning the preservation at national level of the cultural and natural heritage.
- *UNEP:* The United Nations Environment Programme (UNEP) is a dominant global environmental organization that advocates a coherent implementation and sustainable development of the environment.

The preservation of industrial heritages is something that has been going on years, for instance, the 1830 warehouse, Liverpool Road railway station is the warehouse built in 1830 and it is a part of the Liverpool railway station complex (Figure 3.2). It is a listed as an industrial heritage since May 1972[2]. Built with red Flemish bond bricks and with interior timber and cast iron structure, the 1830 warehouse embalms the culture of people in Manchester and Liverpool during industrialization. Initially built with a manual processing system of goods, it was later replaced by a steam-powered system and then by a hydraulic system in order to cope with the volume of goods and to increase efficiency.

[2] "Old Warehouse to North of Former Liverpool Road Railway Station, Machester". *British listed buildings* [https://britishlistedbuildings.co.uk]

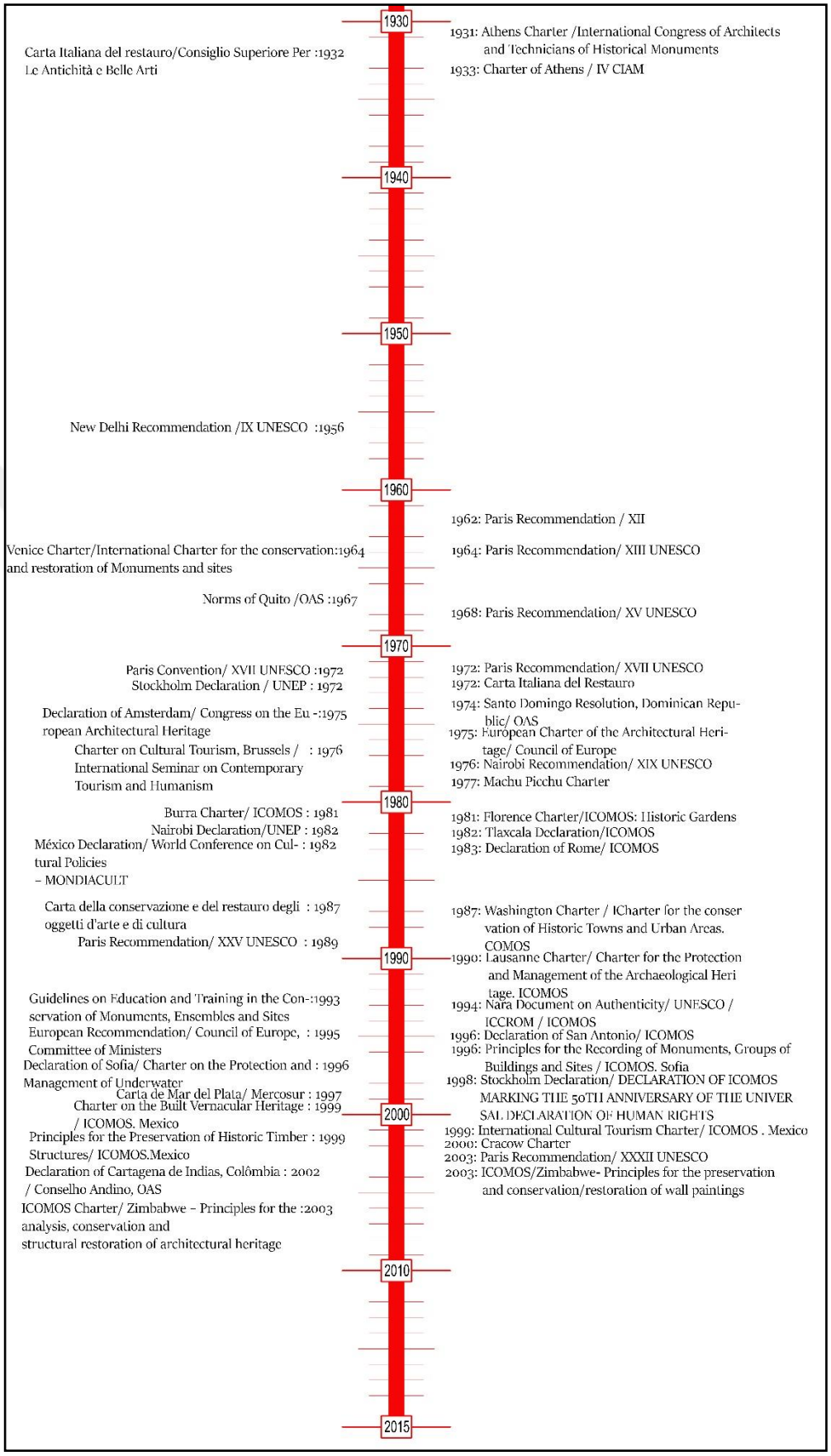


Figure 3.1. Time line of world historic preservation from 1900s

(a) (b)

Figure 3.2. (a) The 1830 warehouse, Liverpool Road railway station , (b) Manchester-Liverpool railway [39]

Another example of an industrial world heritage is the windmills at Kinderdijk in the Netherlands (Figure 3.3). A group of 19 windmills located in Kinderdijk, in the Southern region of the Netherlands, it has been recognized as the UNESCO industrial World Heritage since 1997[3]. The windmills at Kinderdijk were built around 1730s and 1740s for irrigation of polder and drainage of lands for agriculture and settlements. The hydraulic windmills doesn't only change the urban fabric but it also embalm the identity and culture of people in that city (Figure 3.4).

However, all left industrial buildings are not necessarily considered as world heritage, but they are part of the urban fabric and settlement, and most of them play a great importance in the society. These buildings are industrial buildings that are not listed in the UNESCO world heritage lists.

[3] This is stated in http://whc.unesco.org/en/list/818/

Figure 3.3. The Windmills at Kinderdijk [40]

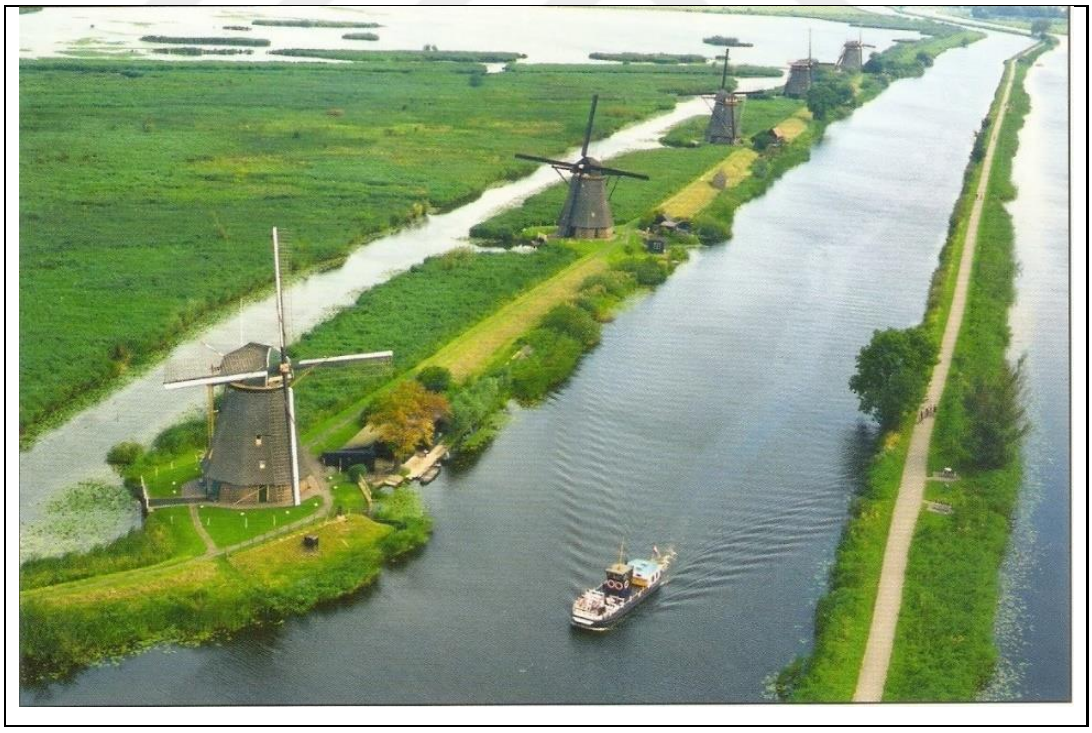


Figure 3.4. Landscape created by the windmills in Kinderdijk [41]

3.1.2. Ordinary Industrial Buildings

> Cities need old buildings so badly it is probably impossible for vigorous streets and districts to grow without them. By old buildings I mean not museum-piece old buildings, not old buildings in an excellent and expensive state of rehabilitation—although these make fine ingredients—but also a good lot of plain, ordinary, low-value old buildings, including some rundown old buildings[4] [39]

Any old building can be asset for the development of cities, if it's not in a very bad state where it cannot be used anymore. Many unused industrial buildings in our cities are not listed in the UNESCO world heritage list, or any international organization's list of that kind. Abandoned industrial buildings are sometimes hard to be adjusted in our contemporary societies, unless they are demolished or destroyed. There are many examples of abandoned industrial buildings in our cities, for instance, the Millennium mills, in West Silvertown on the south side of the Royal Victoria Dock, in London (Figure 3.5). Millers William Vernon & sons designed the millennium mills in the beginning of the 20th century. The Millennium was a flourmill constructed with two plants that had a capacity of 100 sacks per hour. Having made a way into several aspects of popular culture, it has become a portrait of post-industrial Britain[5]

The Millennium mills has played a great importance in the culture and was even used several times as backdrop in movies and television shows. The Millennium mills closed definitely in 1981, and since then there have been some attempt of renovation.

The Michigan Central Station is another example of abandoned industry (Figure 3.6). Located in Detroit, in the state of Michigan, it was built between 1913 and 1914 and designed by the architecture office Warren & Wetmore and Reed & Stern, to replace the old Michigan train station that was shuttered after a fire. The Michigan train station was built in a suburb far away from the downtown of Detroit in order to allow a further development of the city in the future, and people were travelling to and from the train station by interurban services

[4] Jacobs, J., *The Death and Life of Great American Cities* , Random House, New York ,1961.

[5] Koch, Christian (17 August 2009). "Urban explorers – the thrillseekers infiltrating unseen London". London Evening Standard.

and streetcars (Figure 3.7)[6]. The Michigan train station was made of two parts: the train station and an 18-story tower, which was used for offices. The height of the tower is 70 m and was the tallest train station tower at the time it was constructed. Built with the Beaux-arts classical architecture features, the main waiting on the ground floor was decorated after an ancient Roman bathhouse with marble walls and ceilings with vaults[7]

During the first and second world war, the number of passengers had increased. After the 1950s with the shrinkage of population and the expansion of the automobile industry, more people have started to use cars for travelling in the USA, and trains were only left for travelers for holidays. Thus, the number of passengers has started to decrease and the last rain left the Michigan train station in 1988[8]. Many attempts of demolition and renovation of the Michigan train station have occurred so far.

The Chelsea Market in New York City is also one of the industrial buildings left unused for a while. The Chelsea Market reflects the past. It puts the past with the present together. The Market used to be a National biscuit company complex and the remaining ruined shell and partially demolished bricks can be observed in it, which reminds us of the former industry and of the past history contained in the present. This is an adjusting example of a re-use of an industrial project where the old and the new are put together. In the Chelsea Market in New York, people work, live and dwell among the past and the new, as it is mentioned in its website: ‘A visit to the market offers ghostly evocations of the site’s history (Figure 3.8).

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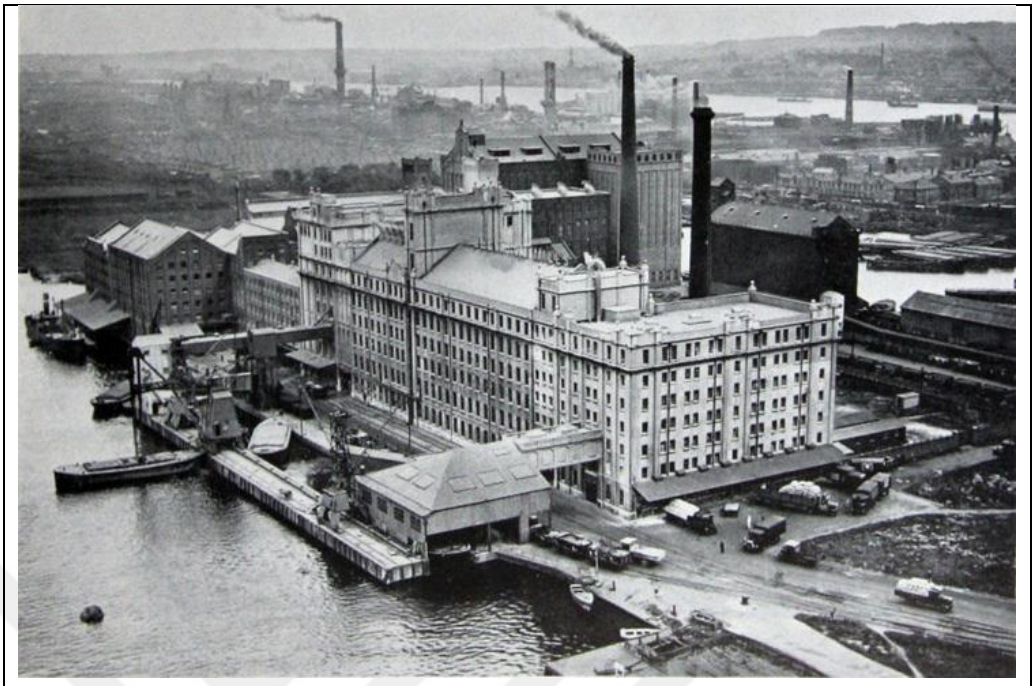
[6] Hill, Eric J. & John Gallagher (2002). *AIA Detroit: The American Institute of Architects Guide to Detroit Architecture*. Wayne State University Press. p. 220. ISBN 0-8143-3120-3 (108).

[7] Hill, Eric J. & John Gallagher (2002). *AIA Detroit: The American Institute of Architects Guide to Detroit Architecture*. Wayne State University Press.

[8] Roskopp, Jack (September 14, 2017). "The Michigan Central Station light show is the coolest thing you'll see all week". *Metro Times* (109).



(a)

(b)

Figure 3.5. (a) The Millennium Mills in 1934, (b) the Millennium Mills after being abandoned; in London

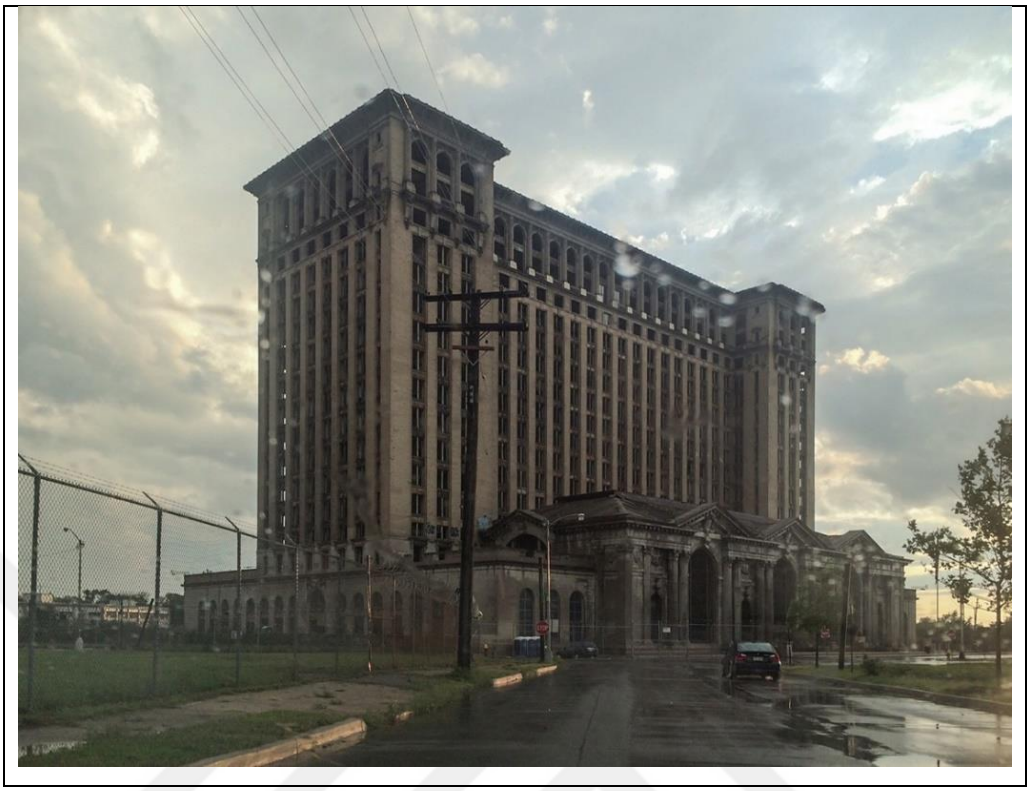


Figure 3.6. The Michigan central train station [43]

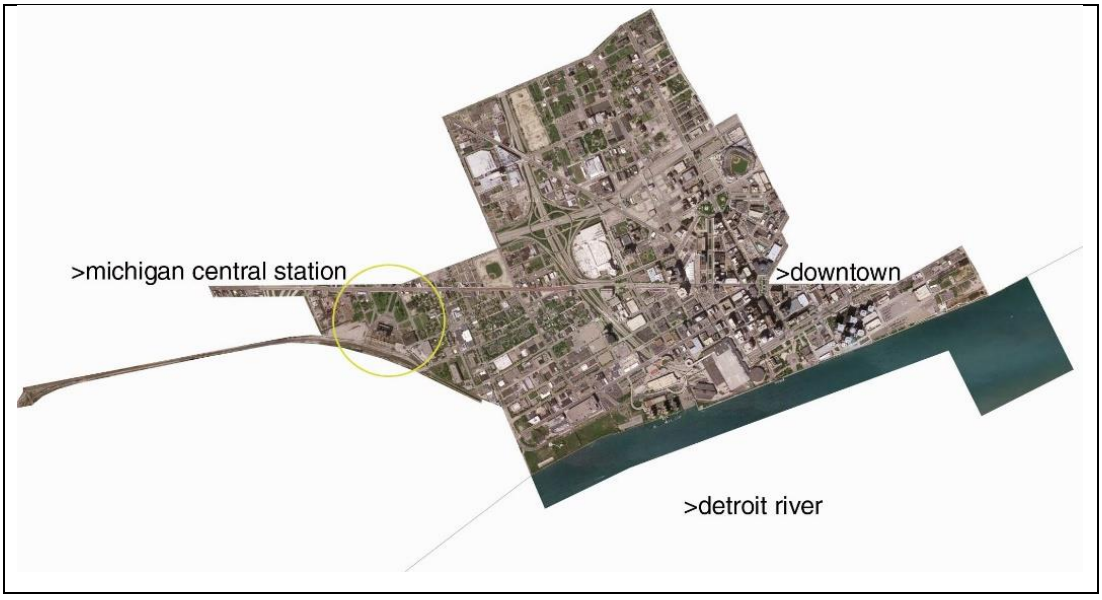


Figure 3.7. Map of the Michigan Central Train Station located away from the downtown [43]

Figure 3.8. Chelsea Market, New York City, November 2011

The unused ordinary industrial buildings, which date from the 18th, 19th, or even the first half of the 20th century in our contemporary societies, have created blanks in the urban fabrics. The problem is how to deal with them, and how to fit them in the actual context. The change in the economy has affected many cities' urbanization. In many cities, many companies were forced to shut down and were then abandoned. Industrial buildings are left obsolete and unused in cities. Scientists and scholars have understood that buildings contain the identities of cities, and that those unused buildings are important and affect the urban fabric. The question is how to preserve ordinary industrial buildings, should they be preserved the same way as the world heritage buildings or differently?

The practice of conserving is a practice that has started long time ago. Preservation during time proves that preservation does not only affect monuments, structures, religious buildings, etc., but also of everything that people can inhabit in. It can be then said that

preservation is one of the contemporary's creativity. Living without preserving our culture is neglecting our identity. According to Koolhaas, R., the historical preservation regulations have changed in time, and their consideration of preservation-worthy architecture has also changed with time. For Koolhaas, R., preserving is adjusting the past to the present, it is a way of not only conserving the past, but also adapting to the contemporary time [1].

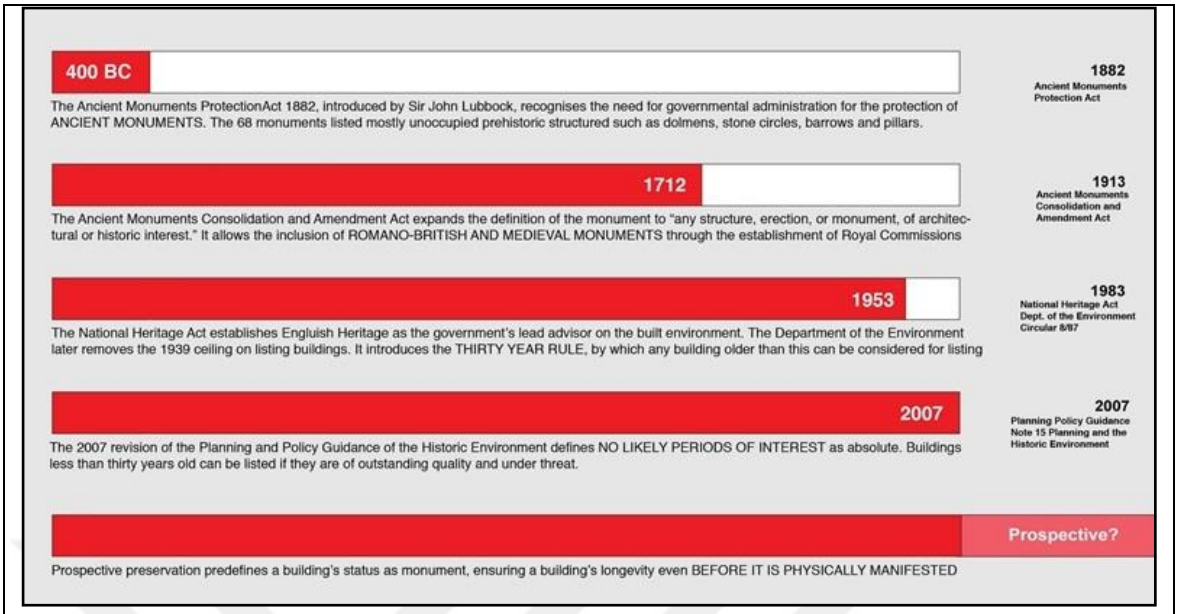
Koolhaas, R. shows in graphics represented in the Figure 3.9.a and Figure 3.9.b that the interval between preservation in time is decreasing in the present. Preservation was about 2,000 years in 1818, 20 years in 1900; and 20 years near the 1960s. This shows that there is now a big urge for preservation of not only the world heritage, but of our identity, which is embalmed in buildings and urban fabrics.

In many countries, artists, architects, and scientist have become aware of the importance of preserving abandoned buildings. The Figure 3.10 shows an exhibition of abandoned buildings in the Netherlands, calling the attention of people to preserve them and spare them from demolition.

3.2. TRANSFORMATION BEYOND PRESERVATION

The awareness of preserving and reuse have grown bigger since the second half of the 20th century, exhibitions, books, and practices that call our intention on preserving have really multiplied. The practice of preserving in architecture in a sense of reusing materials was already noticed in the early 1970s, with the artist Gordon Matta-Clark, when he reused trashes and garbage to make a wall in the "Garbage Wall" exhibition (Figure 3.11). The streets of the down tow of New York at that time were full of garbage and abandoned buildings. He showed how abandoned materials could be reused in art.

The "*conical intersect*" (see Figure 3.12) is the piece of art created by Gordon Matta-Clark reused in 1975, to prevent the destruction of two 17th century townhouses that were located in a historic Parisian district of Les Hales. The Conical interset exhibition consisted of cutting a large conical hole through the two historical buildings to prevent their destruction. The exhibition of the piece of art crated by Matta-Clark has saved from destruction and at the same time preserved the existing.



(a)

(b)

Figure 3.9. (a) and (b) Cronocaos Exhibition, 12th Venice Architecture Biennale. Interval between preservation in time [1]

The Figure 3.13 shows that literatures and exhibitions about reusing were already noticed in the early 1970s, and this practice has grown bigger in the last two decades.

Reusing industrial architecture is not only recovering the identity or culture of a society, but it's also developing the society according to the contemporary needs and criteria.

Figure 3.10. Exhibition of abandoned buildings in the Netherlands [44]

It is a creative technic of reconsideration of architectural, urban and landscape forms. It is ubiquitous and usually a distinct combination of the old and the new. In the physical realm, the reuse of materials and artifacts is routine in pre- or non-industrial economies that generate little surplus and cannot afford waste. Not using abandoned materials or elements that can still be profitable to the society or environment is considered as a spoil or waste.

> This new strategy (recycling) is effective because it is capable of embracing the transformation of spaces, providing multiple, lightweight answers to the crisis of large systems or even the very idea of progress [34]

This reuse combines the past, the present and the future; it's a way of dialoguing with the time. Reuse deals with the past and the present, the full and the void, the urban and the anti-urban [34]. Reuse is also a way of preserving the culture, it's a technic that reminds us of the past, and it's like a form of modernism, able of absorbing the past, the pre-existing identities, and the context without replicating them, and also without letting them overwhelm that form [34]. Reuse is the mixture of the remaining and the new architecture; it is a way of thinking about the contemporary mode of art and architecture in more intense and contradictory times. Reuse can be minimal, temporary, final or constant; but they are all

meant to transform the society by keeping the core of the society, by preserving the culture and identity. There are so many words that can be used for the Reuse practice, like recycling, conserving, readapting, preserving (according to Koolhaas, R.) etc. and many other words like referred in Figure 3.14.

Figure 3.11. Gordon Matta-Clark. Garbage Wall, 1971 [45]

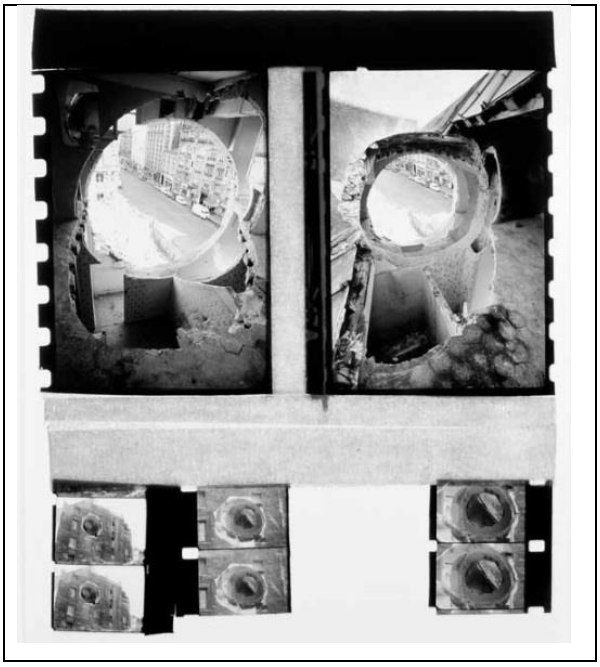


Figure 3.12. Conical Intersect,1975 [45]

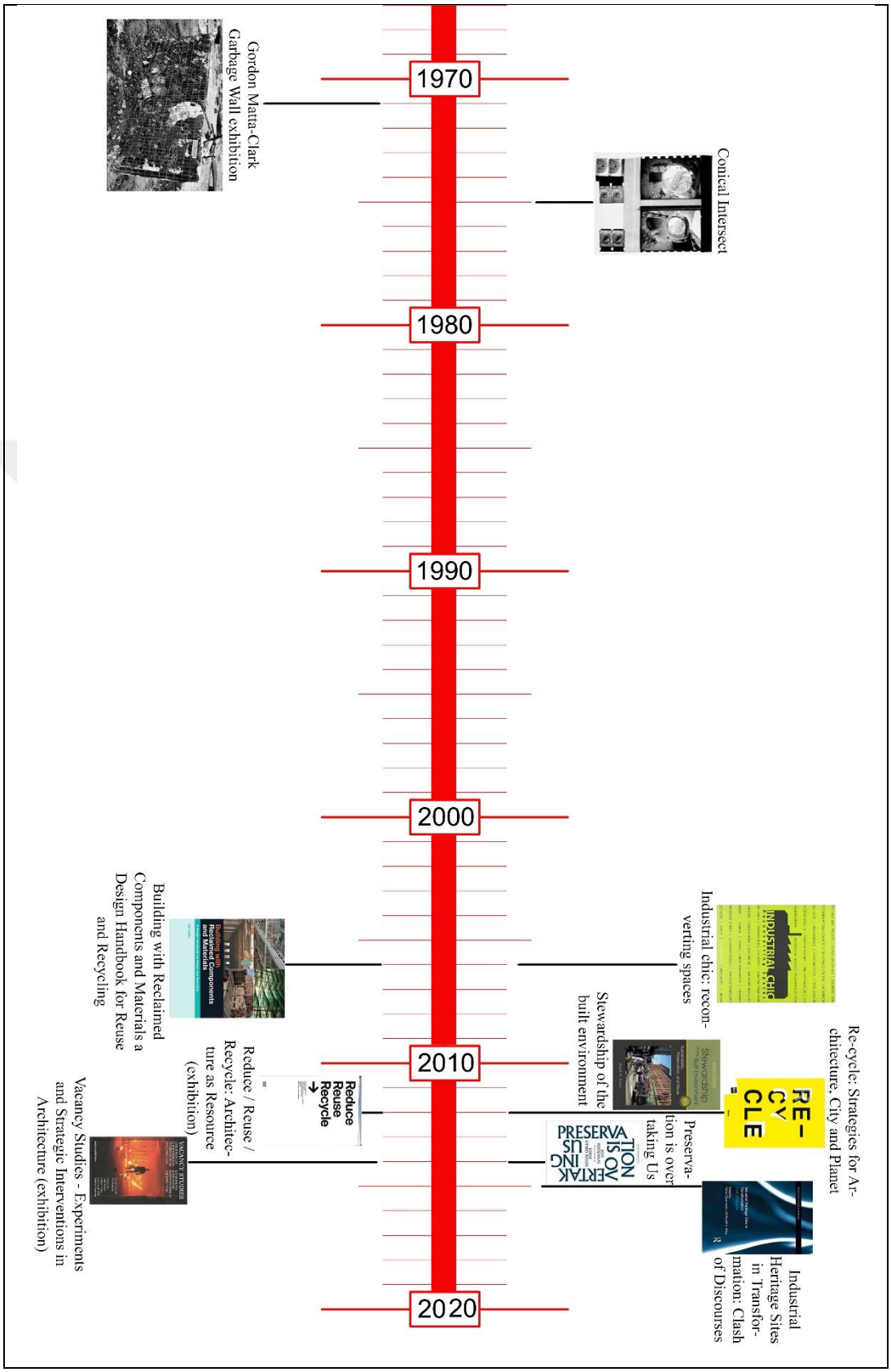


Figure 3.13. Time line of some books-exhibitions that have awaked the preservation and reuse of buildings

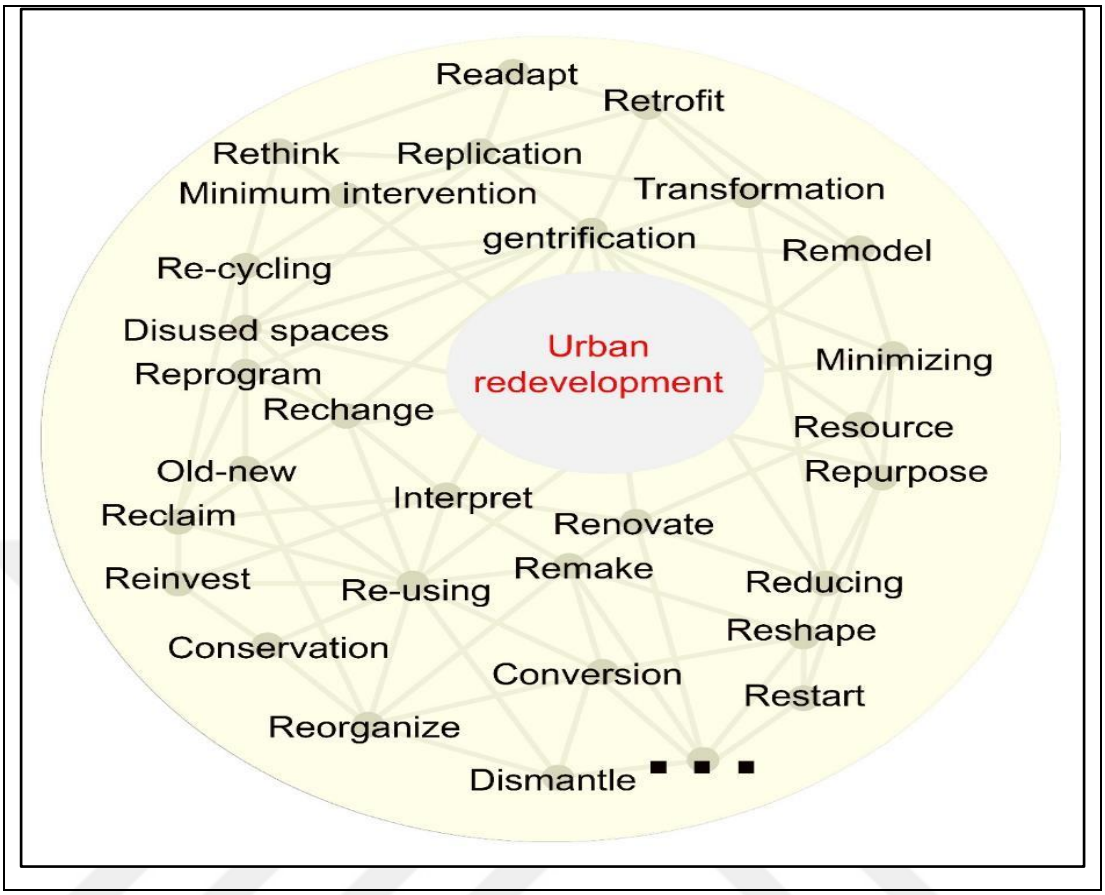


Figure 3.14. Synonyms of preservation of industrial heritage

The practice of reuse of industrial buildings likewise the reuse of any building in architecture is contextual, and depends on the approach of the environment, site, economic factors, social factors, environmental factors, etc. In the reuse of industrial buildings the old and the new are combined in a distinct way, and they both adjust to the needs of the contemporary period. Reusing of industrial buildings is restructuring, reorganizing or restyling the existing environment, urban, monument, element, or fabric. It is conserving the identity and memory of a fabric, urban, landmark, element or environment. It conveys the information of the past in the present and future and shape the relationship between present and the future.

Reusing of industrial buildings is a combination of the bridge between the past, the present and the future. Although it contains the memory and information of the past of societies, it gives means for the development of the present and the future environment. It is a practice that allows development with preservation of identity and memory. Reusing of industrial buildings is an intellectual design challenge and dynamic continuous art form that is of a

crucial importance in design. It revives the history of the element that was about to die, like Rem Koolhaas says in his book [1] that preservation is always suspended between life and death.

Rethinking in the subject of urban change and the issue of how to control preservation, protection and development are the main elements needed to manage industries. As long as the number of industries increases, development also becomes as important as industrial sites. This bring about new challenges not only with the monumental preservation and contemporary architecture but also with the great need for the urban economic development by reusing the built industrial sites.

There are many clashes of ideas between conservation and changes of industrial buildings. The regular matter in conservation is the preservation and protection of the fabric; whereas economic assets and values, and the general environmental qualities are the main concerns of the development. On the other hand, transformation and change can be considered as a matter for the urban development of cities which include preservation and protection. There are also many conflicts between conservation and architectural production that rise questions of protection, preservation and at the same time of changes and development of the material.

There are two main factors of industrial sites that influence the specific variations of this conflicts, which are: *Cultural factor, and Architectural production factor* [37]. There are many different perceptions of preservation that guide the transformations of industrial buildings; some of them are: *Conservation of industrial sites as a proof of the past, conservation of industrial sites as cultural landscape or urban landmarks, conservation of industrial sites as built infrastructure and spatial resources, conservation of industrial architecture as architectural and atmospheric space* [37].

- ***Conservation of Industrial Sites as a Proof of the Past:*** This conservation is about the sites with everything they contain (buildings, machinery, stones, etc.) which are proof of specific time in the past. They have an authenticity and specific integrity that document their past. Their culture, technical innovation, production, labor organization, living styles etc. all document the past of industrial sites. Cramer and Breitling (2007) show that users in urban development and architectural production can learn or profit from this information.

- ***Conservation of Industrial Sites as Cultural Landscape or Urban Landmarks:*** Here the matter is to preserve the industrial architecture which is considered as a distinct industrial landscape pattern or a specific spatial landmark. The relationship between the patterns, the industrial landscape developed through time and the distinct spatial patterns is of a very crucial value.
- ***Conservation of Industrial Sites as Built Infrastructure and Spatial Resources:*** Here, a certain identity and authenticity of the area is kept, even if it seems to have changed the identity in order to achieve new demands. According to Mieg and Töpfer [43], this approach enhance the value of sustainability which is crucial for both conservation and innovation-oriented urban development perspectives [37]. However, identity is a crucial aspect for urban innovation-oriented and is significantly important for urban development referring to creative industries and attracting culture.
- ***Conservation of Industrial Architecture as Architectural and Atmospheric Space:*** Architecture can be displayed in space, in a matter, and atmosphere. Space, matter and atmosphere are intrinsic values of urban development and new architectural production. Studies have shown that despite different approaches and perceptions of preservation and development, industrial sites are turning into the core of urban transformation and their planning practices [37].

The reuse of industries and their texture can bring about many approaches varying from strict preservation, which are affected by classical theories on conservation up to radical changes that are mostly influenced by economy [37]. There is a line between preservation and change, in such a way that questions arise between conserving the present state of industries and preserving an authentic important part of the particular sites while minimally changing certain things that can allow to accommodate new demands in architecture.

The contemporary architecture aims for new shapes and forms, and architectural interpretation. This is why new forms and new constructions are mostly preferred in the contemporary world, rather than preserving the history. Nowadays, conservation is altering from a preserving behavior to a more shaping behavior that consists of transforming the urban fabric. Architecture therefore focuses on preservation, re-use, and urban industrial development. Re-using involves a strict preservation and protection of the history and identity of the place and radical changes that are influenced by the economic factors.

The intact preservation is contradictory to the change influenced by the economic and other factors. The conflict between preservation and changes is that there are questions about the time to which the site should be conserved (should it be conserved in their present state?), and the amount of change necessary in order to satisfy the new demands and at the same time preserve the genuine core of the site [37].

Changes and redevelopment of the urban fabric are driven by economic demands and the need to reorganize infrastructures. Sometimes, buildings can be put to a temporary use from the moment they become unused until the moment they are renovated, destructed or redeveloped. During the temporary use of industrial sites, some of their values can be revealed, and the temporary function can remain the final one after redevelopment. The application of design as a value implies that an object has to be designed through a process of decision making, not just created without a particular process, plan, or an optimized shape [37]. The cases presented in this thesis will introduce some perspectives of planning practices that are deeply related to a definite significance of planning approaches for industrial buildings.

The three main transformation processes of industrial redevelopment are: *Conservation of identity, urban development, and Architectural production* [37].

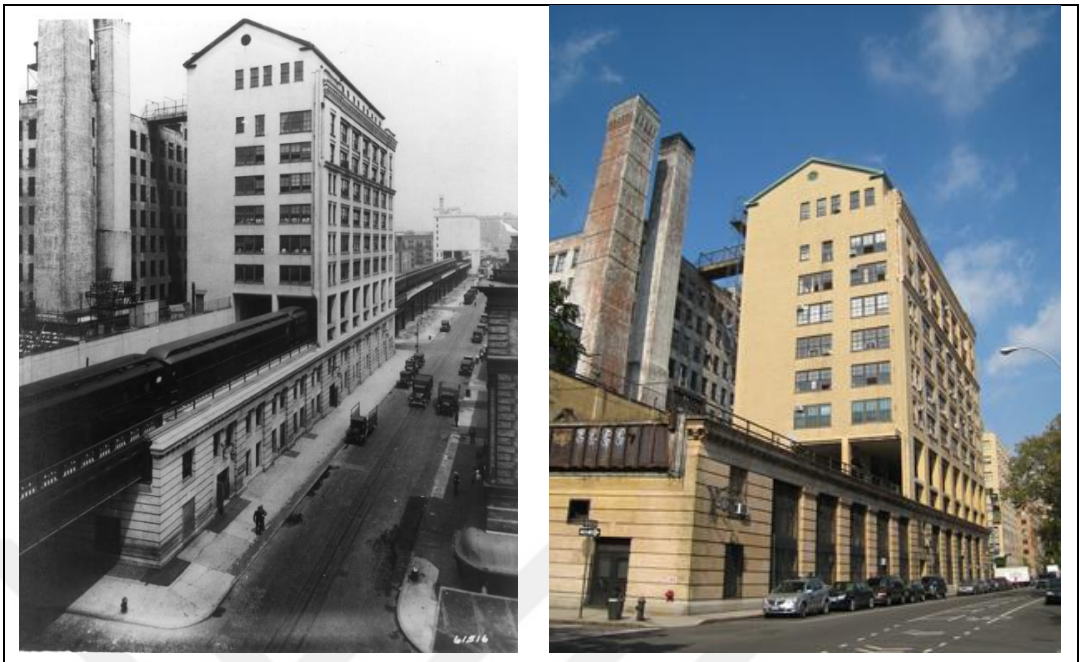
- ***Conservation of Identity and Values:*** This focuses on preservation, and protection of industrial structures and sites. This perspective is against demolition and supports conservation. This perspective involves many concepts such as temporary use, minimal intervention, repairing, reusing, preserving, conserving, etc. The core element in this perspective is the conservation and protection of the history and the remaining urban fabric as a testimony to the past. The remaining fabric stands as an architectural masterpiece, it's a heritage value. The decisions on conservation of the existing fabric should be taken in the alignment with the core assumptions, which are authenticity, integrity, and heritage values. The conservation and preservation in this perspective is related to the redevelopment and transformation of the urban.
- ***Urban Development and Values:*** This perspective focuses on developing and creating a prosperous and sustainable environment. The urban transformation of the society and urban development based on conservation and preservation are crucial concepts for redevelopment of industrial sites. The primary purpose of this perspective

is to achieve an urban fabric that fits into the contemporary world we are living in, to develop cities, to make unused industries fit into our contemporary world, and make our cities livable. The core values in this perspective are the environmental and economic values, and development and planning values.

- ***Architectural Production and Values:*** This process aims to provide a contemporary architecture, and convert existing areas. New forms and architectural designs are expressed. The existent physical space and its character and atmosphere are the raw material for the new design" [37]. The main values in the architectural production interact with creativity, design-planning and new esthetics

In 1970, the transformation of the Westbeth artist's housing project (see Figure 3.15) from one of the world's most important research center (the Bell laboratories), the project was conceived in the 1960s into affordable houses and studios for artists and their relatives and opened in 1970. It is considered as one of the first examples of reuse of industrial buildings in the US. The intervention in this project is minimal, transforming 13 buildings, which used to house a research center into 384 live-work spaces for artists and housing. The previous Bell Laboratories were disused in 1966, and since then the project of renovating the buildings had started. The transformation project was managed by the architect Richard Meier. The architect adjusted the building into the new function by renovating the interior design according to the need. The Westbeth was recognized as a historic place by the National registry for historic places in 2009 and as a New York City landmark by the NYC Landmarks preservation commission in 2011. The New York high line used to pass through the buildings of the Westbeth and later in 2014, the high line was transformed to a high line park (Figure 4.93).

The recycling project of the Ironworkers local 580 in New York, USA, is a transformation of a medical product warehouse into a training center for the Ironworkers union (syndicate) (Figure 3.16). The transformation project was designed by the architectural firm Daniel Golner Architects in 2004. The recycling in that project is minimal, leaving almost the remaining building as it was, but just covering the brick façade with iron and combining it with glass. The iron façade is used in testimony to the skill and homage to the iron union's workers [44].



(a) (b)

Figure 3.15. Westbeth Artists' Housing (a) before transformation; (b) after transformation [46]

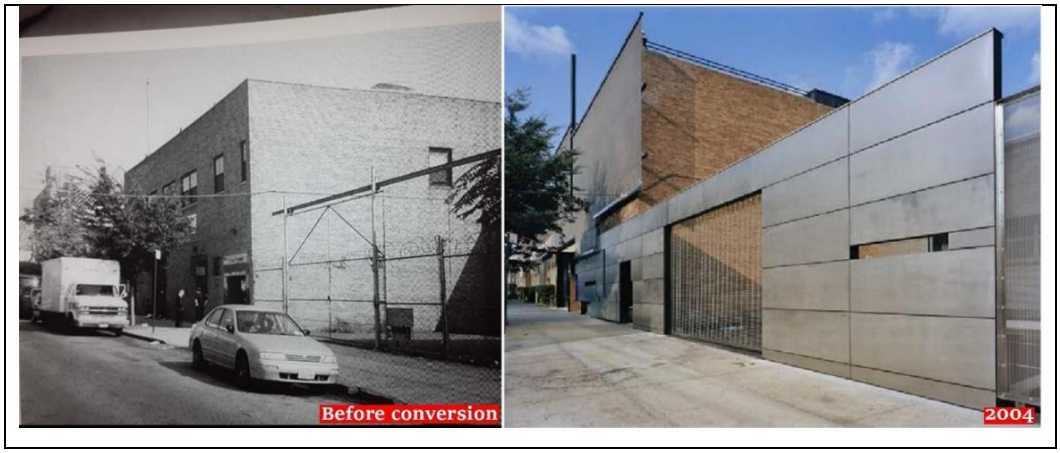


Figure 3.16. The Ironworkers local 580 before and after transformation [47].

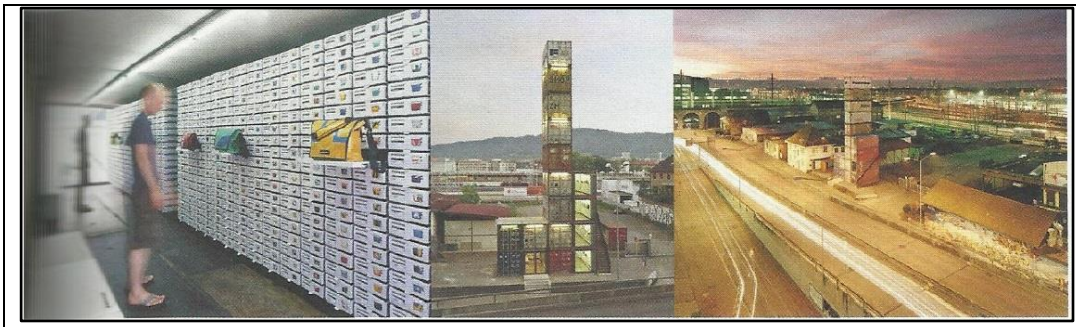


Figure 3.17. Freitag Flagship Store Zurich [34]

Recycling can be also a use of remaining materials to create something else new according to the contemporary need, like the Freitag Flagship store project in Zurich which is a recycling of containers put one on top of the other, to make an 85 feet story store building (Figure 3.17). The artist Kara Walker reused the abandoned Domino sugar factory of Brooklyn in 2014, by installing sugarcoated sphinx piece of art that looks like a woman inside the relic of the factory. This exhibition of art has revived the abandoned factory and saved it from destruction by making it an art exhibition (Figure 3.18).

Figure 3.18. A massive installation of a sugar-coated sphinx-like woman inside the sprawling industrial relics of Brooklyn's legendary Domino Sugar Factory [49]

The urban fabric changes with time and longtime unused industrial buildings are sometimes no more a good match with the current urbanism in terms of function, technology, modernism, etc. For instance, deindustrialization has transformed many Detroit's industrial

areas into slum areas (Figure 3.19). Many abandoned industries or industrial structures couldn't be sustainable anymore in the current urban fabric, although they embalm the identity of the society.

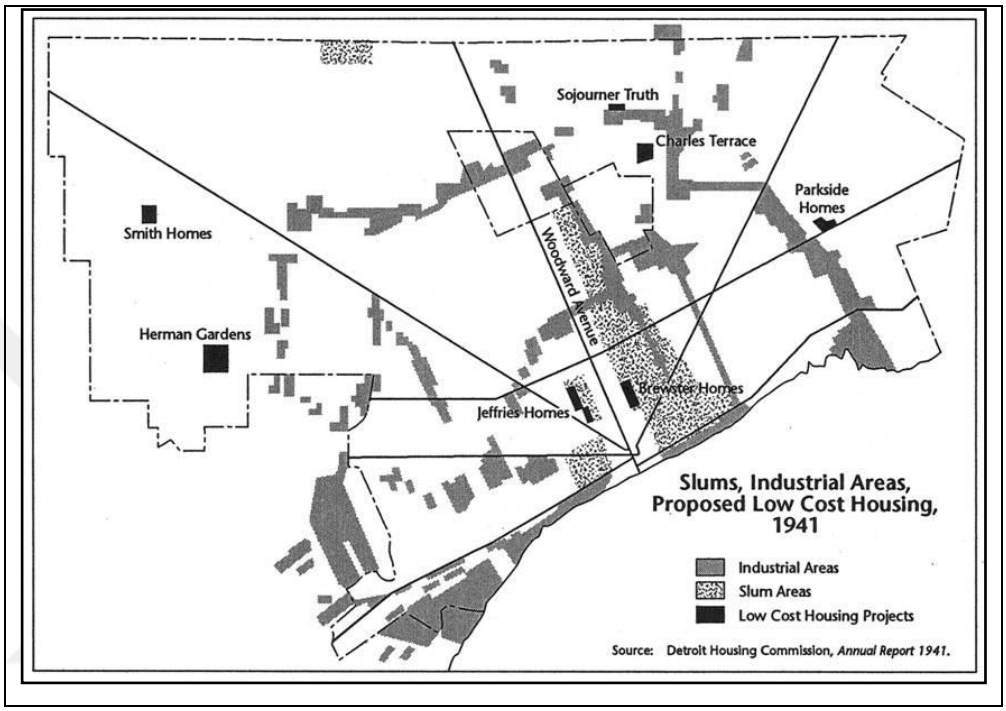
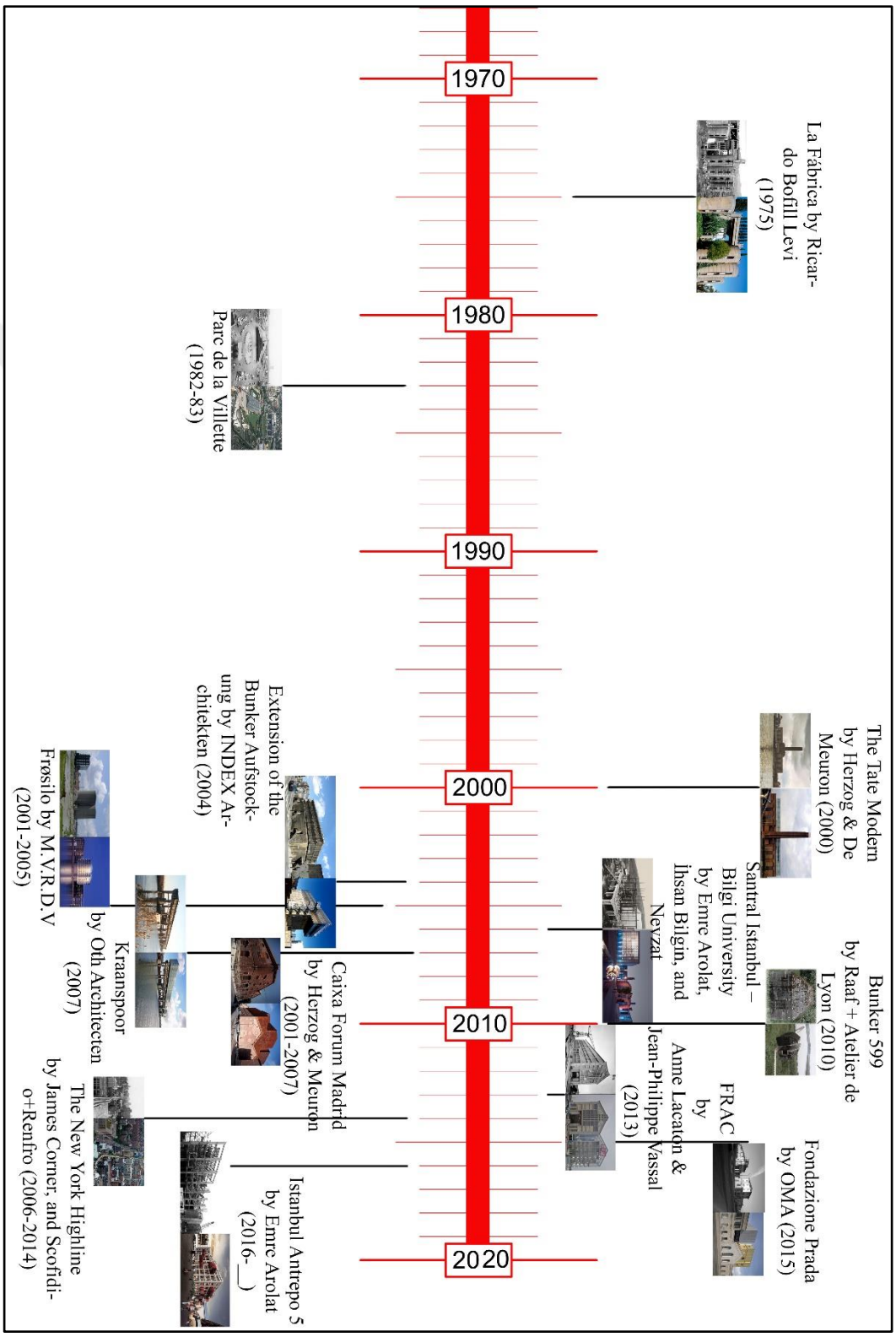
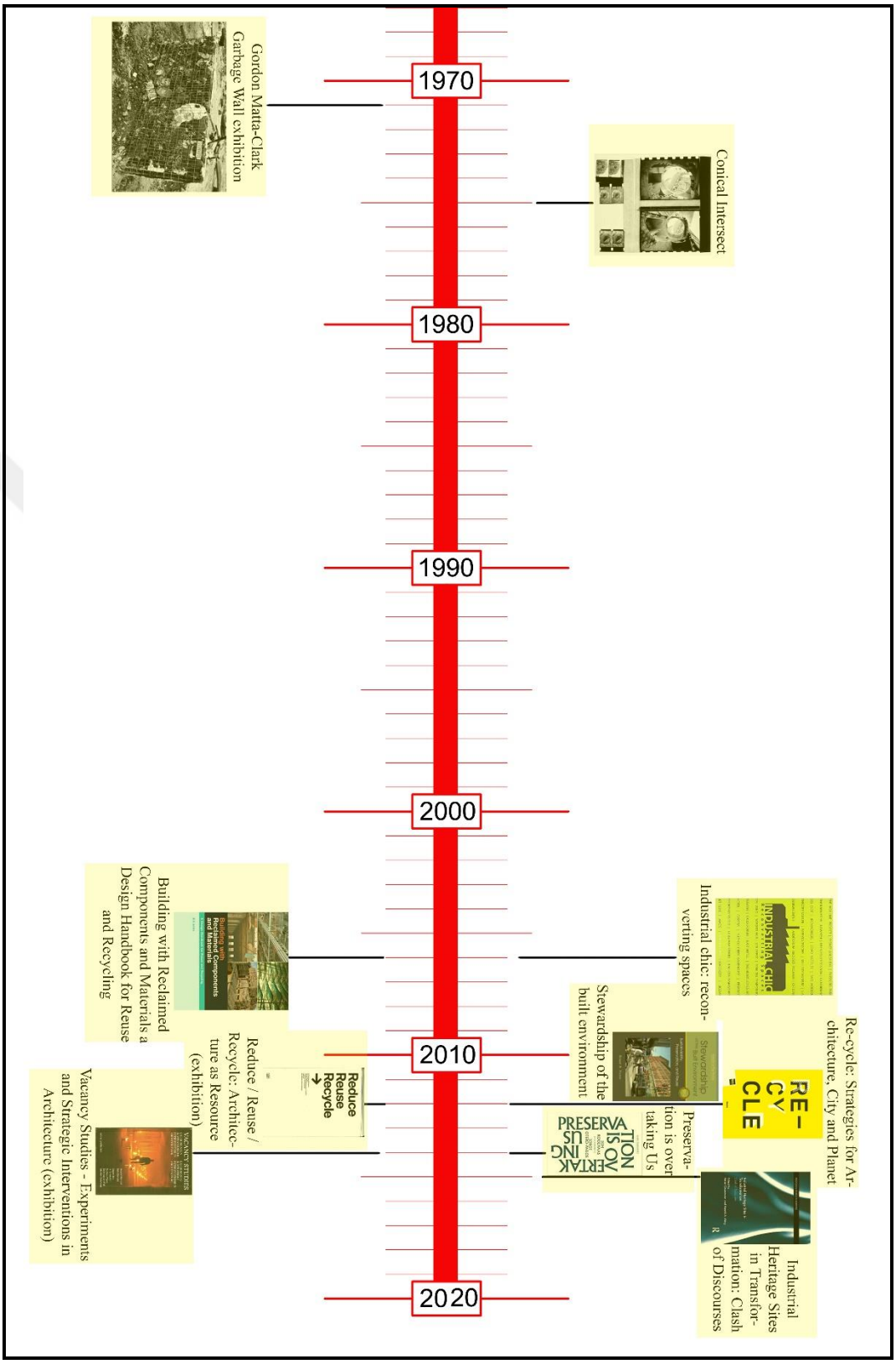


Figure 3.19. Map of Detroit, industrial and residential areas in 1941 [50]

4. CASE STUDIES



(a)



(b)

Figure 4.1. (a) Timeline of case studies, (b) Researches and exhibitions of recycling projects

The architectural reuse of factories is a process that has started long time ago. Reuse buildings can change the function of the original infrastructure into a new one that fits the needs of the contemporary world for the urban development. Many cities have developed their environment and made it sustainable by recycling their industries.

Re-use is an adapting method of restructuring, reshaping and redeveloping; it's a method that doesn't reject the past but rather accepts its cyclical and regenerating nature, which comprises a "re"-device that makes it possible to keep up the necessary distance needed to free us from the implication of conserving the past [34].

A series of 13 case studies of industrial recycling will be studied, starting from the 1970s up to this time, to show how reuse and recycling have been used as a sustainable method to prevent not only industrial heritage buildings but also ordinary industrial buildings from the destruction of the past and at the same time to ensure the present and the future. These case studies are ordinary industrial buildings, they are not listed in any industrial world heritages lists. They vary from small to big projects, architectural to urban projects. The Figure 4.1 shows the timeline of the case studies that will be discussed in this section, and in parallel, it demonstrates also the great importance given on abandoned buildings in the last three decades. More researches and exhibitions have also been carried on during these last decades.

4.1. LA FÁBRICA BY RICARDO BOFILL LEVI

Table 4.1. Table of Là Fabrica before being recycled and after

Before	**After**
Function: Cement factory (30 silos)	*Function:* Head office «Taller de Arquitectura», office, conference and exhibition room.
Architect:	*Architect:* Ricardo Bofill Levi
Location: Barcelona, Spain	*Location:* Barcelona, Spain
Year: First period of the industrialization of Catalonia	*Year:* 1975

(a)

(b)

Figure 4.2. Là Fabrica (a) before recycling, (b) after recycling in 1975 [51]

Figure 4.3. Map of Là Fabrica

This project is a transformation of a cement factory built during the 19th century into a workshop studio, offices, conference, exhibition and cultural center. The cement factory Là Fabrica, was built during the first period of the Catalonian industrialization period, around the second half of the 19th century.

Located in a Catalonian industrial area, in Barcelona, Spain; the cement factory was one of the major element that propelled the industrialization of Catalonia [51]. The process of construction of the factory was not a one process construction but rather a long process, blocks of buildings and silos were added to the construction as long as diverse productions were becoming important. In the old cement factory, there is a brutalism in the crude treatment and sculptural qualities of the materials (Figure 4.4) [51]. The new Là Fabrica is obtained by a minimal transformation of the old cement factory. The architect Ricardo Bofill did not change the outside of the old cement factory, he wanted to keep the massive concrete view of the old cement factory, and just adapt the interior with the new functions.

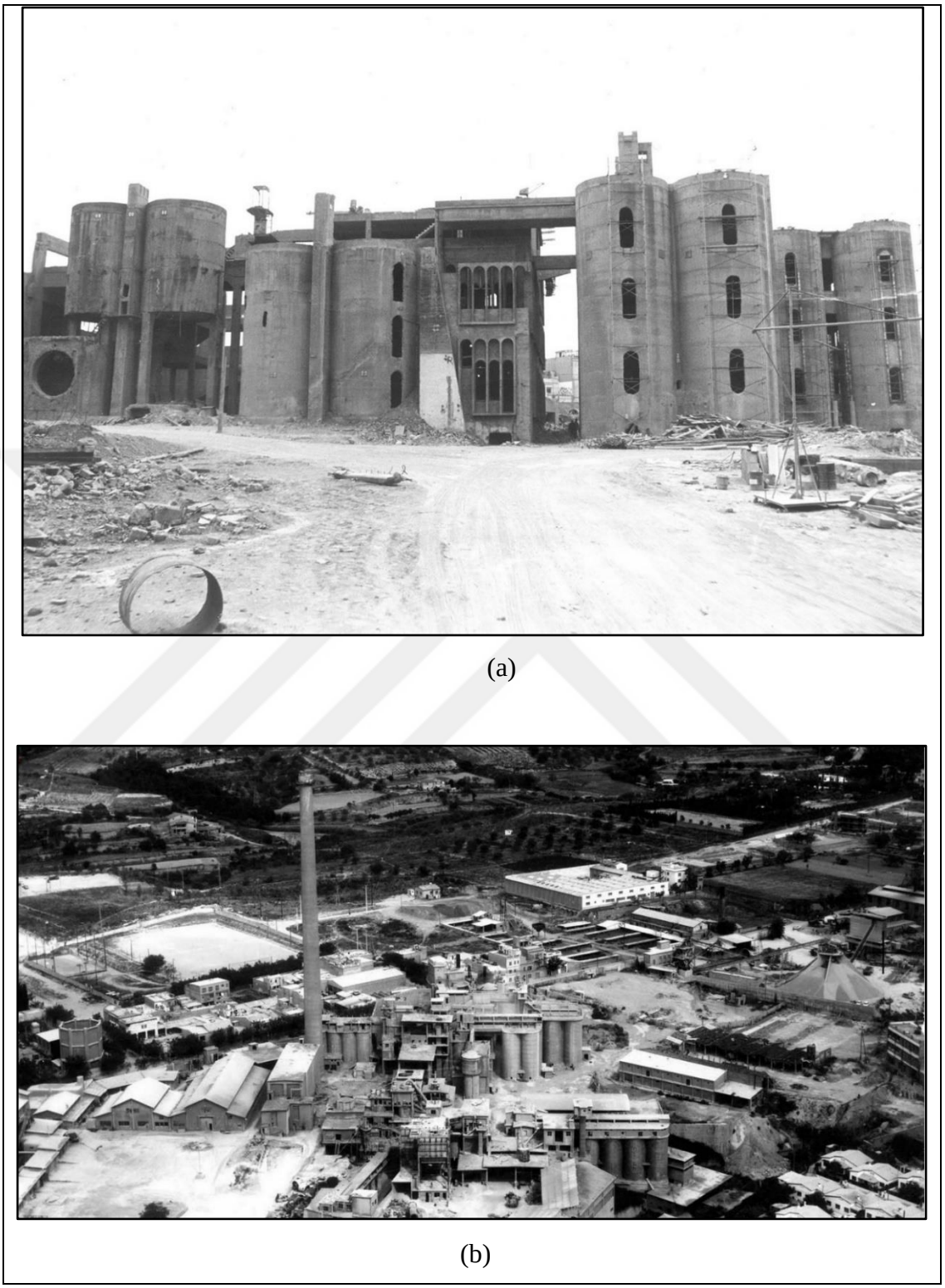
According to the architect, the form and function cannot be associated. In this project, the function didn't create the form; instead, any spaces was allocated according to the use the architect wanted. The architect, seduced by the vagueness and contradictions of the place, he modified the original brutality of the factory and sculpted it.

The process of transformation was made in three steps: ***Deconstruction/ Construction, planting and greening, and the cancellation of functionalism.***

Deconstruction/ Construction: The transformation started with partial destruction of the remaining factory in order to reveal the hidden forms and restore some spaces. This is compared to a work of a sculptor whose job is to first confront the material before sculpting it.

Planting and greening: The architect provided a green plinth to the massive volumes of the old factory, and made plants climb walls and hang from roofs of blocks (Figure 4.5, Figure 4.6).

Cancellation of functionalism: The factory was given new structures and different Functions, making some spaces evident: ***The Cathedral, the garden, and the silos.***



(a)

(b)

Figure 4.4. (a) Là Fabrica, (b) the site view of the cement factory Là Fabrica, showing the brutalism of materials [51]

The new construction is opposed to the vernacular architecture, integrating diverse languages from the history of architecture.

- ***The Cathedral:*** The Cathedral is a creative regeneration and an adaptive reuse of the old cement factory. The old cement plant hall is transformed into an exhibition and conference rom. The rooms are immense, having high ceilings of about 10 meters. The little oxidized raw concrete walls preserve the industrial memory, the aesthetics and spatial quality of the former cement factory (Figure 4.7).

Figure 4.5. Perspective view showing plants climbing walls and hanging from roofs of blocks of Là Fabrica [51]

The minimal architectural intervention here is visibly strong and fascinating, with some furniture elements designed by Taller Design: leather sofa, and chairs, a wooden and steel meeting table, etc. [51].

- ***The garden:*** The garden makes the largest part of the site, covering it with plants and trees like palms, olive, eucalyptus, prune trees, mimosas; etc. climbing and wrapping the concrete walls, giving it a unique cryptic attitude of romantic ruin (Figure 4.8)
- ***The silos:*** The silos are converted into the studio, galleries, workshop, offices and Residence.

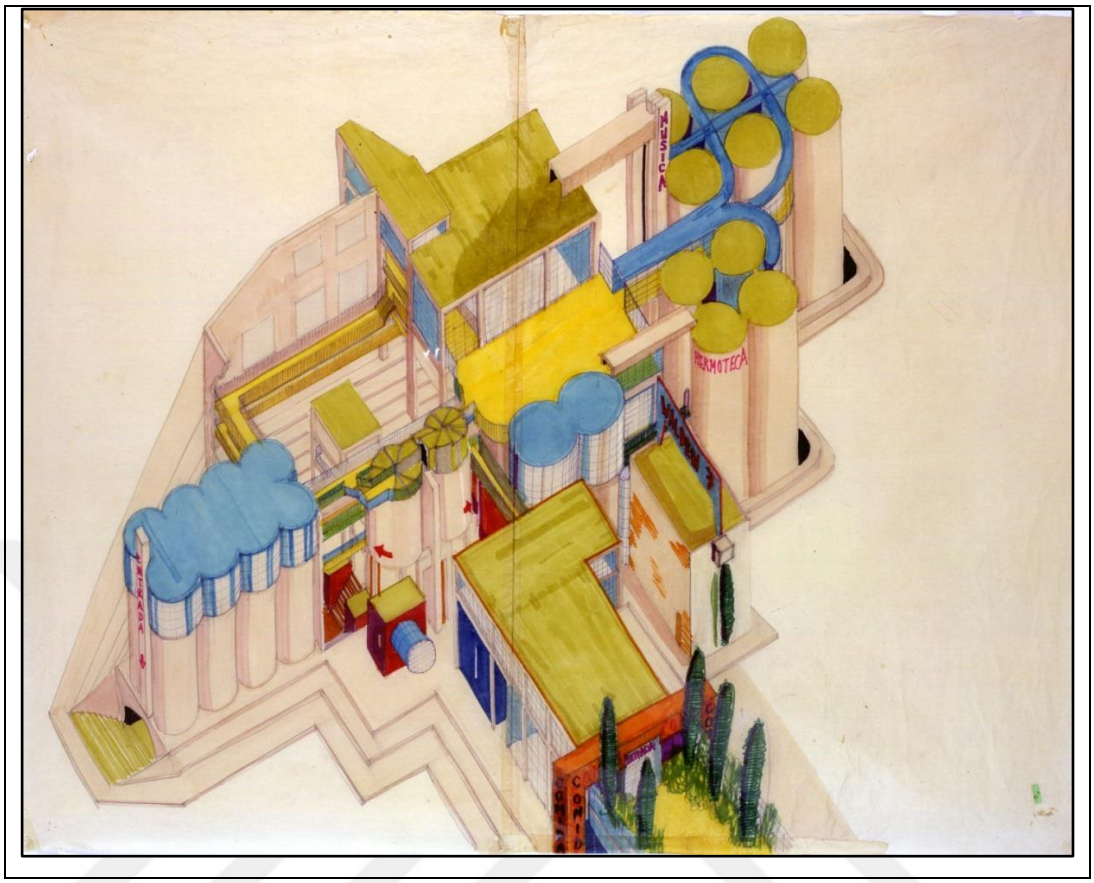
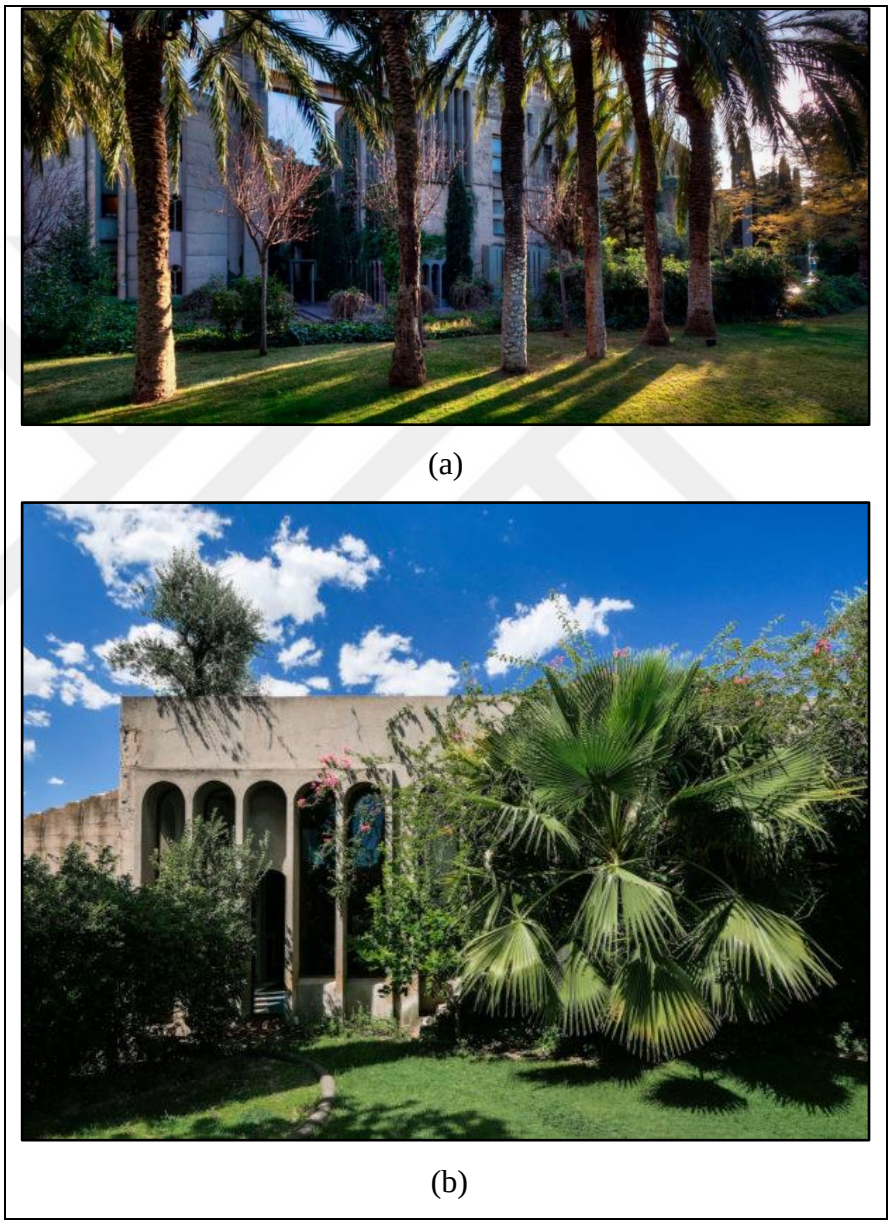


Figure 4.6. Perspective drawing showing the greenish plinth of Là Fabrica [51]

Figure 4.7. The oxidized raw concrete walls preserving the industrial memory [51]

The architect designed the interior with modern furniture and traditional Moroccan wall finish. He has never stopped to renew his office and residence for the past forty years. The transformation of the old factory always remains an unfinished work (Figure 4.9). This is

one of the earlier example of reuse of industrial buildings. Although in the 1970s the practice of reuse was not frequent like today, this project stands among the pillar examples of reuse of industrial buildings that paved a way to the practice of reuse and especially the reuse of industrial buildings.



(a)

(b)

Figure 4.8. (a) & (b) View of the garden with trees [51]

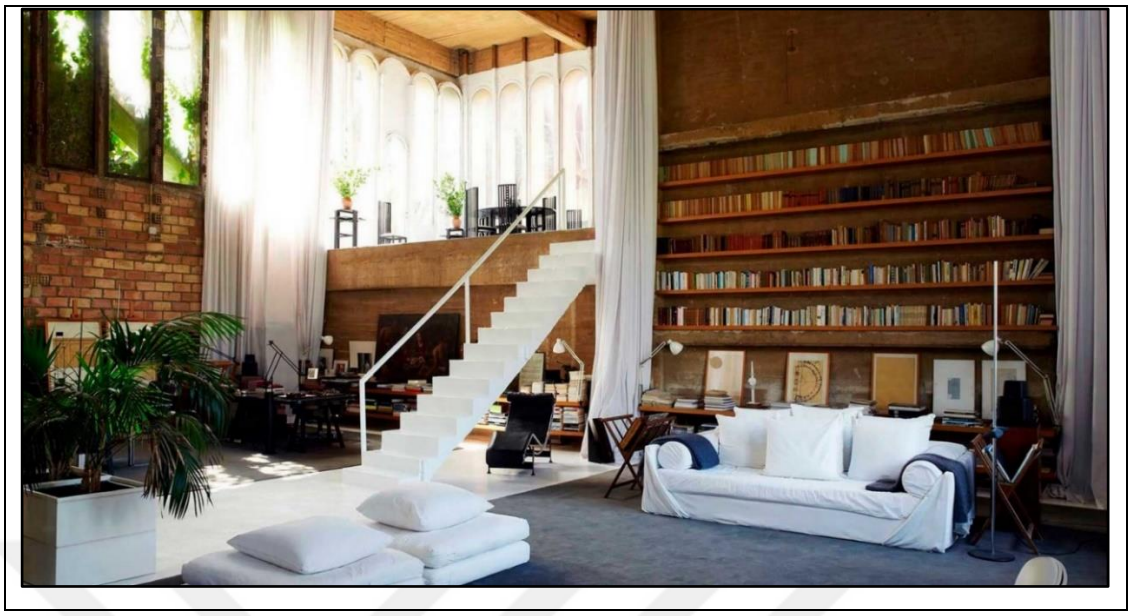


Figure 4.9. The interior view of the residence [51]

This is one of the previous example of re-use on ordinary industrial buildings. With a minimal intervention, the architect revived the spirit and history of the environment and the building by rehabilitating and reusing the abandoned cement factory and giving it new functions that fits in the contemporary urban design.

- ***Some technical drawings and sketches***

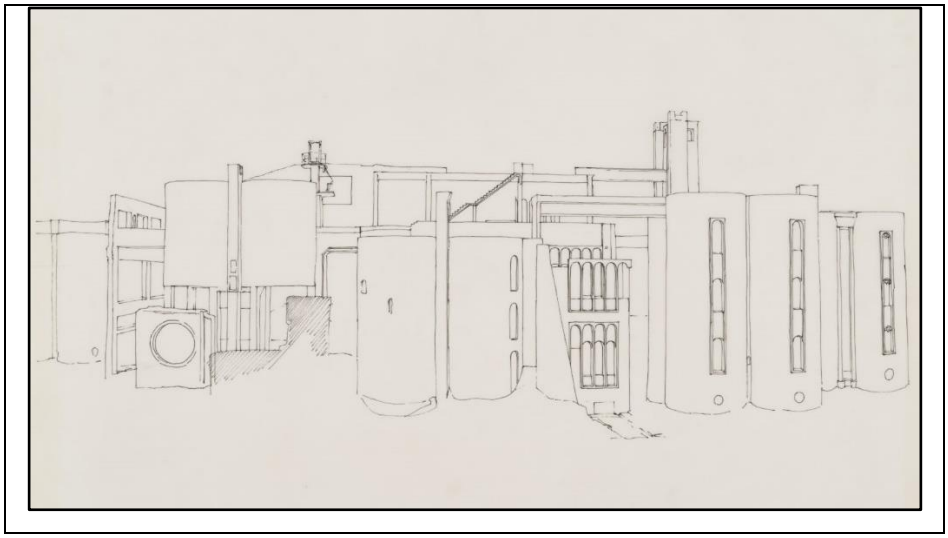


Figure 4.10. Sketch of the complex, revealing the raw massive concrete [51]

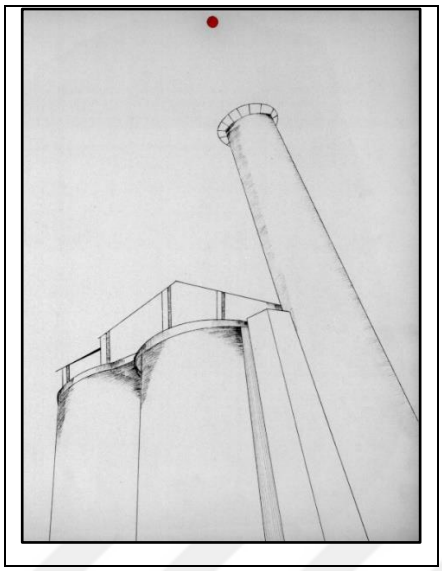
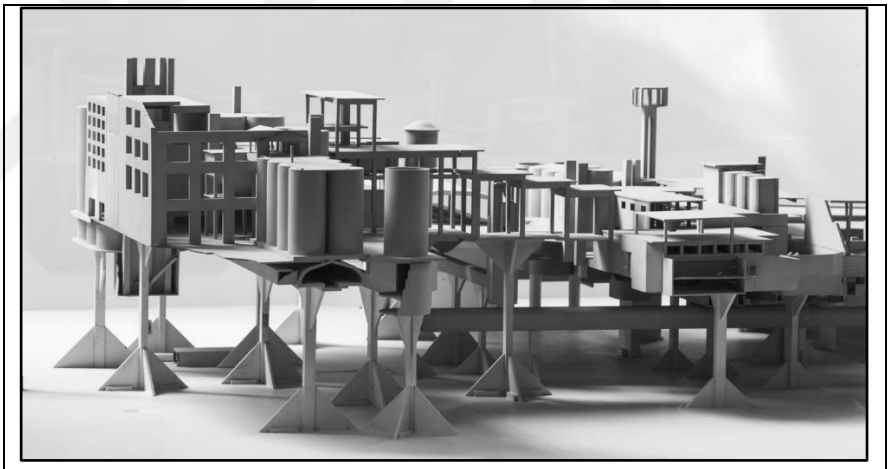


Figure 4.11. Sketch of the silos [51]



(a)

(b)

Figure 4.12. (a) & (b) Model of the new Là Fabrica [51]

4.2. PARC DE LA VILLETTE BY BERNARD TSCHUMI

Figure 4.13. Overview of the city's slaughterhouses and cattle markets of la Villette in 1965 [52]

Figure 4.14. Over view of Parc de la Villette [52]

Figure 4.15. Map of Parc de la Villette

Table 4.2. Table of Parc de la Villette before and after transformation

Before	**After**
Function: The city's slaughterhouses and national wholesale meat market	*Function:* Museum, auditorium, and urban park.
Architect: Louis Janvier	*Architects:* **Bernard Tschumi**, with (Adrien Fainsilber, Phiippe Chaix & Jean-Pierre Morel, Christian de Portzamparc, and Gérard Chamayou, for other Facilities)
Location: La Villette, France	*Location:* La Villette, France
Year: 1865	*Year:* 1983

The old La Villette's slaughterhouses and cattle markets were built in 1865 and designed by the architect Louis Janvier. After many years of operation, the slaughterhouses and cattle markets shut down in 1974. The project of transformation of the slaughterhouses and markets started in 1979. The timelines below show the historical evolution of the project. (Figure 4.16 a, b, c, d & e)

The transformation of the Parc de la Villette, designed by the architect Bernard Tschumi did not rely on the history as precedent, rather it focused on the contemporary and the future at the same time. The architect foresaw the Parc de la Villette as a cultural place where the real and unreal, the natural and artificial are merged and contrived in an attitude of constant exploration and reconfiguration. He wanted the park be a site of exploration and discovery for the visitors.

There are three main principles that the architect considered when designing the Parc de la Villette; these main three principles are ***points, lines, and surfaces***. The main idea of the project is overlapping these three elements (points, lines and surfaces) (Figure 4.17).

Figure 4.16. (a), (b), (c), (d) & (e): Timeline of Parc de la Villette

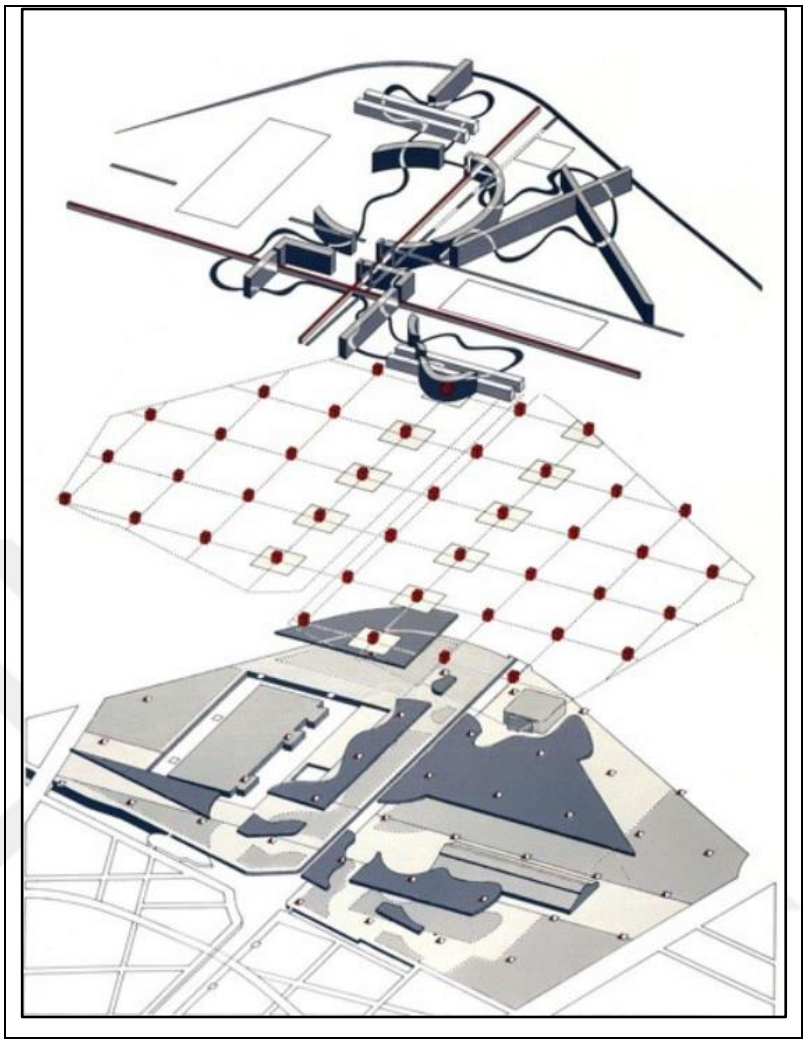


Figure 4.17. Overlapping of reference points or follies with lines on surfaces [53]

- ***Points***: The architect designed the Parc de la Villette as a place for activities and interactions for visitors with a sense of freedom within an overlapped organization that would give visitors points of reference (Figure 4.18). The 135-acre site was spatially arranged by using those 35 points that he calls follies throughout the site as reference points (Figure 4.17). The architect scattered 10 gardens throughout the site, which are places for meditation, relaxing and playing. The park being immense, there is a loss of human scale inside the park. All follies have different form and are unique, their constant nature allow people to maintain the sense of place and human scale inside the immense park (Figure 4.19).
- ***Lines:*** Lines for Bernard Tschumi are the main delimited movement pathways in the Park which don't follow any specific or organizational arrangement, but they rather

converge and conduct to different points of intersection across the urban area of the park and the surrounding (Figure 4.21). The architect did not design the follies with specific programs, he designed them as spaces that can host activities; but those follies have been recently transformed into restaurant, information centers of the park, and offices.

- ***Surfaces:*** is the 85 acres out of 135 acres of the total park. It is the large open green area that gives people a space to relax, to interact and play.

In this project, the architect used a geometrical approach to preserve the slaughter house and meat market. Creating points of references and connecting them with lines or paths. Keeping the immensity of market and creating a reference to the human scales (follies).

Figure 4.18. Point of reference [53]

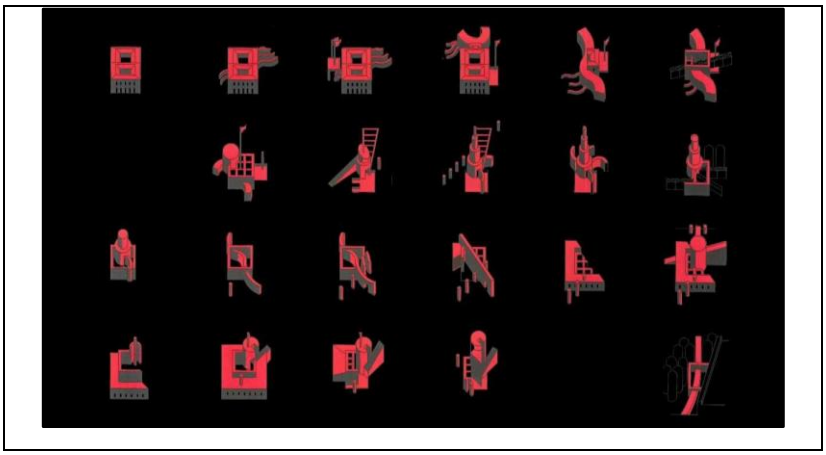
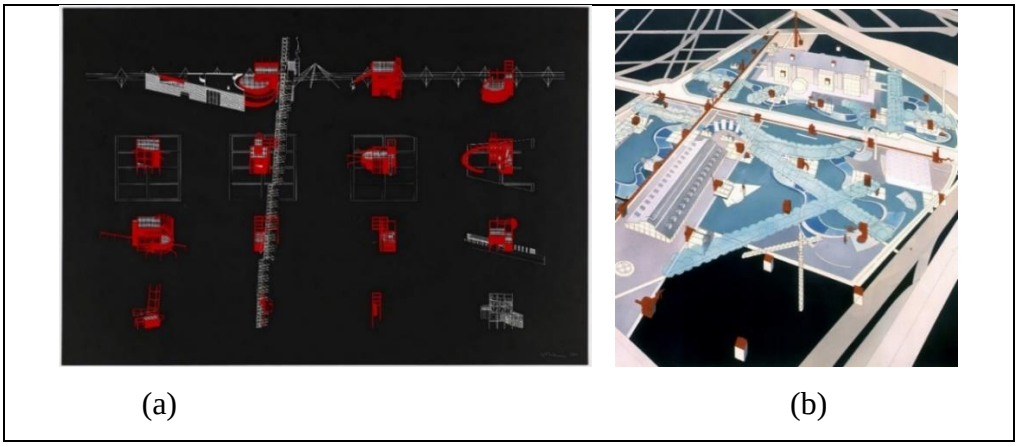


Figure 4.19. Different form of follies allowing people to maintain the sense of place and human scale [53]

(a) (b)

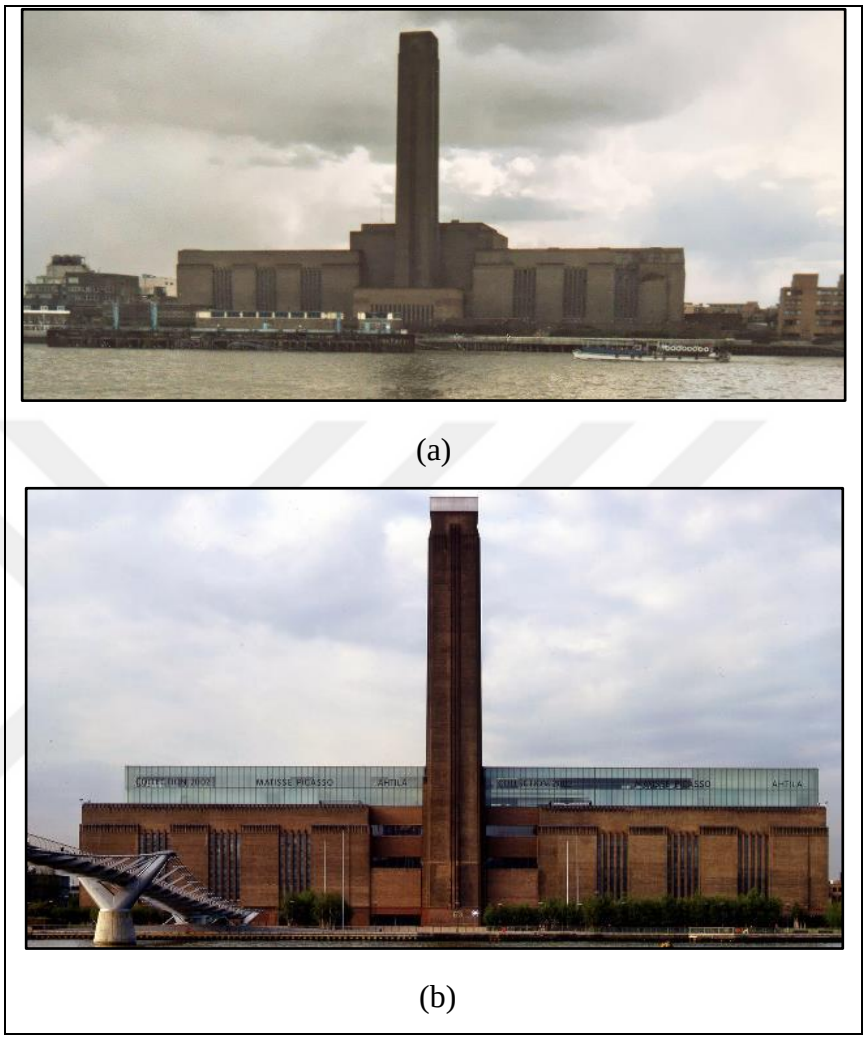
Figure 4.20. (a) & (b), A line with a folly [53]



(a) (b)

Figure 4.21. (a) & (b) Follies and lines that connecting follies or points [53]

4.3. THE TATE MODERN BY HERZOG AND DE MEURON



(a)

(b)

Figure 4.22. (a) Bankside Power Station before (b) Tate Modern [53]

The former Bankside power station was designed by Sir Giles Gilbert Scott and constructed in 1891. It has generated electricity from 1891 to 1981. Located on the south bank of the River Thames, in the Bankside area, in London; this former electricity generating station was located at the heart of London enjoying the sight of St. Paul Cathedral (Figure 4.24). That building was made of almost 4.2 million brick-clad and steel structure. The structure was built symmetrically and was presided by a central chimney which was standing up to 325 feet (99 meters) which was a little bit lower than the dome of St. Paul's Cathedral, the structure also contained a 152 m long and 35m high turbine room, and a room for cauldrons.

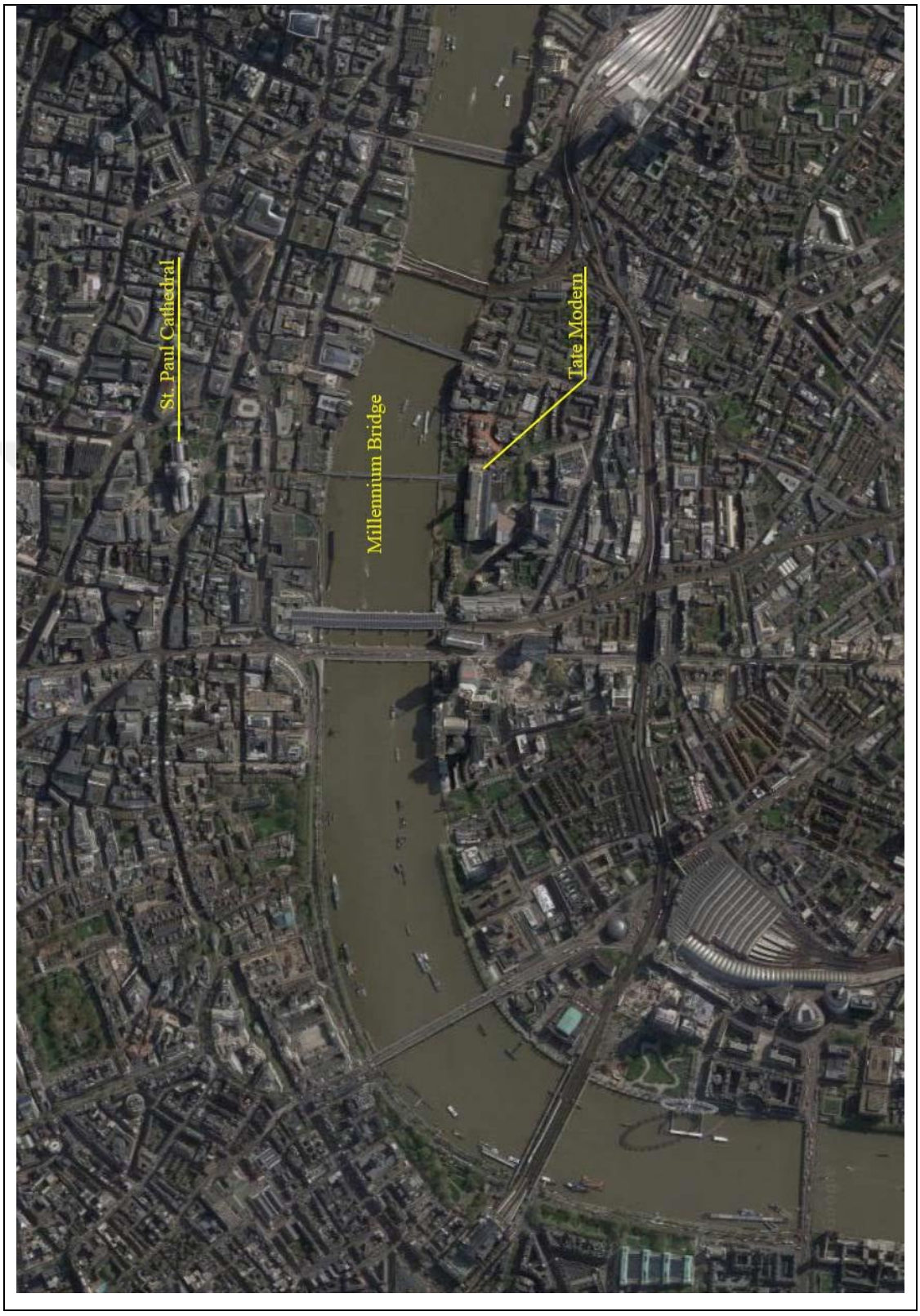


Figure 4.23. Map of the Tate Modern

Table 4.3. Table of Tate Modern before being recycled and after

Before	**After**
Function: Bankside Power Station (electricity generating station)	*Function:* Museum of modern art
Architect: Sir. Giles Gilbert Scott (1947)	*Architect:* Herzog & de Meuron
Location: London, UK	*Location:* London, UK
Year: 1891	*Year:* 2000. And in 2012 (The Tank Exhibition)

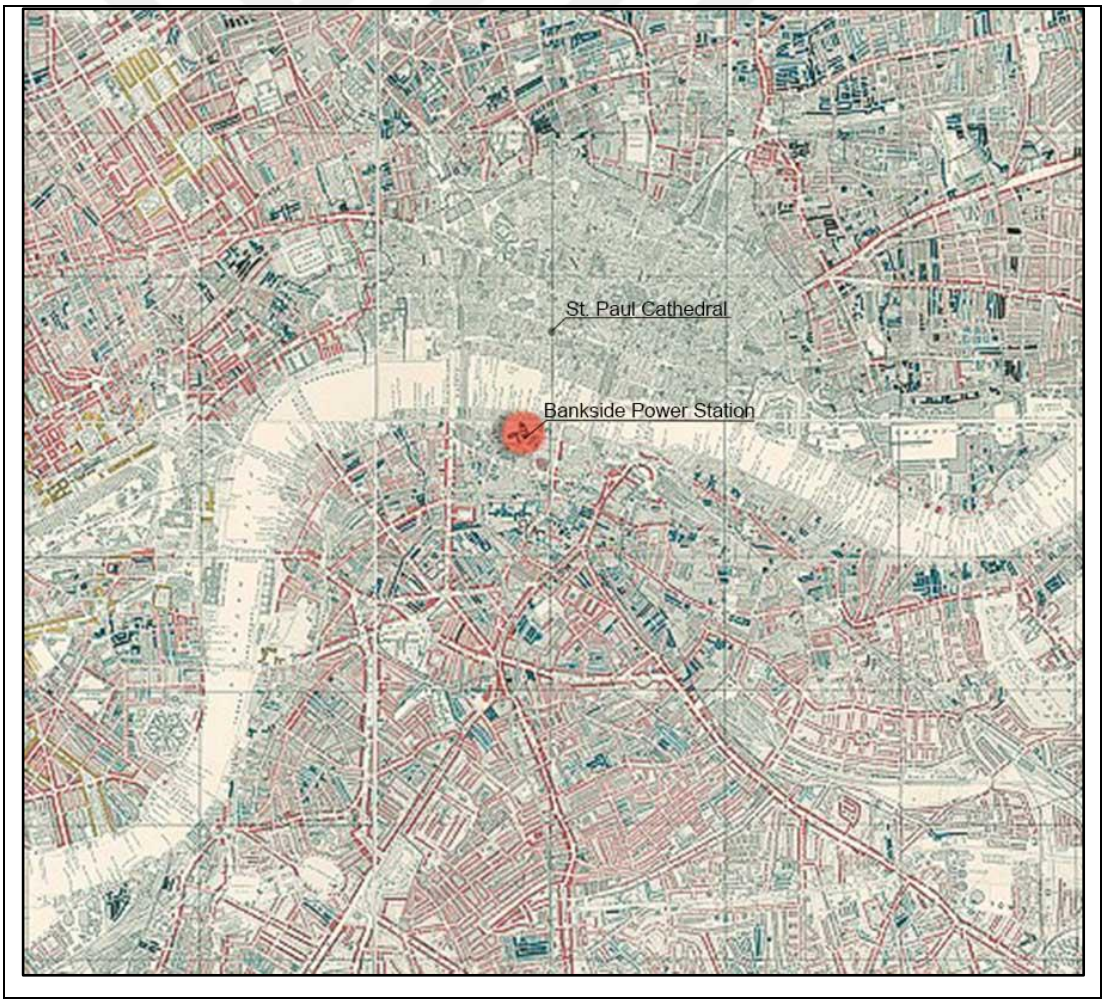


Figure 4.24. Map of the London Bankside Power Station in 1899 [16]

It was a massive building interrupted by numbers of thin and long vertical windows that allow a controlled sunlight to get inside the building (Figure 4.25. The former Bankside Power Station stopped operating in 1981, and had since been a suggestion of demolition until that threat was prevented by BBC in 1993 [53]

Figure 4.25. The south view of the London Bankside Power Station in 1957, with thin and long vertical windows [54]

The Tate modern is one of the good example of industrial reusing and urban redevelopment. After the Bankside Power Station had stopped operating, and after the prevention from its demolition; the Tate gallery which focuses on the collection of modern art purchased the abandoned power station to transform it into a museum of modern art.

An architectural competition was organized and the Swiss architecture firm Herzog and De Meuron won the competition for their plan to revitalize both the Bankside power station and the Bankside neighborhood. The conception proposed by the Swiss firm Herzog and De Meuron was a project that preserves the authenticity of the power station and at the same time redevelops the urban surrounding of the area, linking the new museum to the city center,

and especially to the Cathedral of St. Paul, which is one of the most important building in London. The connection of the museum to the city center and the Cathedral of St. Paul is made by a pedestrian footbridge over the Thames called the Millennium Bridge (Figure 4.23, Figure 4.26)

Figure 4.26. The Tate Modern and the Millennium Footbridge [53]

The process of transformation started with the removal of the industrial machines "*de-planting of machines*" in 1995, and then leaving the structure empty like a brick shell with steel structural skeleton. Further, other demolition of some old buildings outside and of the roofs of both the power station's boiler house and the turbine hall were done between the year 1996 and 1997. In the same years, the repairing and repainting of the remaining steel structure and the sandblasting of the area took place [53]. The design provided by the architect emphasizes on the preservation of most of the parts of the former power station, and using it as a source of energy and power for the design. The roofs of the boiler house and the turbine hall are then replaced by a two-floor glass roof structure, which with the chimney intensify the presence of the building (Figure 4.27). The building is accessed on the west side by a ramp that leads straight to the huge long turbine hall, which is recycled as a dazzling internal square space receiving light from both the vertical windows and above from the 524 glass panels (Figure 4.28, Figure 4.29).

The dazzling internal square space is used as an exhibition place for giant installations and sculptures. The three levels of art galleries are accommodated in the former boiler room adjacent to the turbine hall, having a strong visual and spatial connection with the large square of the turbine hall (Figure 4.30).

The connection of the large space and the art galleries is emphasized by the glassy greenish boxes on the surface of the galleries walls which are used as balcony. These greenish boxes create a contrast with the dark black metal structure supporting the building (Figure 4.31). The two-story glass roof accommodates offices for the members of the Tate and restaurant with great views, including the view of the cathedral St. Paul and the waterfront. The glass roofs is a contrast to the massive volume station made of brick, and at night, it illuminate the area.

The Tate modern project is an ongoing project, there have been some extension done in the project and some other extension are planned. The first extension of the project was the transformation of the former tank oil into the tank exhibition (Figure 4.32), and the Tank exhibition opened in 2012. The Tate modern firm has thought again about the second extension of the Tate modern museum. The project selected was the one designed by the Swiss firm Herzog and De Meuron. The Swiss firm made two proposals, the first proposal project was inspired by the shape of the ziggurat and the pyramid (a glass pyramid with boxes extruded in all directions), and the second proposal is a design of the project as block pyramid with brick-clad, creating a strong harmony with the former Bankside Station. The Tate modern project is a striking example of industrial reuse. There is a minimal is a minimal transformation of the old bankside Power Station into a museum by leaving the brick walls of the old power station as they were, and adding a glass roof structure at the top of the building and floors to host the new gallery. The Tate modern project has enlivened the region of the city where it’s located by connecting many important parts of the city.

The re-use intervention in this project is minimal, but it’s a very striking example in London. London, being one of the industrial motor city in Europe during the 18th century, has many industrial buildings listed in the industrial world heritage list. The Tate modern project shows how preserving and re-using an ordinary industrial building in an industrial city full of world heritages can affect the urban life and architecture of the city.

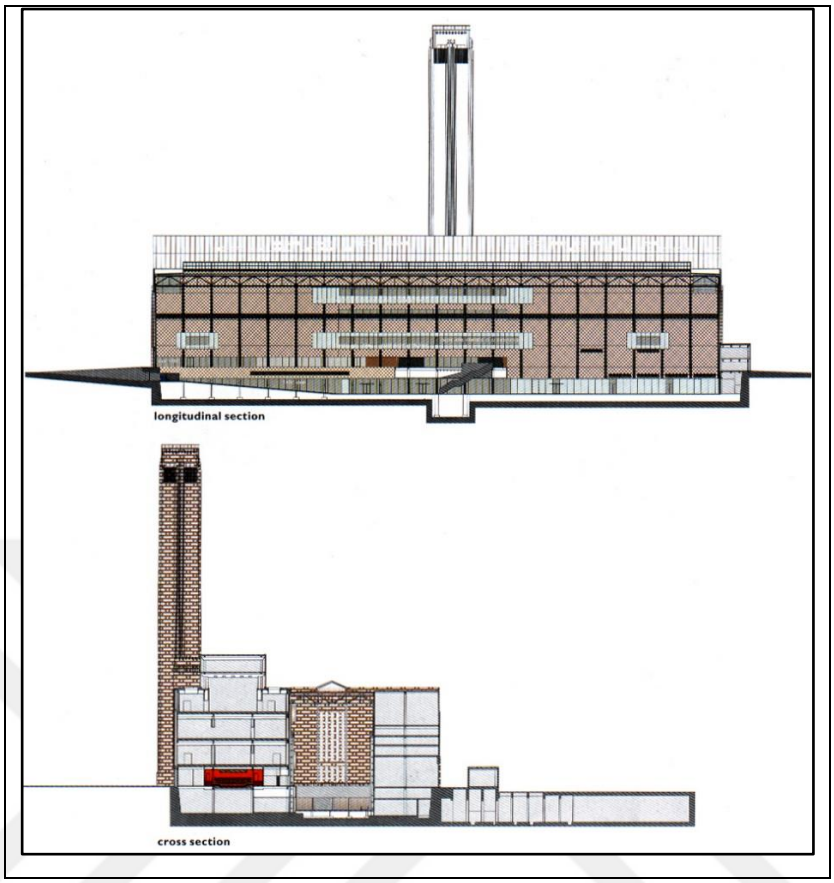


Figure 4.27. Sections of the Tate Modern, showing the glass roof structure and floors created to host the gallery [53]

Figure 4.28. The photo on the left shows the turbine hall from the plaza level, contemplating the slope of the ramp and light from above. The right photo shows the entry level, and the stairs descending that level [53]

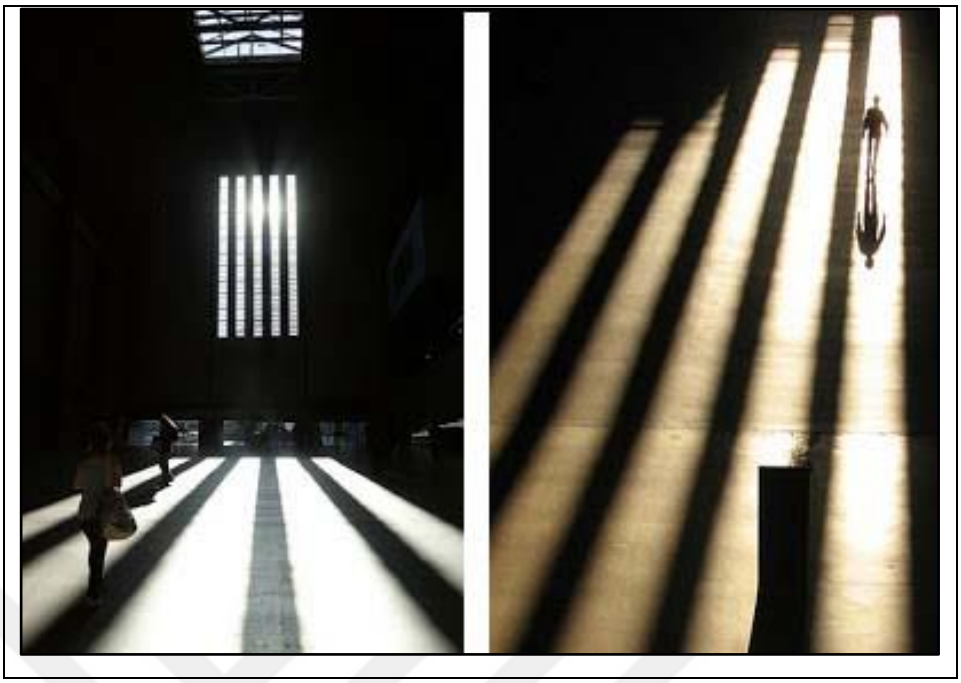


Figure 4.29. The photo of the Turbine hall showing natural light coming in from the vertical windows and glass panels from above [53]

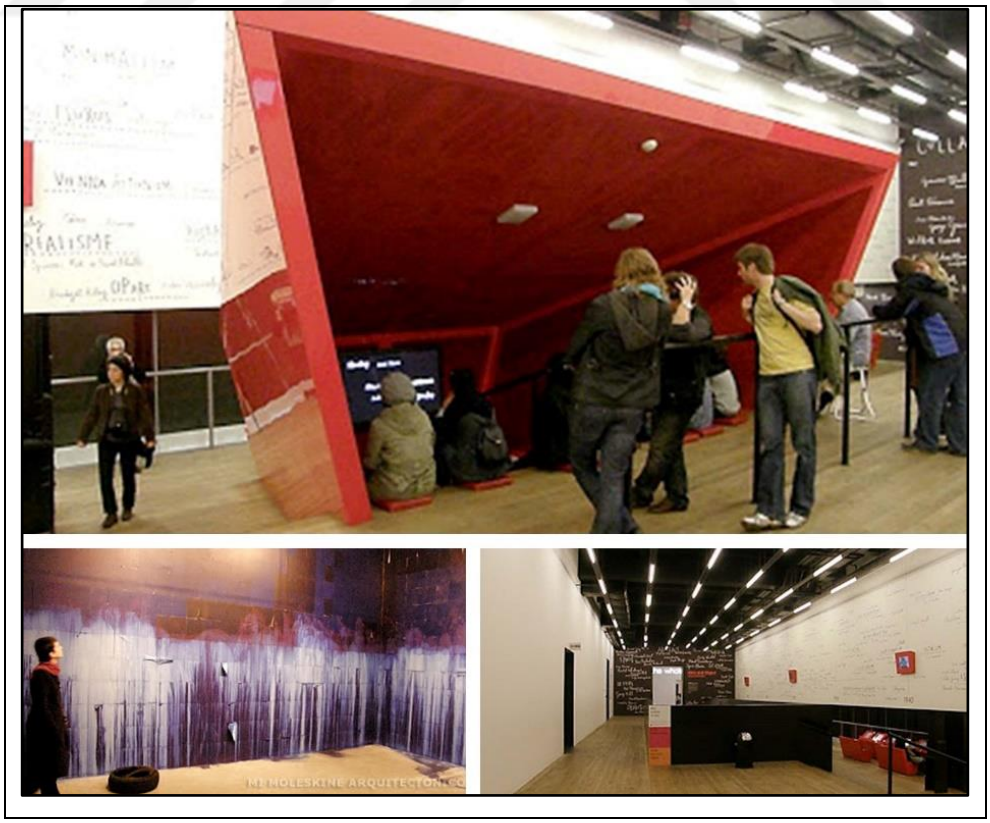


Figure 4.30. Photos of the boiler room transformed into art galleries [53]

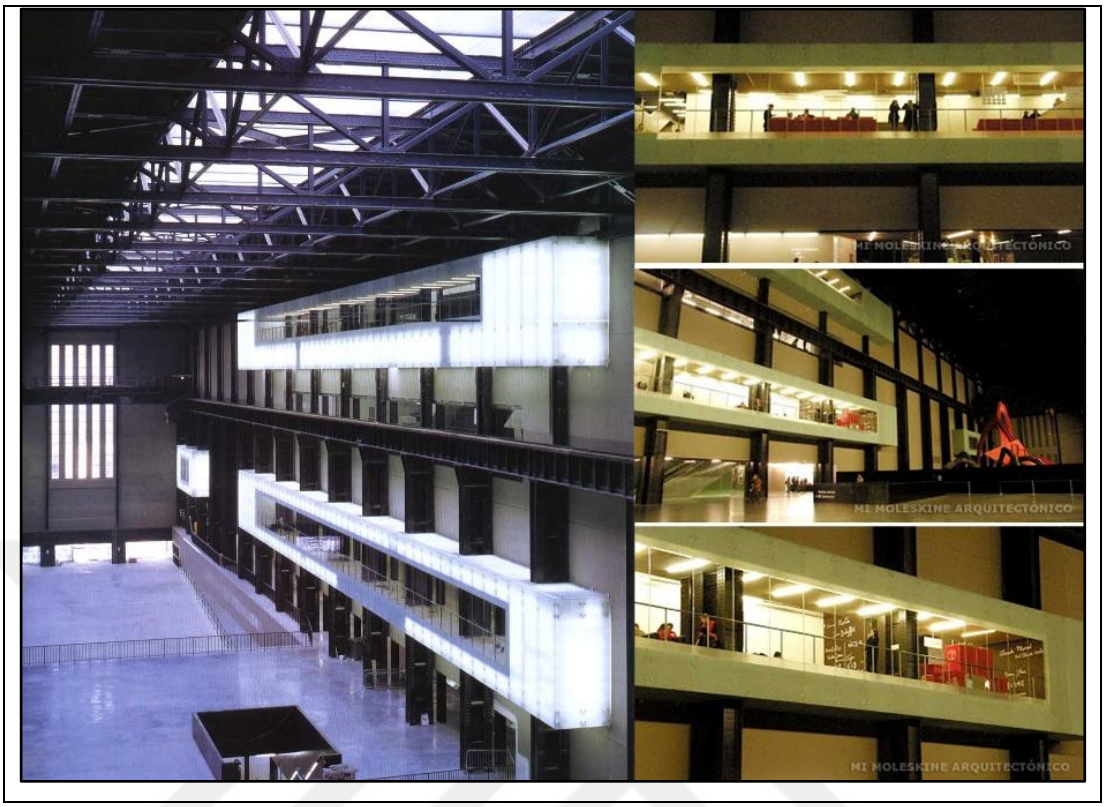


Figure 4.31. Photos of the galleries and the balconies created with the green boxes [53]

Figure 4.32. The interior exhibition of the Tank (expansion of the project) [53]

4.4. EXTENSION OF THE BUNKER AUFSTOCKUNG BY INDEX ARCHITEKTEN

Figure 4.33. Bunker Aufstockung before transformation [56]

Figure 4.34. Bunker Aufstockung after transformation [56]

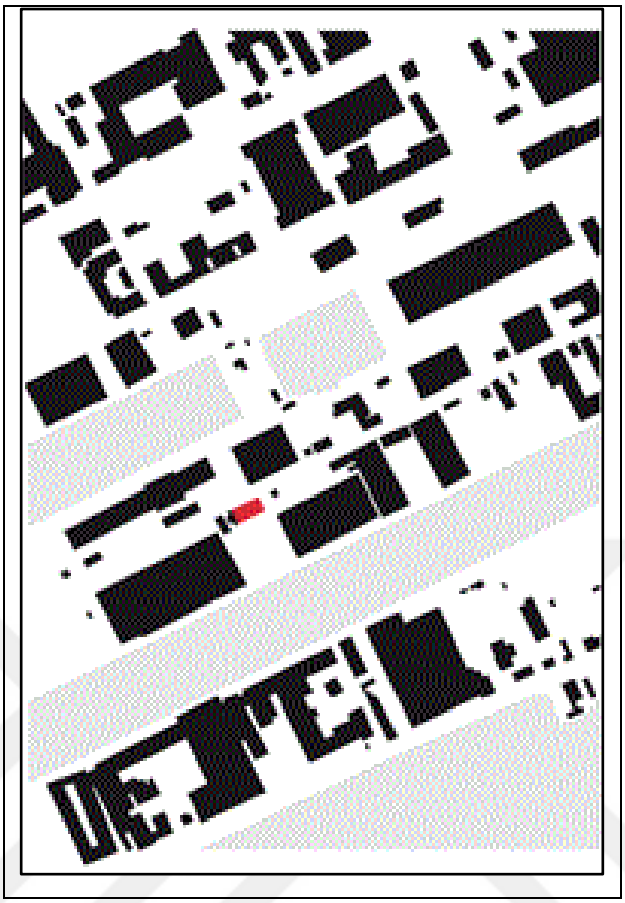


Figure 4.35. Map of the bunker Aufstockung [56]

Table 4.4. Table of bunker Aufstockung before being recycled and after

Before	**After**
Function: Bunker of the World War II	*Function:* Cultural place
Architect: ------	*Architect:* INDEX Architekten
Location: Frankfurt, Germany	*Location:* Frankfurt, Germany
Year: around world war II	*Year:* 2004

The transformation of Frankfurt's 1912 east harbor is an important planning project for the urban redevelopment of the town. Most of the parts of Frankfurt are already affected by structural change. Nevertheless, the East harbor part which is behind the large market hall is totally different from the rest of the city. That part of the city is not inhabited, and it's filled with containers and recycling materials and products that are waiting for their shipment.

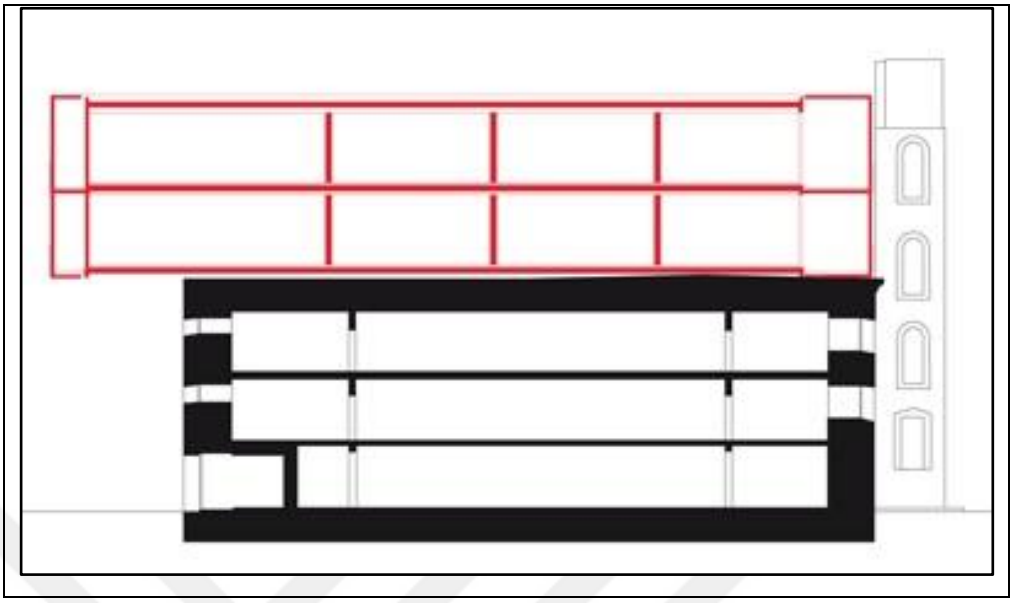
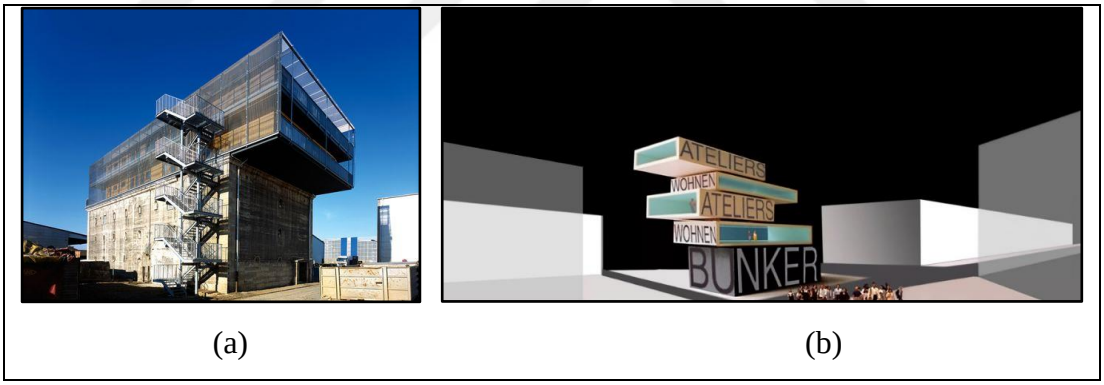


Figure 4.36. Section of the bunker Aufstockung [56]



(a) (b)

Figure 4.37. (a) Perspective of the bunker Aufstockung (56); (b) model concept of the bunker Aufstockung cultural center [56]

It’s in that dusty and dead straight area that an old World War II bunker is located. Observing the redevelopment of the area, and seeing that most of the times art projects attract further development rundown cities, the intention was to transform the old bunker into a cultural building that would trigger the transformation of the area. However, the roof of the bunker was leaking and the cost of repairing it was so expensive that it was out of question to repair it, neither was it to demolish it. The architect built a large lightweight wooden box on top of the bunker that covers the roof and accommodate the studios for artist and an institute for

new media (Figure 4.36 & Figure 4.37). The wooden box is open on its perimeter, both creating a dialogue between the inside of the building and the outside environment, and also serving as an escape way to the outside (Figure 4.37 & Figure 4.38). The heavy concrete core of the bunker houses now rehearsal studios for musicians. The holes on the concrete walls regulate the sunlight inside the building and they also revive the structure of the façade (Figure 4.38).

Figure 4.38. View of the bunker [56]

The architect created a contrast of materials between the heavy concrete and the light wooden box on top of the concrete. This project is an example of reuse and transformation of a military bunker that served during the Second World War into a cultural place. The transformation of the bunker has saved it from demolition and excessive expenditure for repairing or demolishing it. Recycling the building has also helped develop the remote area (East harbor of Frankfurt) where it is located. The reuse practice in this project shows how reusing can be economically and socially sustainable in an environment.

This transformation shows how the re-use of a random bunker can affect the environment and architecture of a city. Despite the hard concrete and materials that bunkers are made of, they can be re-used to transform life in cities.

Figure 4.39. View of the bunker [56]

Figure 4.40. Perspective of the bunker [56]

4.5. FRØSILO BY M.V.R.D.V

(a)

(b)

Figure 4.41. (a) Waterfront warehouse silos, (b) Frøsilo Residence [57]

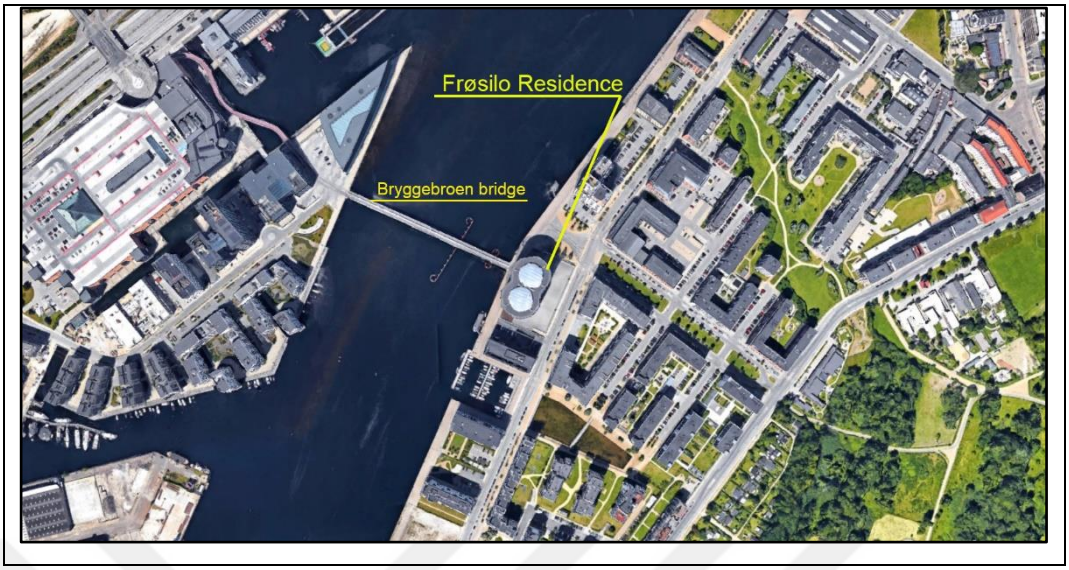


Figure 4.42. Google map of the waterfront silo

Table 4.5. Table of the Frøsilo residence before being recycled and after

Before	**After**
Function: waterfront warehouse silos	*Function:* Residence
Architect:	*Architect:* MVRDV
Location: Copenhagen, Denmark	*Location:* Islands Brygge, Copenhagen, Denmark
Year: 1963	*Year:* 2001-2005

Program of project: 10.700 m^2, 84 apartments (ranging from 90-200 m^2) and parking.

This project is the transformation of abandoned warehouse silos located in an old harbor in Copenhagen. The silos being hard concrete structures, they have structural limitations, and especially in the case of making openings on that without destroying their characteristics (Figure 4.41.a). The structural limitations of cutting through the silos hold the solution of transforming it into residence buildings, and maintaining its emptiness characteristic. The architect chose to hang the apartment floors on the outside of the silo rings as a second wall but this one made of glass, and keeping the inside emptiness of the silos and creating two

big atrium in the inside of the silos. The atriums are covered with translucent plastic materials (Figure 4.44).

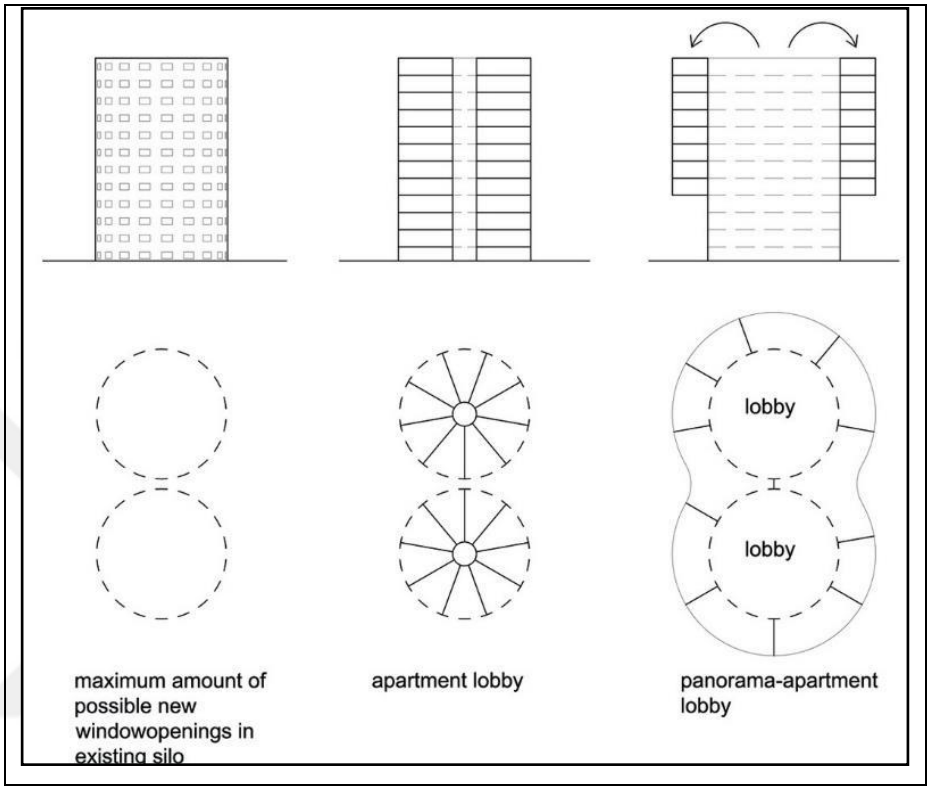


Figure 4.43. Transformation steps of the Frøsilo Residence [57]

Warehouses are almost complete structures, they require moderate adjustment to be transformed into housing without giving up on their core emptiness characteristic. But silos work differently, they are very simple bald and incomplete structures. It's hard to cut through the exterior silo rings, and make big openings. This makes it a big challenge for this project. The steps of converting the silos into residence will be explained in the lines below (Figure 4.43):

- ***Making holes on the exterior concrete rings***: Making door and window openings was hard and could only be made in definite areas of the exterior silo rings. The architect kept the identity of the silos by conserving the emptiness inside them and making openings without destroying the structure (Figure 4.43).
- ***Making the apartment lobbies:*** The architect willing to keep the baldness of the structure, created two big atriums inside the silos (by keeping its emptiness) that will be

covered up with transparent plastic materials, and then making apartment lobbies from the center of the atriums, which create vertical movements in the building (Figure 4.43 & Figure 4.45).

- ***Hanging out the apartment floors***: Filling the inside of the silos would have destroyed its aspect which is its emptiness. A second exterior glass wall is added outside the silos and apartment floors are then hung on the outside, maximizing the outside beautiful views of the waterfront (Figure 4.43). The outside hung apartments creating a light and nearly a sustainable outdoor living environment will beneficiate from the great view of the waterfront and the harbor.

The transformation of the silos into residences is a great example of transformation and redevelopment of harbors. Silos are made of hard concrete rings that are very difficult to cut through. This project shows how the reuse practice can modify hard concrete materials into something sustainable and suitable for the contemporary city. This project has redevelop the Bryggebroen Island and with the Bryggebroen footbridge, it connects the two sides of the island (Figure 4.46).

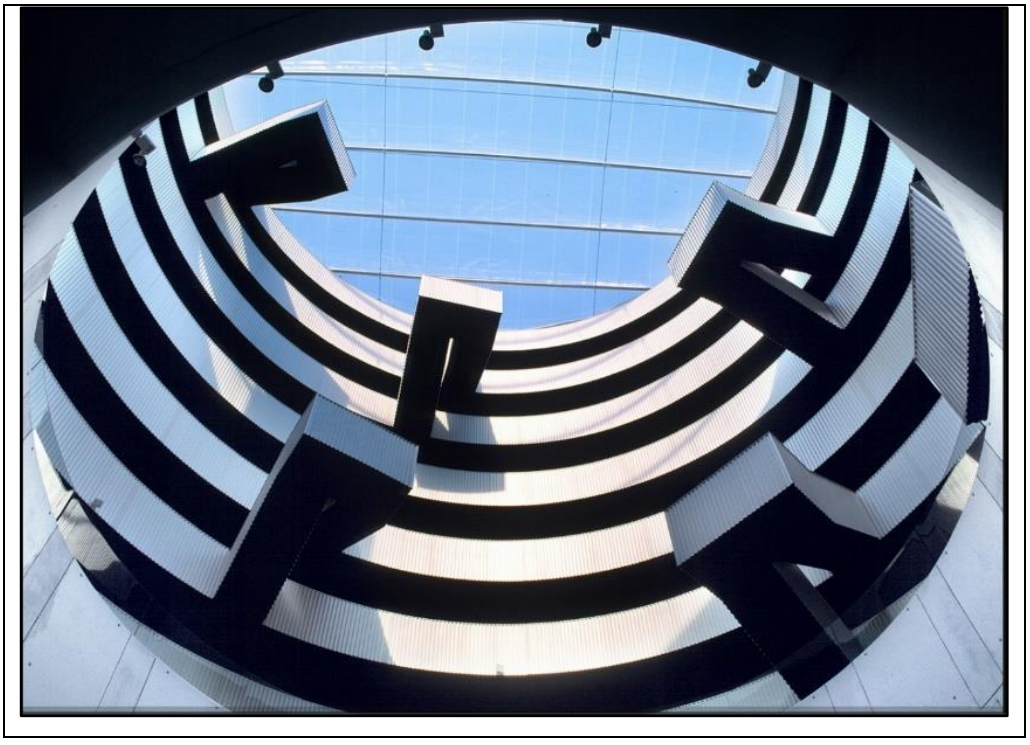
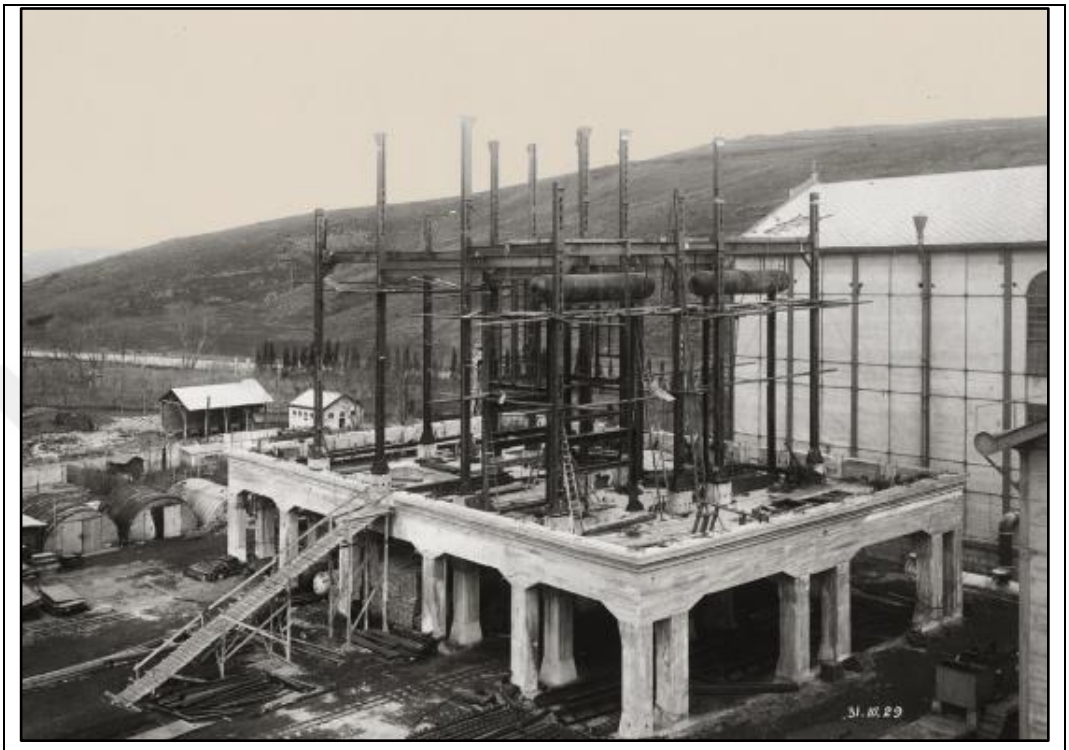


Figure 4.44. The atrium covered up with the transparent plastic material [57]

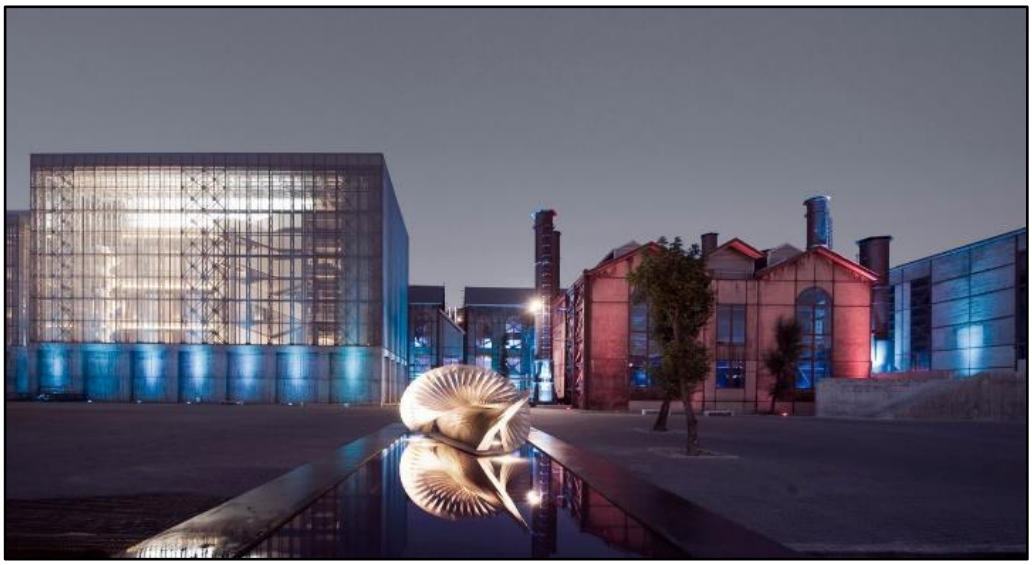
Figure 4.45. The vertical movement in the atrium [57]

Figure 4.46. The Frøsilo with the Bryggebroen footbrdige, connecting both sides of the Bryggebroen island [57]

4.6. SANTRAL ISTANBUL, BILGI UNIVERSITY BY EMRE AROLAT, İHSAN BİLGİN, AND NEVZAT SAYIN



(a)



(b)

Figure 4.47. (a) Silahtaraga Power Plant, demolished, (b) Santral Istanbul museum [58]

Figure 4.48. Google map of the Silahtarağa Power Plant, 2001

Table 4.6. Table of Santral Istanbul before being recycled and after

Before	**After**
Function: Silahtarağa Power Plant	*Function:* museum, recreational and educational center.
Architect:	*Architect:* Emre Arolat (EAA), İhsan Bilgin, Nevzat Sayın (NSMH)
Location: Istanbul, Turkey	*Location:* Istanbul, Turkey
Year: Beginning of the 1900s	*Year:* 2005-2006

- *Program of project*: Museum, recreation and educational center
- *Area of the lot***:** 107,000 m2
- *Total area of the project***:** 7,000 m^2

Located at the upper end of the golden horn, in Istanbul (Figure 4.48); the former Silahtarağa Power Plant used to generate coal-fired until 1983 when it closed. It was the first Ottoman Empire's power plant station. At first, the former power plant supplied electrical power to the tram line in the beginning of the 1900s, and then after it supplied electrical power also to the sultan's palace. The former Silahtarağa Power Plant had been the only one supplier of the electricity in Istanbul until the 1950s when it was then linked to the new Turkish national network first, and then later to the Turkish Electric Institution (TEK) in the 1970s. It supplied electrical power until 1983, when it was shut down due to economic changes. In 1991, it was then listed among the "natural and cultural heritages of Istanbul". The protection of the former power plant has started since then.

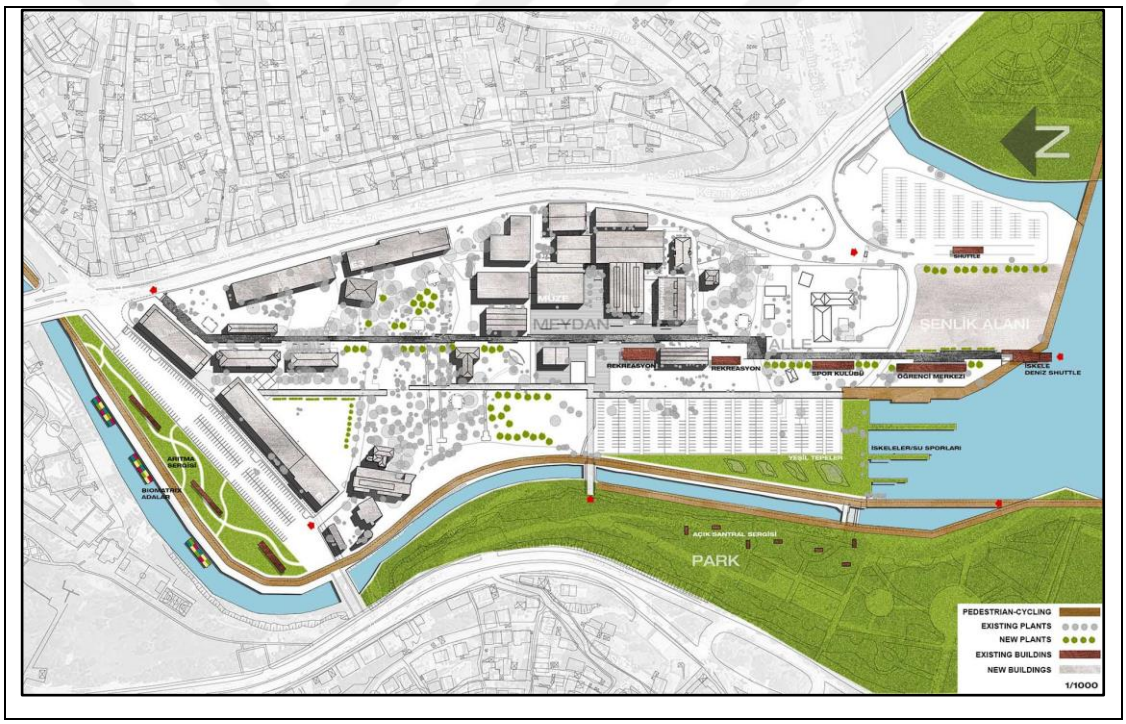


Figure 4.49. Map of Santral Istanbul [58]

In the beginning of the 2000s a redevelopment plan that led the former power plant to be converted into a university campus, which will house a gallery museum for modern art and an energy museum, was developed (Figure 4.49). The project include the construction of some new buildings, renovation of demolished buildings, and transformation of the remaining structures. The architect based on the history of the power plant and its layered construction to transform and develop the Santral Istanbul project. The new buildings are

the mixture of heavy core concrete (the old remaining structures) with light and almost translucent metal mesh covering the concrete core (Figure 4.50). The architect redevelop the project by working on the construction layers, adding almost transparent metal sheathings on the remaining structures that give the historical structure a contemporary aspect. First, the architect work on the interior layers on top of the remaining structures and then covers it with the semi translucent metal meshes, allowing enough sunlight to illuminate the inside of the building (Figure 4. 51 & Figure 4.52).

According to the architect,

> Just like the old buildings, the new structures are composed of a dense and heavy inner core and a light, semitransparent exterior sheathing that covers the core without touching it to the greatest possible extent.

This is a striking example of re-use of an ordinary industrial building in Istanbul. The new design embalms features of the past, while adjusting to the new functions. This is one of the earliest recycling project in Istanbul showing the possibility to sustain environments by re-using remaining buildings.

(a) (b)

Figure 4.50. (a) & (b) External façade of one of the Santral Istanbul museum, the metal mesh covering the concrete base [58]

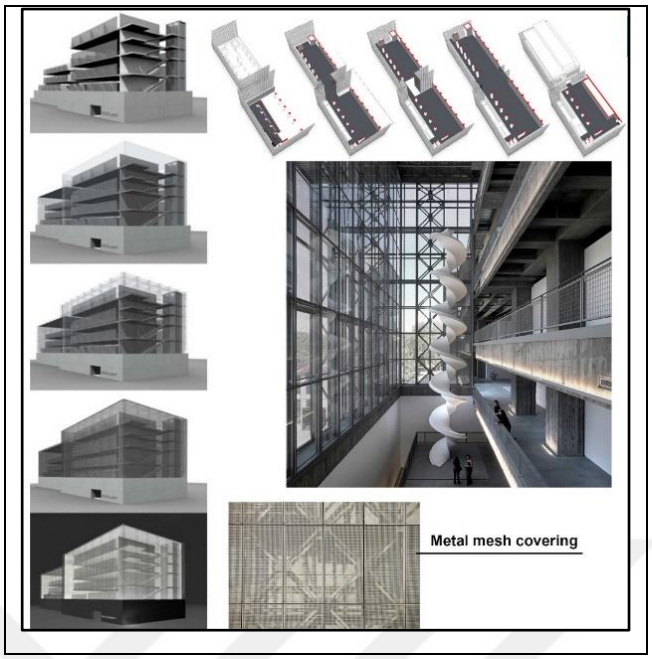


Figure 4.51. The layered construction of the buildings, and the semi translucent metal mesh covering [58]

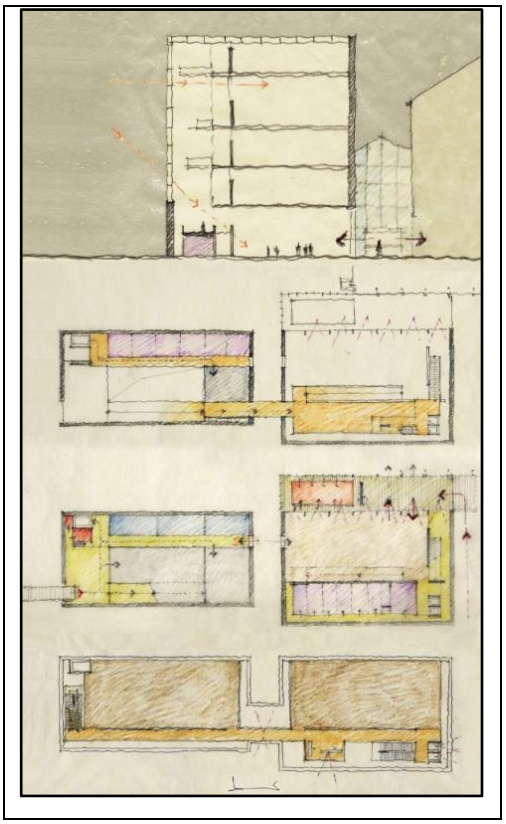


Figure 4.52. Sketches of the redevelopment project [53]

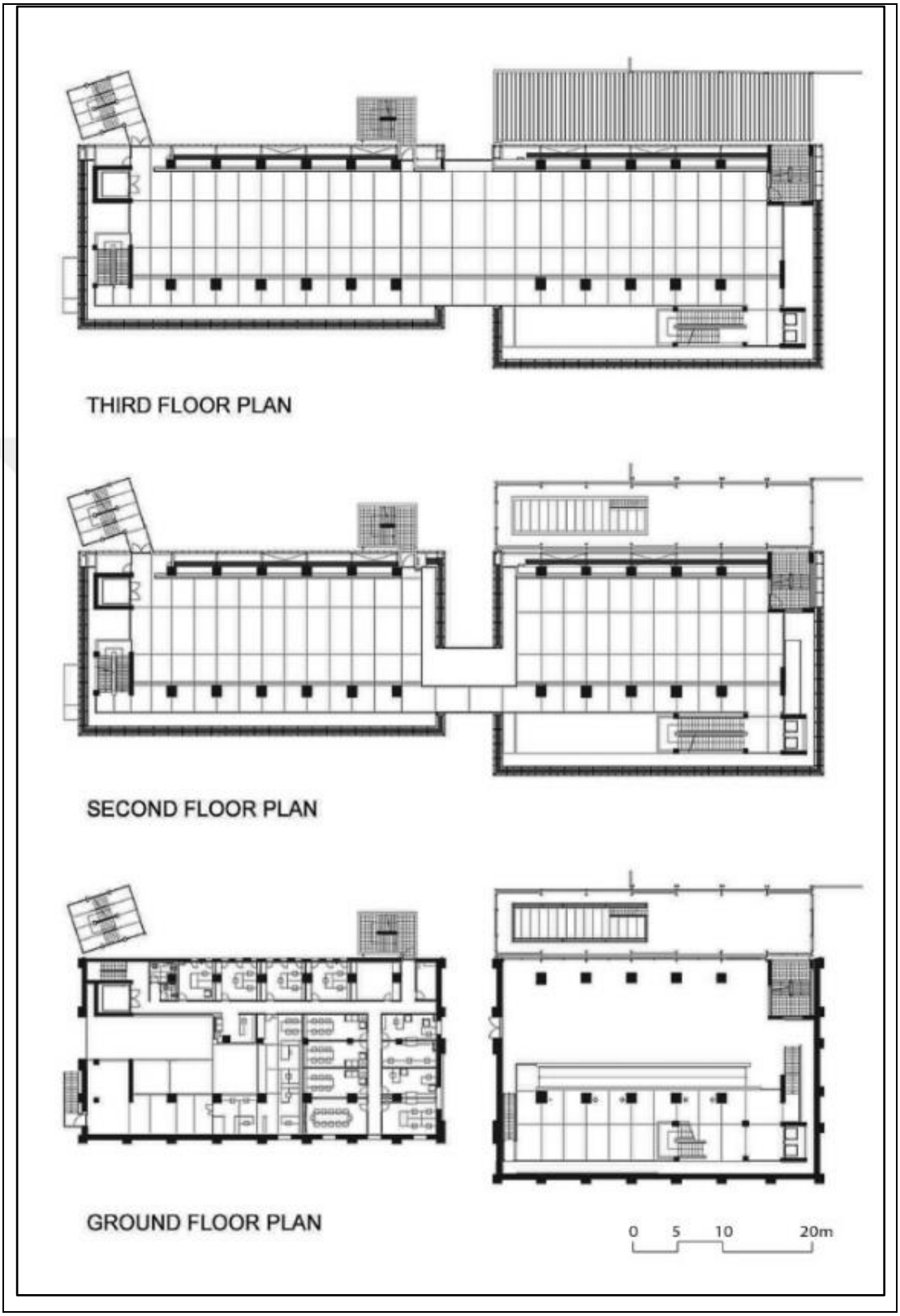


Figure 4.53. Floor plans of the museum [53]

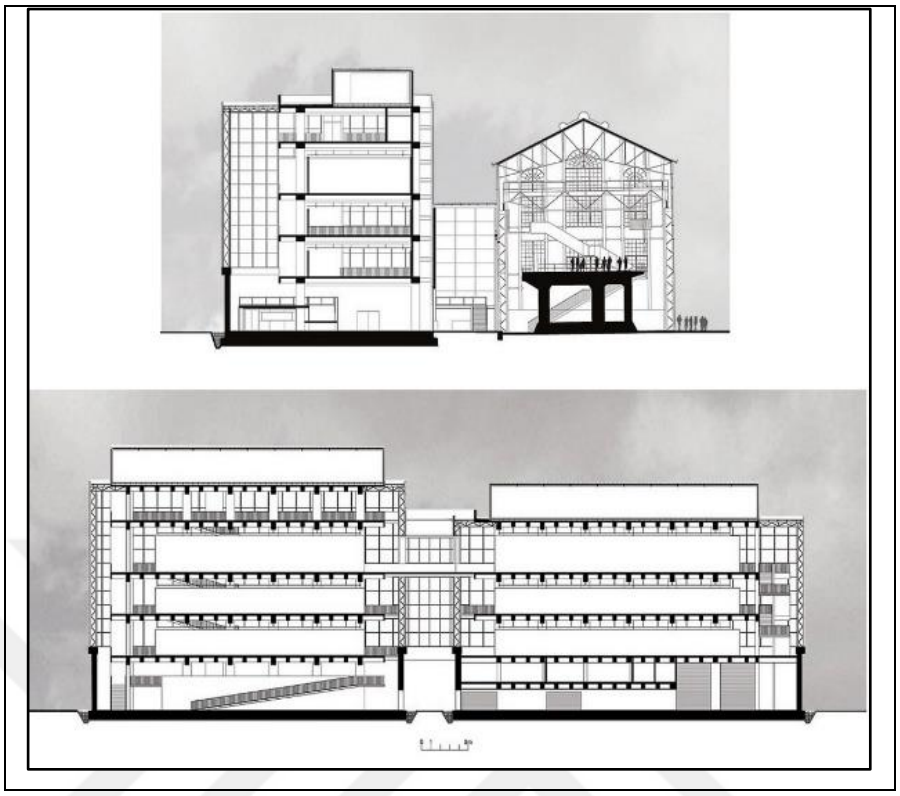


Figure 4.54. Sections of the museum [58]

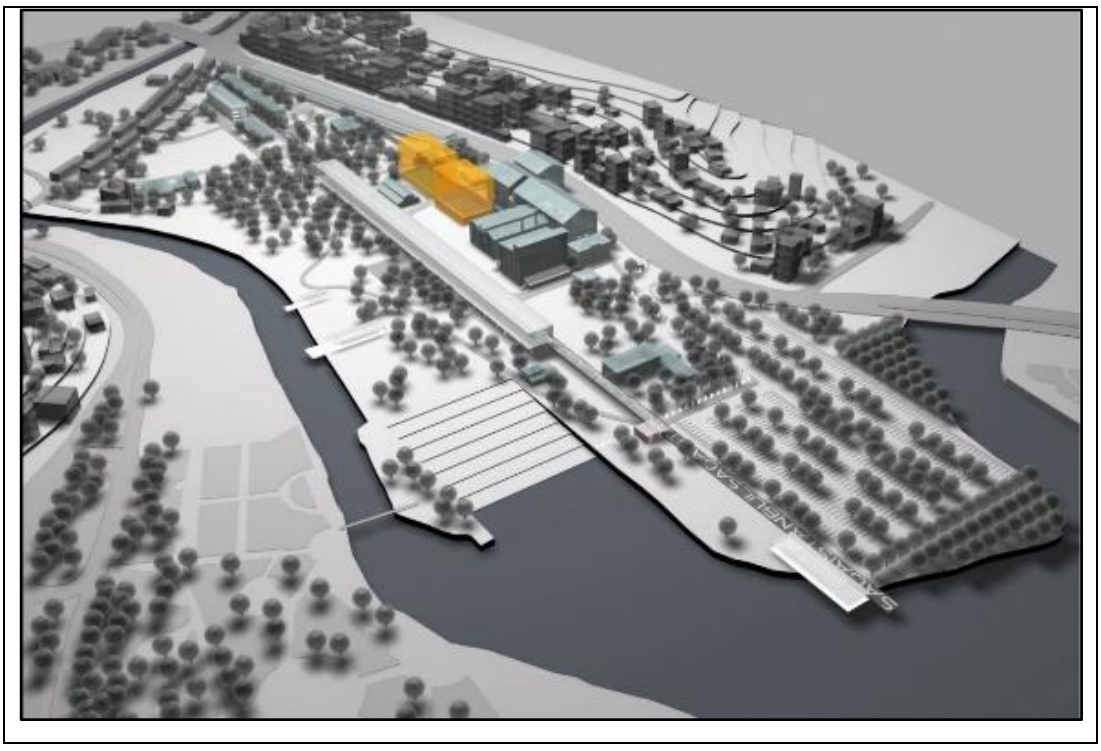


Figure 4.55. A 3-dimensional model of the Santral Istanbul [58]

4.7. CAIXA FORUM BY HERZOG AND MEURON

(a)

(b)

Figure 4.56. (a) The old power station ,(b) La Caixa Forum after 2000s [59]

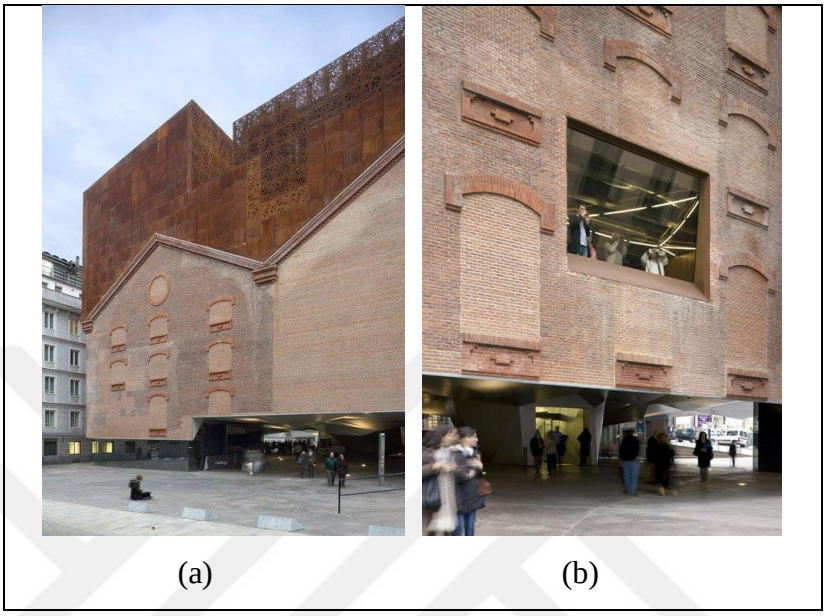
Figure 4.57. Map of Caixa Forum

Table 4.7. Table of Caixa Forum before being recycled and after

Before	**After**
Function: Electrical Power station	*Function:* Caixa museum and cultural center.
Architect: -	*Architect:* Herzog & de Meuron.
Location: Madrid, Spain	*Location:* Madrid, Spain
Year: Early industrial age of Madrid	*Year:* 2001-2007

The Caixa Forum Madrid is a transformation of an old electrical power station into a museum and cultural center, located in Madrid in a very busy area close to the Botanical garden of Madrid and facing the Paseo del Prado avenue (Figure 4.57). The Caixa Forum Madrid has become a site of attraction not only because of its function and program which is museum and cultural center but also because its architecture. The architecture of Caixa Forum gives

the impression of being detached from the ground in defiance of laws of gravity [59] (Figure 4.58).



(a) (b)

Figure 4.58. View of the Caixa Forum Madrid detached from the ground, creating an open space [59]

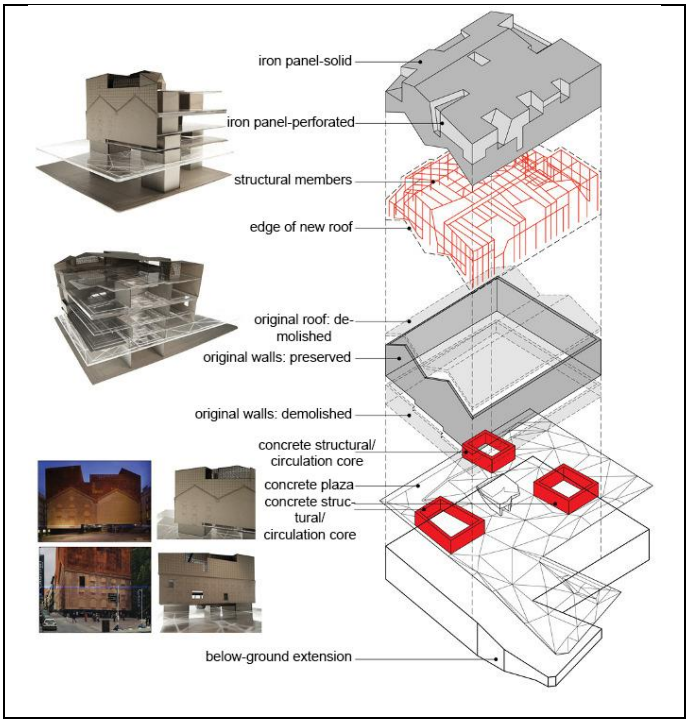


Figure 4.59. Concept of transformation of the Caixa Forum [59]

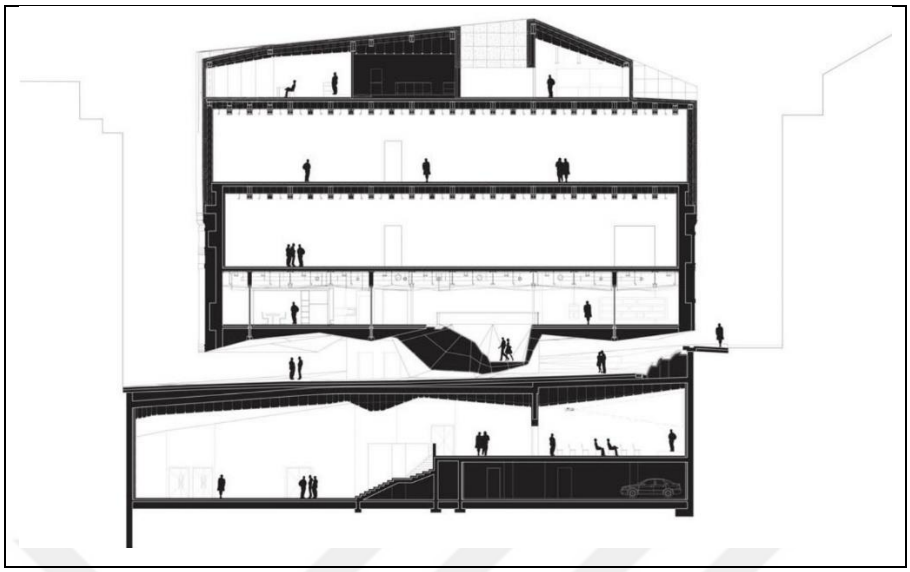


Figure 4.60. Section of the Caixa Forum [59]

Figure 4.61. Opening area created after removal of the base [60].

The architect kept the walls of the old power station; the only material preserved from the old power station is the classified red brick walls. The red brick walls kept from the old power station is a feature that reminds us of the early industrial age in Madrid [59]. The transformation of the old power station started with the separation and removal of some parts and the base of the old power station that could not be used anymore. (Figure 4.59). The removal of the base of the old power station created an open area that hosts the entrance and

solved many problems posed by the site like narrow streets, etc. (Figure 4.61). The open area under the Caixa Forum Madrid created a place for people to hang around and also it solved the problem of placing the main entrance.

After the architect had separated the building from the ground, he mixed the old building with new floors encased on the top with oxidized cast-iron materials, which have a similar color with the brick of the remaining old power station (Figure 4.59). The removal of the base of the old power station creates two different worlds: an underground world and one world above the ground level. The “underground” area of the building beneath the Plaza hosts auditorium, theater, service rooms, and parking areas; whereas the above ground levels provide rooms for the entrance lobby, galleries, restaurant, and offices. The architecture and aspect the Caixa Forum Madrid is a reflect of the roofs cape of neighboring buildings and at the same time, it’s in contrast with the green wall of the building next to it, which was designed by the French botanist Patrick Blanc (Figure 4.62).

Before the transformation of this project, this electrical station was just a random ordinary industrial building. The transformation has not only preserved the building and reminded the past of the city, but it has also considerably changed the life in that environment.

Figure 4.62. Contrast of the Caixa with the Building designed by Patrick Blanc[60].

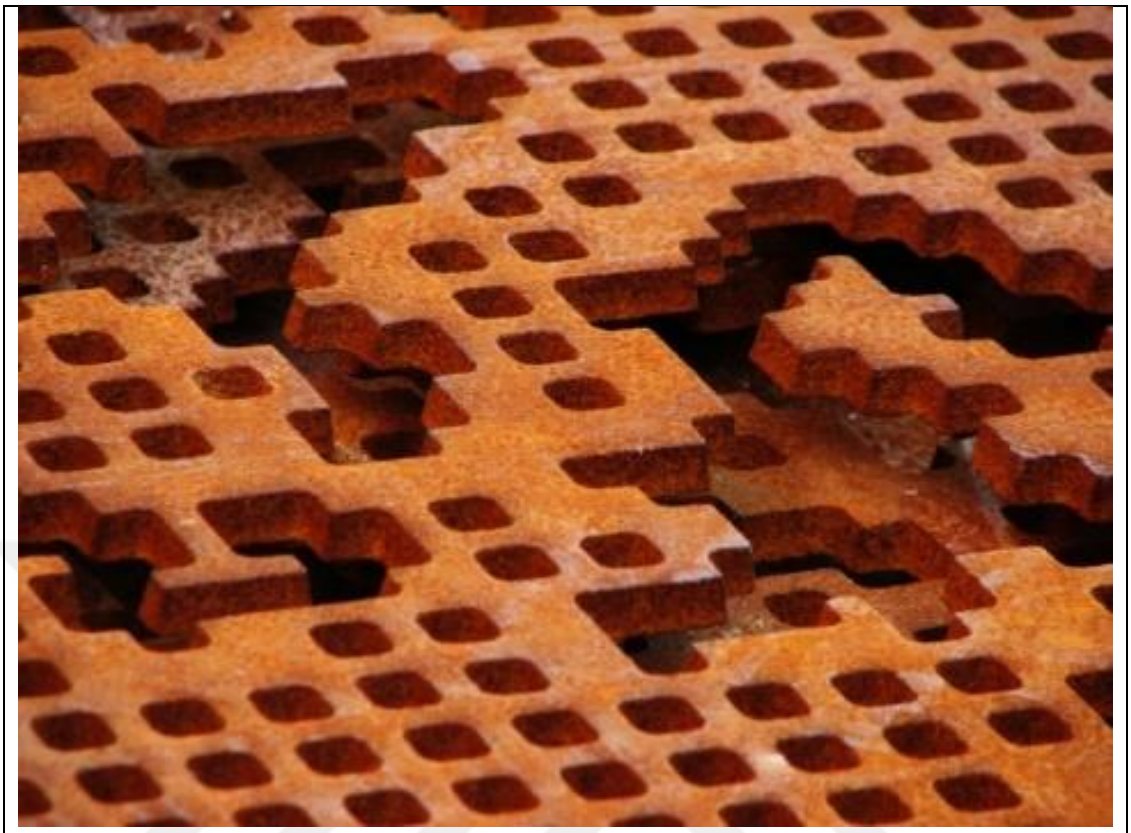
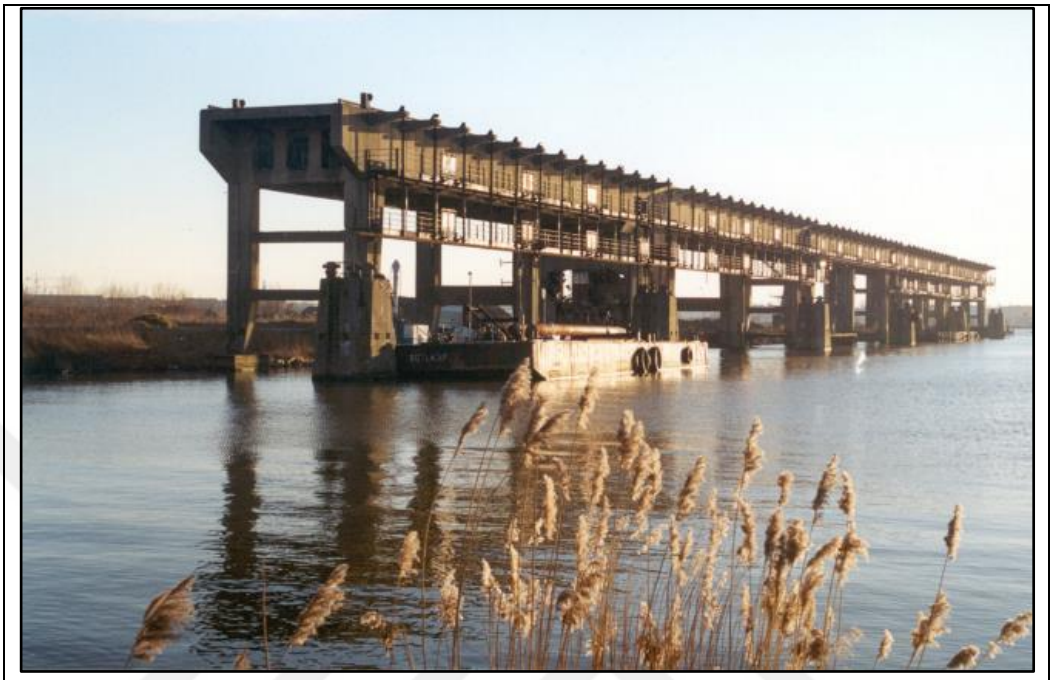


Figure 4.63. The oxidized cast-iron material [60].

4.8. KRAANSPOOR BY OTH ARCHITECTEN



(a)

(b)

Figure 4.64. The Kraanspoor (a) before transformation, (b) after transformation [61]

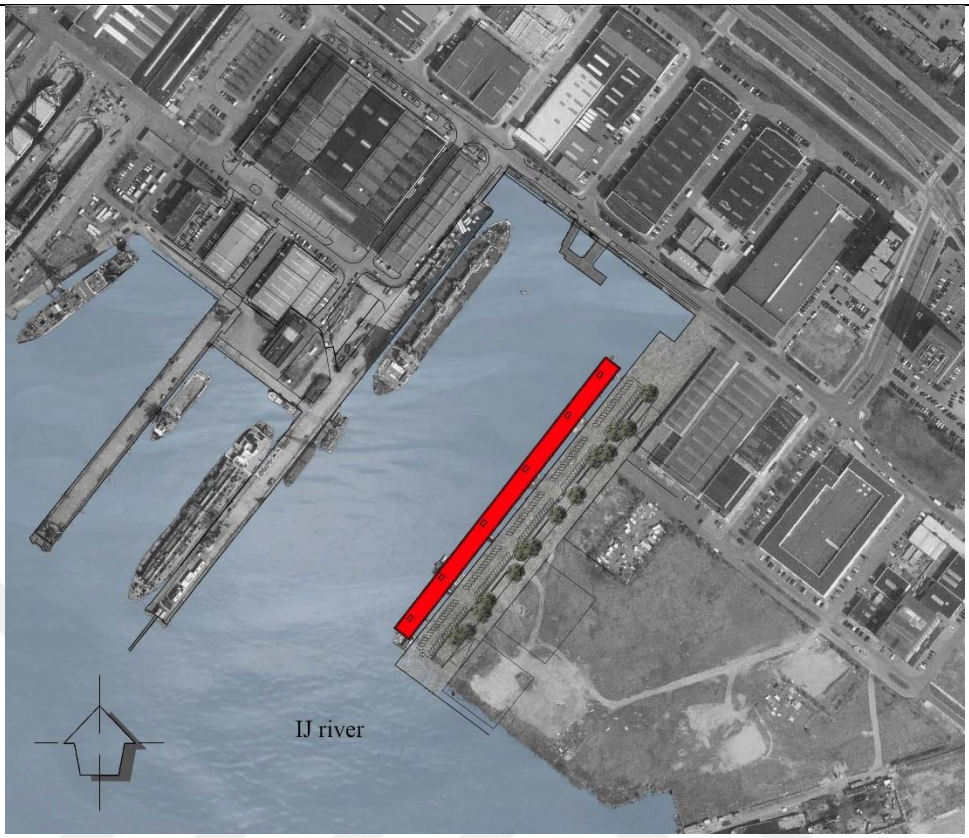


Figure 4.65. Map of Kraanspoor [61]

Table 4.8. Table of Caixa Forum Kraanspoor before being recycled and after

Before	**After**
Function: concrete crane way on the NDSM (Nederlandsche Dok en Scheepsbouw Maatschappij) shipyard	*Function:* light-weight transparent office
Architect: J.D. postma	*Architect:* OTH Architecten
Location: Amsterdam, The Netherlands	*Location:* Amsterdam, The Netherlands
Year: 1952	*Year:* 2007

This project is a transformation of the NDSM (Nederlandsche Dok en Scheepsbouw Maatschappij) shipyard crane into a lightweight transparent three-story office building.

Located on the IJ River in Amsterdam, the NDSM shipyard crane was constructed in the middle of the 20th century with a height of about 13.5 meters, a length of 270 meters and a width of 8.7 meters. The new three-story light steel building is constructed on top of the remaining concrete crane way of the old shipyard with the same length and height, which emphasizes the length of the concrete crane way and gives a remarkable view of the river IJ. The new office building is characterized by a "transparent double skin-skin climate façade of glass", which enables a natural ventilation inside the building and protects against heat during summer and cold during winter.

The lightweight three-story office building lays on the concrete crane way (Kraanspoor) and uses it as its foundation. It is elevated from its foundation by slight steel columns of 3 meters high, and this makes the light office building appear like its floating above the giant concrete crane (Figure 4.66).

The craneway is used as the foundation, and it carries the maximum possible weight of a three-story building with a disproportional overhang on the water side (Figure 4.67). The challenge for the architect in this project was first to use all available spaces without radically modifying the existing concrete craneway, and to use the maximum acceptable load of the remaining concrete craneway. In order to reduce the weight carried by the craneway, the architect used a hollow infra+ light-weight floor system with a light-weight steel structure [60].

There is a water pump in the building pumping water from the IJ River up into the building for heating and cooling purposes. The remaining parts of the old building is still used in the new building's function. The remaining four staircases are still used as the entrance of the building, and new panorama lifts are also added to the building (Figure 4.69; Figure 4.70). The two remaining corridors inside the craneway are still used as fire-escape routes (Figure 4.68). Under the new structure, inside the existing concrete structure is the storage area.

Figure 4.66. View of the Kraanspoor office building giving the impression of floating on the crane way [61].

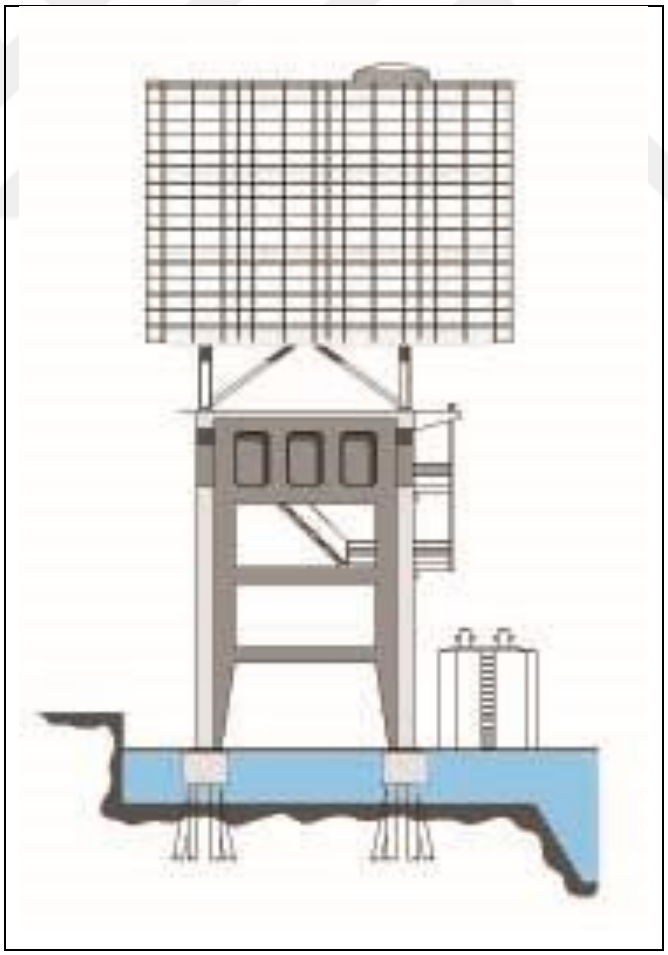


Figure 4.67. Side elevation of the Kraanspoor showing the light steell building unevenly overhung on the water side [62].

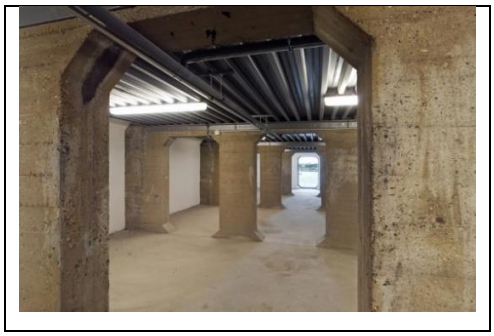
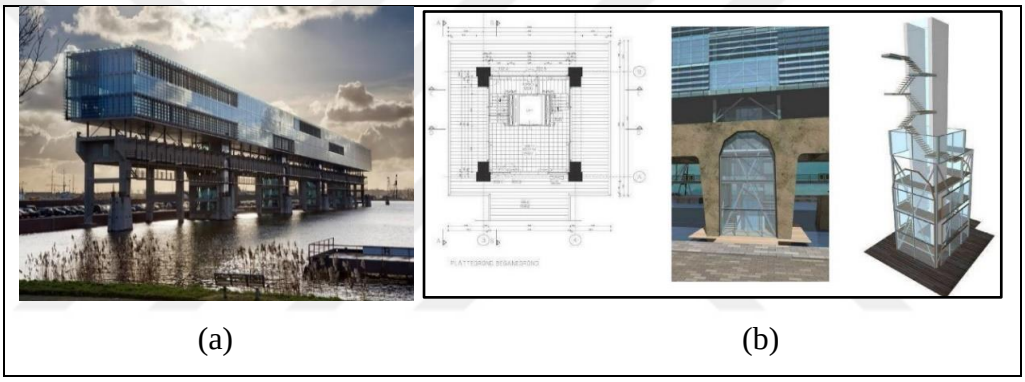


Figure 4.68. The inside of the Kraaspoor showing the remaining wall structure in the corridor used in the new function as fire-escape route [61]



(a) (b)

Figure 4.69. (a) View of the Kraaspoor showing the four lifts, (b) detail of the panorama lift [61], [62]

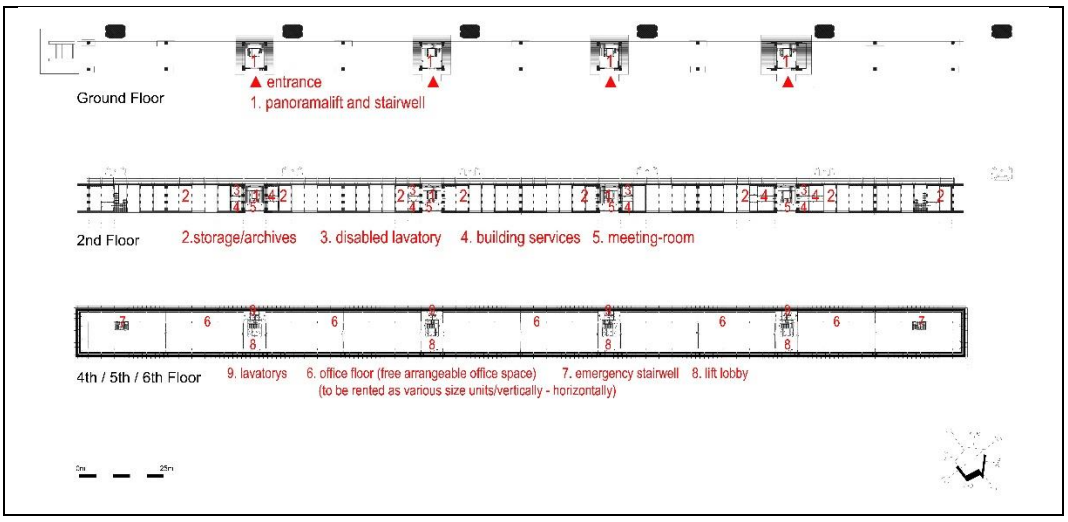


Figure 4.70. Floor plans [61].

The Kraanspoor is one of the preserved industrial heritage whose function has been changed, the remaining concrete, halls, and slipways are integrated in the new design. The Kraanspoor reuse project has restored the waterways, and the intense energy generated in the past by the whole place with its industrial shipping has been restored too. It's a continuous combination of the old with the new, a combination of the industrial heritage with the modern design. The purpose in the Kraanspoor project was to interlace the existing and the new, to preserve the past, and keep the energy generated in the past in that same place.

The project is a sustainable project that has received many awards like: The Dutch Steel prize in 2008, The Glass Award in 2008, The ULI (Urban Landscape Institute) Global Award of Excellence in 2008, The MIPIM Green Building Award + Special Jury Award in 2008, the nomination Mies van der Rohe Award in 2009. It is one of the earliest transformation of structures into buildings.

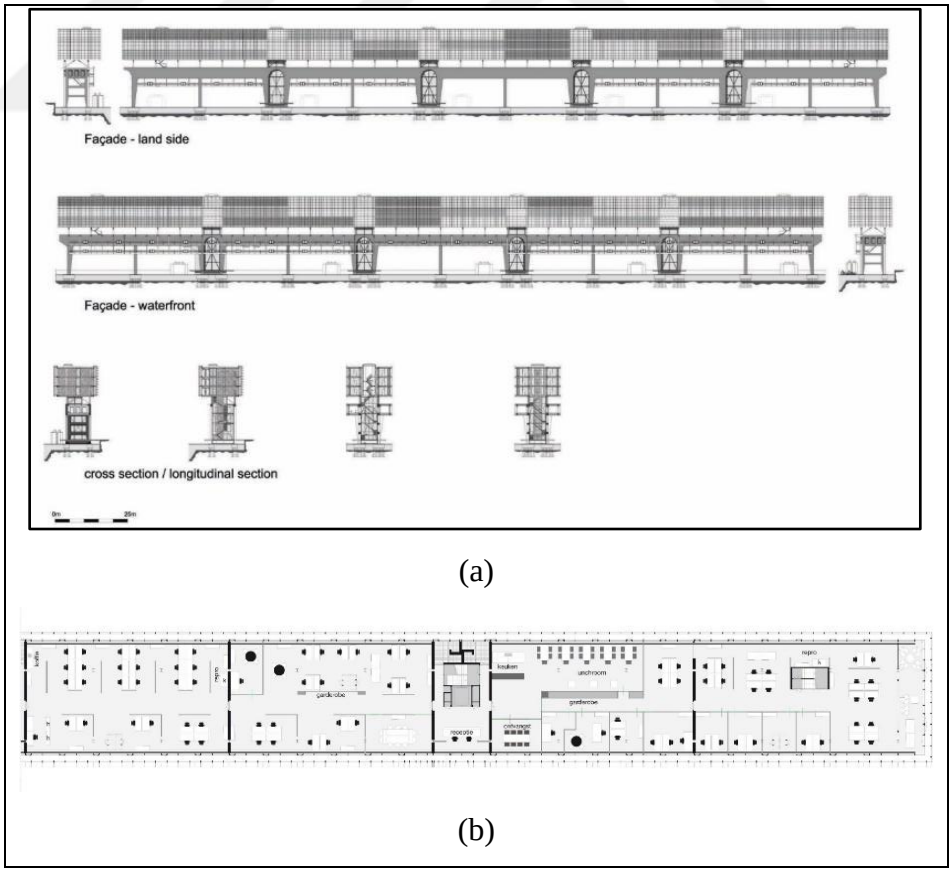


Figure 4.71. (a) Elevations and sections of the Kraanspoor, Office plan of the Kraanspoor [61], [62].

(a)

(b)

(c) (d)

(e)

Figure 4.72. (a) Interior view; (b) view of the glass façade detail; (c), (d) new staircase integrated inside the building; (e) interior view [62].

4.9. BUNKER 599 BY RAAF AND ATELIER DE LYON

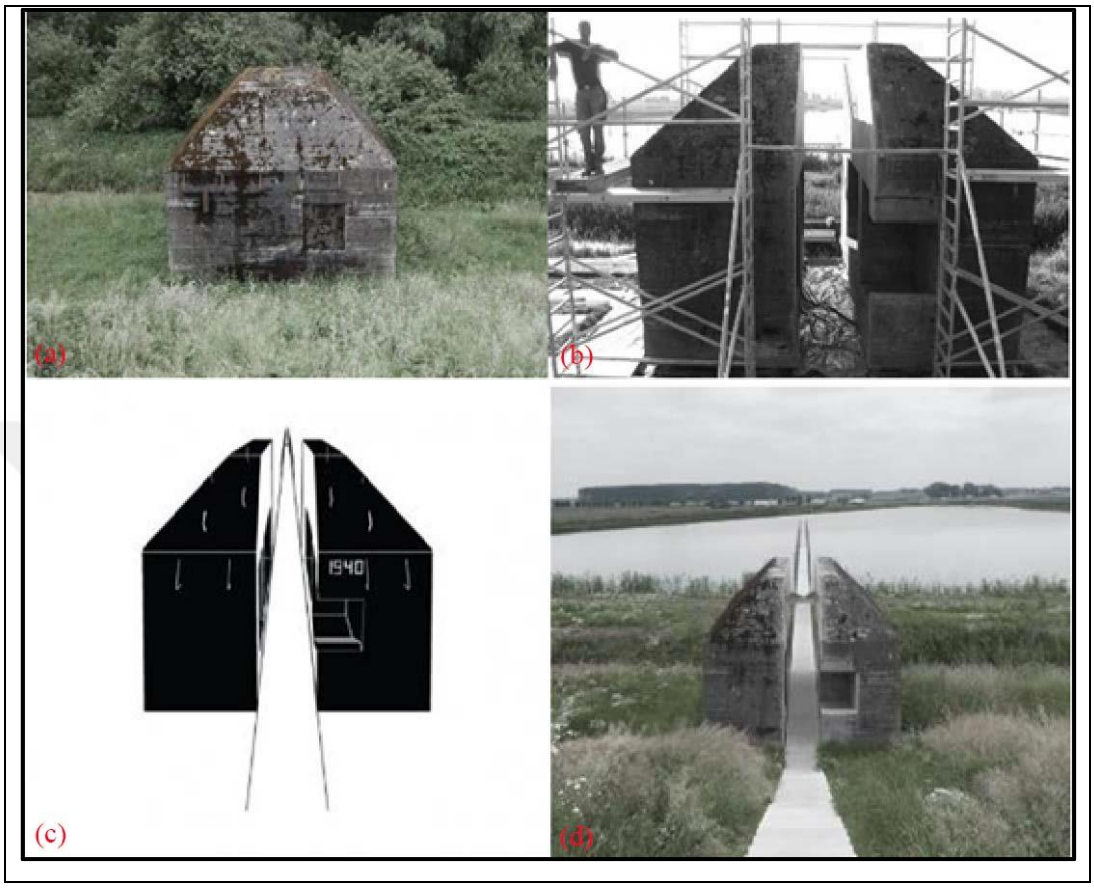


Figure 4.73. The bunker 599, (a) before transformation, (b) during transformation, (c) concept of the art, (d) after transformation

Table 4.9. Table of the bunker 599 before being recycled and after

Before	**After**
Function: Bunker	*Function:* Art installation
Architect:	*Architect:* RAAAF + ATELİER DE LYON
Location: Amsterdam, The Netherlands	*Location:* Amsterdam, The Netherlands
Year: 1815	*Year:* 2010

Figure 4.74. Map of the bunker 599 [64]

This project is a transformation of a New Dutch waterline (NDW) military line of defense, a bunker that was built in 1815 to protect cities of Muiden, Utrecht, Vreeswijk, and Gorinchem in the Netherland by deliberately flooding the area. The NDW was in use until 1940.

The intervention made by the RAAAF atelier is on one of the 700 NDW's bunkers, the bunker 599. The design consists on slicing up the bunker 599, and opening up the interior (Figure 4.75). The bunker is then cut into two parts creating a pathway in the middle, and a long wooden walkway penetrate the concrete bunker right on the space left between the two parts of the bunker after being cut. The wooden pathway leads people into a flooded place and to the walkways of the bordering natural reserve (Figure 4.76; Figure 4.77).

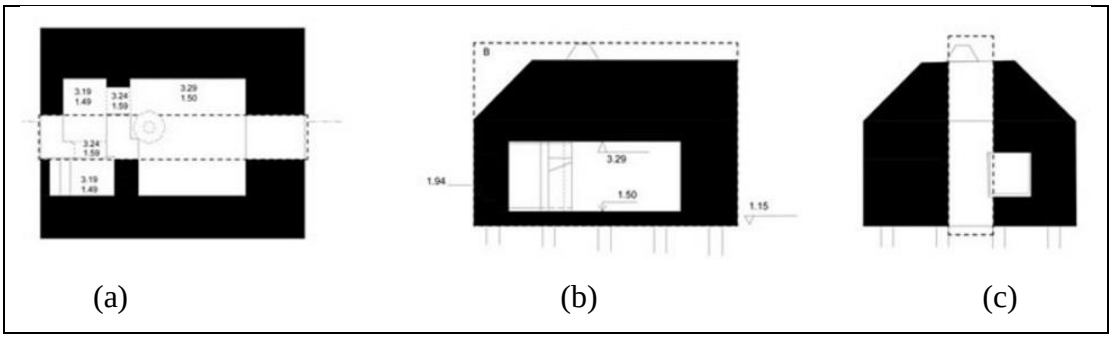


Figure 4.75. Concept of bunker 599 project, (a) plan showing the slicing up and interior openings, (b) section showing the openings, (c) section showing the openings and wooden path [66]

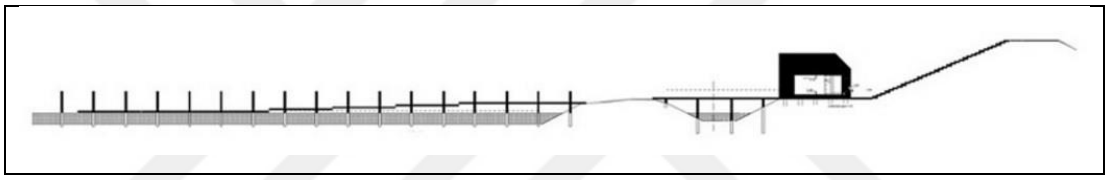


Figure 4.76. Section of the bunker 599 showing the inside cutting and wooden pathway leading people to a flooded area [66]

Figure 4.77. The bunker 599 cut through and the wooden path leading to a flooded area [66]

The flood is not created by the removal of sand, but instead it is just a shallow water, which symbolize the inundations during the war times. This is a transformation of a bunker used as defense line in the past into a sculpture that is publicly accessed by thousands of people each day. It can be seen from the A2 roadway, so thousands of people passing every day can perceive the sculpture. It's a way of making not only this physical unique area of the Netherland known and reachable to a huge variety of people, but also it's a way of making the Dutch history tangible and available to a big variety of people visiting the area. The Bunker 599 has then become a Dutch national monument right after the intervention of the architectural firm RAAAF + Atelier De Lyon on that bunker.

This project is one the earliest transformation of bunker into art installation. Before the transformation, the bunker was just an ordinary bunker. This transformation has given the building more recognition.

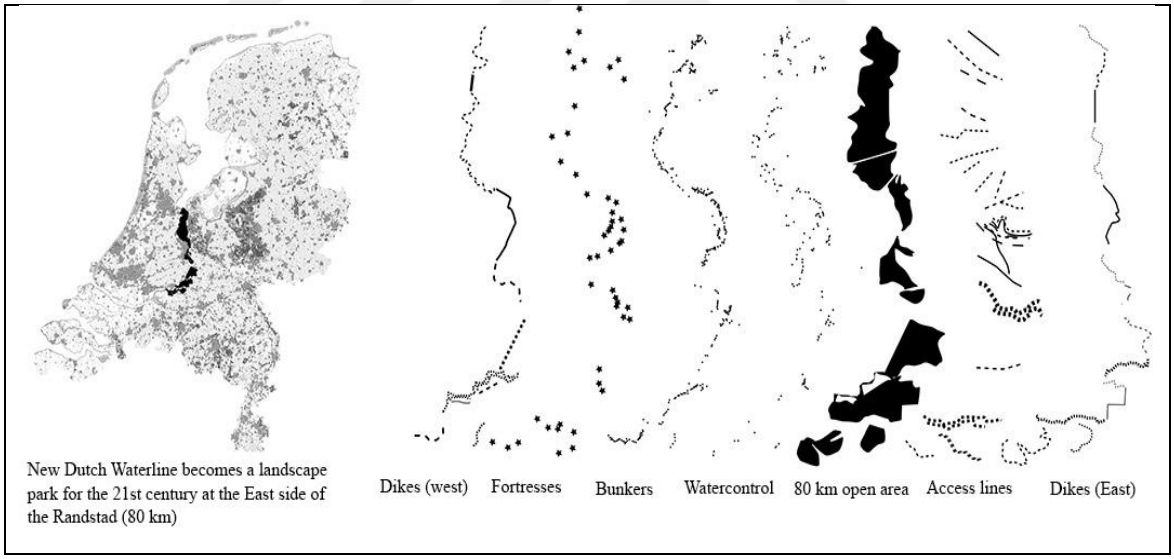


Figure 4.78. Landscape of the NDWline of defense [65]

(a)

(b)

Figure 4.79. (a) Interior view of the bunker cut through by the wooden pathway, (b) view of the Bunker 599 in winter [66]

Figure 4.80. People passing trough the sculpture, the bunker 599 [66]

4.10. FOND REGIONAL D'ART CONTEMPORAIN OF NORD-PAS-DE CALAIS REGION (FRAC)

(a)

(b)

Figure 4.81. (a) AP2 before WW II (b) FRAC in 2013 [67]

Table 4.10. Table of FRAC before being recycled and after

Before	After
Function: Shipyard	*Function:* Contemporary art collection and Exhibition center
Architect:	*Architect:* Anne Lacaton and Jean-Philippe Vassal
Location: Nord Pas De Calais / FRANCE	*Location:* Nord Pas De Calais / France
Year: 1945	*Year:* 2013

Figure 4.82. Site Plan of AP2 [67]

This project is an urban transformation of the region Nord-Pas de Calais in France, it's the transformation of an old workshop shipyards into a Contemporary art collection. The AP2 which stands for "prefabrication workshop No.2" (From French: Atelier de prefabrication 2) located in France in the region of Nord pas-de-Calais, was the shipyard of Dunkirk that was built in 1945. The place still stands as a memorial and geographic landmark that reminds the social and the community life's history of the city and region before the World War II (see Figure 4.83-Figure 4.84). The building was called "The cathedral" by the Dunkirk's due to his gigantesque dimensions (75 meters long, 25 meters wide and about 25-30 meters high)

along the coast of Dunkirk. During almost 40 years, the AP2 had been a place of workshops steamers, postal cargo, sailboats, tankers, warships until it finally closed in 1988.

The FRAC "Fond Régional d'Art Contemporain" in French, is a regional international contemporary art collection that has to be shown to a wide audience as often as possible.

- *Program*: artwork reserves, exhibition rooms, education.
- *Area:* 11129m2 net:-9157m2 new building - 1 972 m2 existing hall
- *Competition and design:* Competition 2009, design 2010, completion: 2013
- *Budget:* 12 M Euros net (2011)[9]

Figure 4.83. Prefabrication of a boat at the AP2 Workshop [67].

(a) (b) (c)

Figure 4.84 (a) Boat on the Nord-Pas de Calais's harbor, (b) Welding of materials in the Workshop and (c) Assembling materials to prefabricate a boat [67].

[9] Philippe R., Published in "Europaconcorsi Beta", online magazine on February 11, 2014.

Figure 4.85. Aerial view of the urban complex before the construction of FRAC Nord- Pas de Calais with the link provided between the exhibition and the seaside area de Calais with the link provided between the exhibition and the seaside area [67].

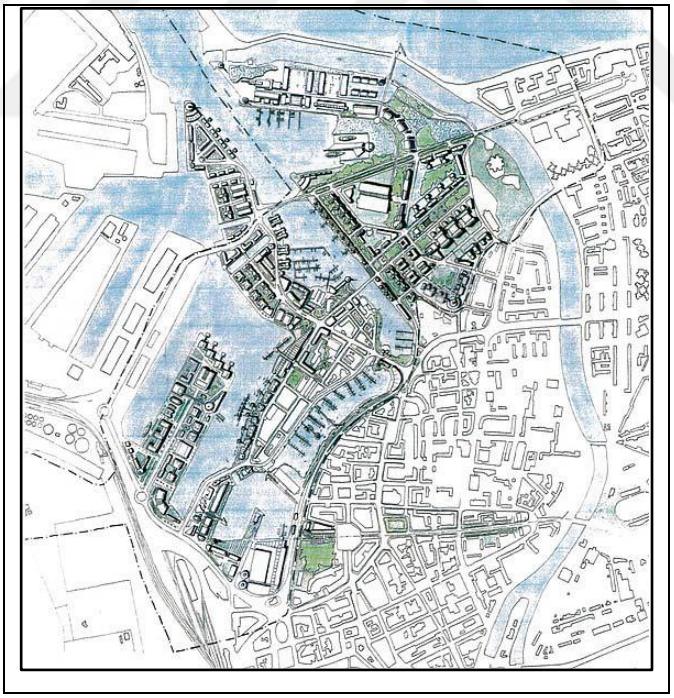


Figure 4.86. Master Plan of Dunkirk, 1991 by Richard Rogers [67]

Dunkirk city was destroyed along with Richard Rogers « Master Plan» of the city during the WWII. And during that time the shipyards workshops in France played a great role in the urbanism of the after war. The city was built around the workshops which played the role of

the heart of the economy of that area. The closure of French Shipyards Workshops (FSW) in 1987 disconnected the city to workshops which created a social unsustainability in the territory. The redrawing of Richard Rogers's master plan of the city in 1991 gave new perspectives and vision to that dead space. The Richard Rogers's master plan makes the presence of the sea more conspicuous by connecting the city to the open sea area. This converted the industrial space that existed before into a more contemporary and livable area with housing, universities, services etc. (See Figure 4.86).

Further, the architects Lacaton and Vassal had created a link between the city and the seaside of Malo les Bains. The city is extended into the new building with footbridge free access that cross the first floor of the building, creating an extension of the internal street into a stroll of the seafront. The footbridge creates a pedestrian movement from the new building into the city. (See Figure 4.85).

The AP2 being a city's landmark, the architects Anne Lacaton and Jean-Philippe Vassal, used many perspective of historical preservation and city urban redevelopment strategies to recycle the AP2.

The transformation process of the AP2 can be explained as a ***conversion of industrial heritage***, ***preserving the history of AP2 by duplicating the area***, a ***mixture of the past architecture and epoch with the contemporary one***, a ***connection with the urban city***, an ***economic Sustainability***, an ***environmental Sustainability***, and the ***Heterogeneity and Homogeneity of the two structures***.

- ***Conversion of industrial heritage:*** The AP2 "prefabrication workshop No.2" was an industrial heritage for the people of Dunkirk. Preserving it was the purpose of the architects Lacaton &Vassal. The call for the project was to restructure the industrial heritage. The architects Lacaton and Vassal wanted to leave the AP2 untouched and empty, becoming a vast public space and exhibition area. According to Lacaton and Vassal, the AP2 can be valued and preserved by modifying its original function. It is a vestige that contains a rich memory of the Dunkirk shipyard, which becomes a living public space that can accommodate everything.
- ***Preserving the history of AP2 by duplicating the area:*** In this project, the architects Anne Lacaton and Jean-Philippe Vassal duplicate the existent building that creates a historical relationship with the building and environment, connecting the modernism and

the past. The architects being not willing to change the AP2 which is part of history and not wanting to be exactly conform to the program, they proposed to duplicate the immense building. According to the magazine “Frac: Nord-Pas de Calais”, the new building is like the “twin” of the old one (AP2), and on the formal aspect, it is constructed to provide all the facilities and features defined in the call of proposal and fit in with the art collections of FRAC. The architects doubled the initial volume. The new building and environment created being a reminder of the old French shipyards time stay as a “Contemporary echo of the past industrial”; says the magazine [67]. By doubling the space, the architects maintained the volumetric integrity of the historical AP2 and created a space where the program can fit in.

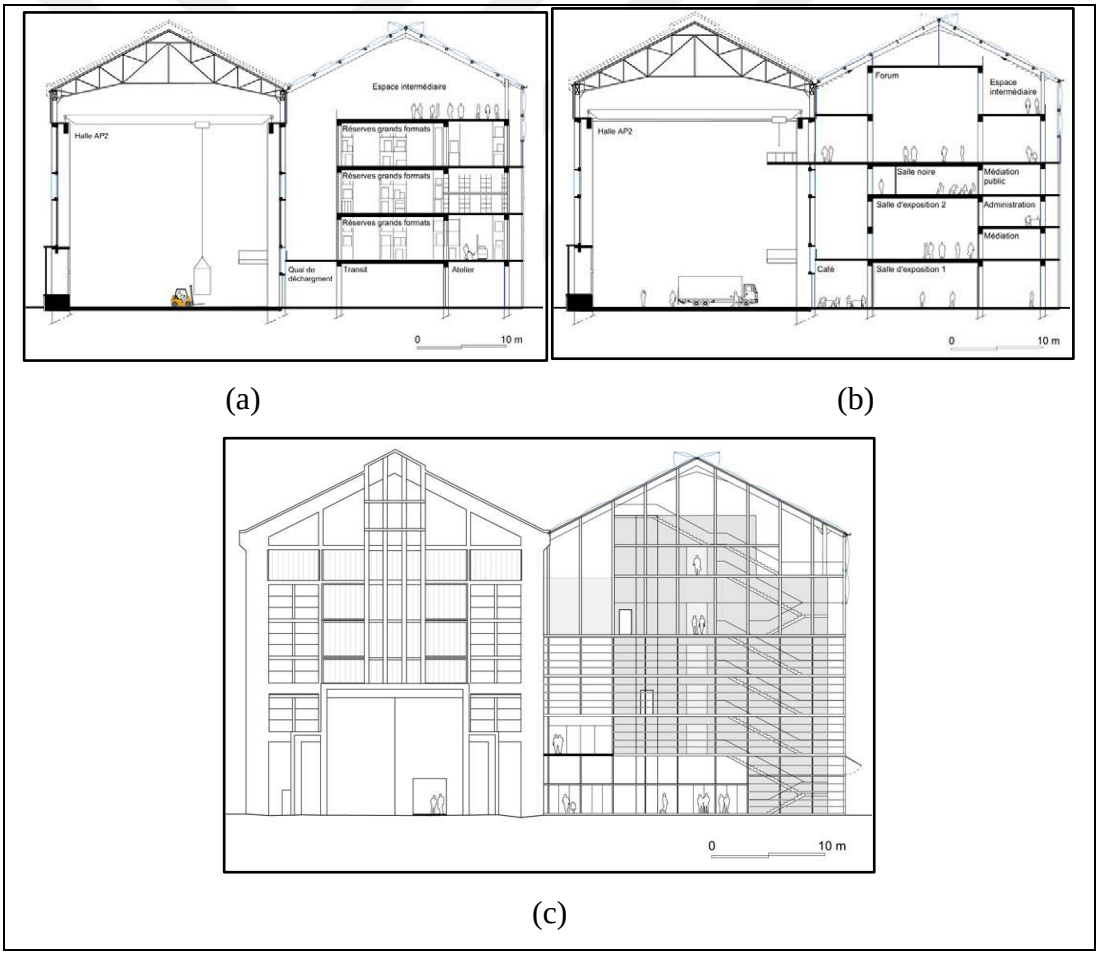


Figure 4.87. (a) Cross section of the exhibition spaces and spaces of FRAC and AP2, (b) Cross section of the exhibition spaces and spaces of FRAC and AP2, (c) East Façade of the project FRAC and AP2 [67]

- ***A mixture of the past architecture and epoch with the contemporary one:*** The structure is a mix of the history with the contemporary design standing next to each other, they are distinct from each other but work together. The two structures create a continuity in architecture, mixing up two different eras, two different construction style but still leaving the previous structure legible. The new structure is the replica of the old one but with a contemporary design and technology, making it more sustainable (Figure 4.88).

Figure 4.88. The mixture of the old and new design [67]

- ***Connection with the urban city:*** The architects wanting to show the connection of the structure with the city, builds a footbridge free access that connects the new building to the city. It creates an interior access which expands the drive of the sea dike (Figure 4.89).

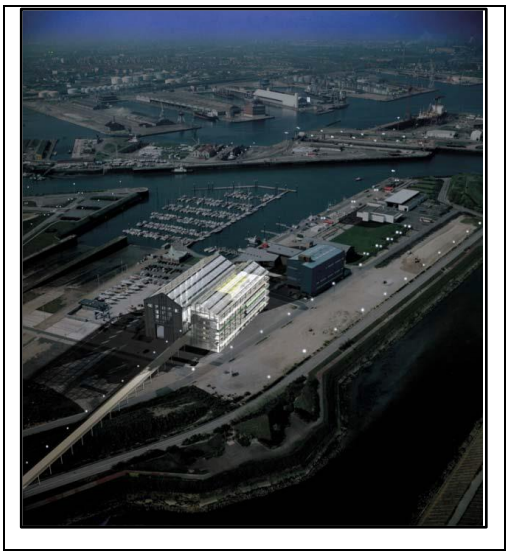


Figure 4.89. The Pedestrian extension into the FRAC [67]

The bridge creates a linear movement and circulation of pedestrians through the city. It increases walkability around the structure and city.

On the technical aspect, the architects Anne Lacaton and Jean-Philippe Vassal resorted to precast materials which are economical constructive. This principle of using economical precast elements obtained from Jean Prouvé workshops allows them to design a transpicuous, light and completely readable structure for the FRAC Nord-Pas de Calais. The architect's principles were based on Le Corbusier's theory; the columns support the floors and slab, that it's completely getting rid of the bearing walls in a way to have large freestanding plaques that can be developed differently or adapted (Figure 4.90)

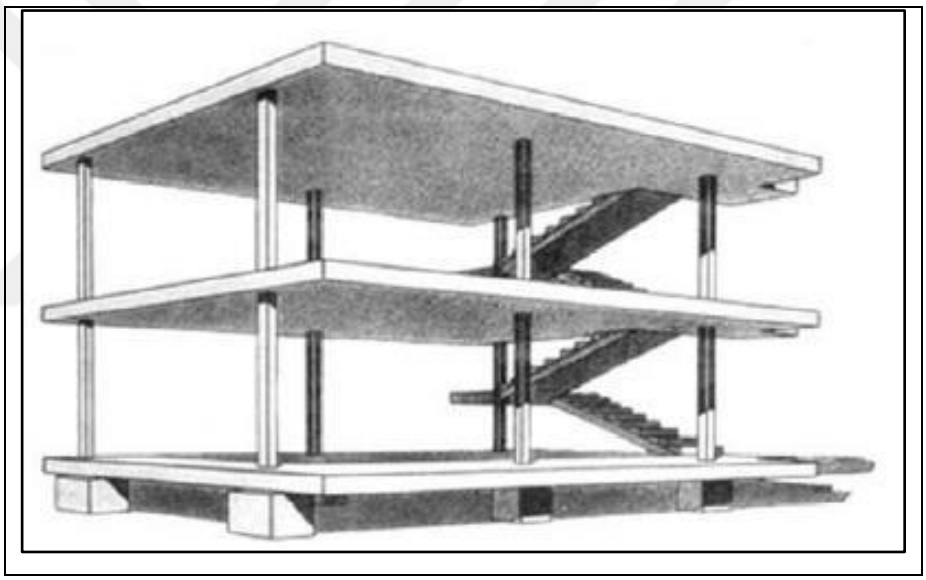


Figure 4.90. Concept of construction in concrete consisting of a frame poles bearing the floors and for any foundation, laying on simple "dice"; the frame can freely compose the facades and plans, designed by Le Corbusier, Maison Dom-Ino, 1914 [67]

On the artistic aspect, the architects creates an open exhibition. The new building is not really looking like museum institution; it leans to the industrial past by almost "disappearing" in the landscape. The building does not feature a typology of museums that keeps the public in distance. The idea of the architects is primarily delicate and sharp. The architectural proposal that seems to establish the apparent simplicity and flexibility comes from the delicate incisiveness of the existing historical place. A clear architectural structure that frees the space from the bearing walls is made by the new building of FRAC adjacent to the AP2.

Space is arranged in a way that it does not depend on the structure which yield a full flexibility of the evolution of the building in time.

- ***Economic Sustainability:*** The architects chose to cover the façade with three millimeter thick metal plates of polycarbonate instead of glass. The material is chosen due to its low production cost, and its lightness that allows an easy and cheap transportation and an easy construction of structures. The cushions in ethylene tetrafluoroethylene (ETFE) which is firstly a horticulture recyclable material, provides a thermal insulation on the belvedere exposed to the light radiation. These materials are both economically and environmentally sustainable, they contribute to the saving (see Figure 4.91). This huge structure is built without any technical constraints, but with a small budget.

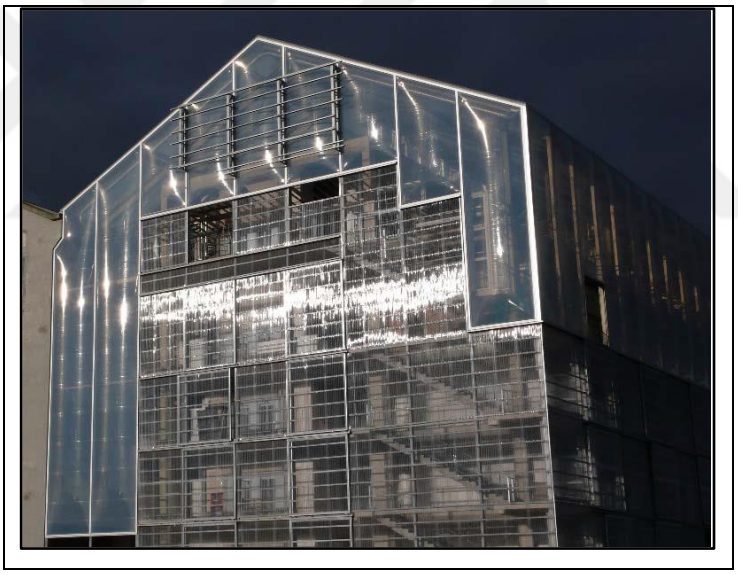


Figure 4.91. Picture taken before the end of the construction, 2013, [67]

- ***Environmental Sustainability:*** The architects have chosen to build open forms so that the qualities of the occupied space would be optimized and users will not feel covered up by only concrete in a closed and harsh shape (Figure 4.92). The structure creates a harmony with both the outside and the inside environment.
- ***Heterogeneity and Homogeneity of the two structures:*** The FRAC is composed of two buildings, the former AP2 and the new structure. The new structure is opposed to the old one in materials but having the same aspects with it. The old structure is empty

and non-translucent or opaque while the new one is full and translucent, creating both a homogeneity and heterogeneity in the project (Figure 4.93).

This project is the transformation of a shipyard into an art and exhibition center, which connects the city and reminds of the history of the city. It shows that “duplicating” can embalms the past and also keep the present together.

(a)

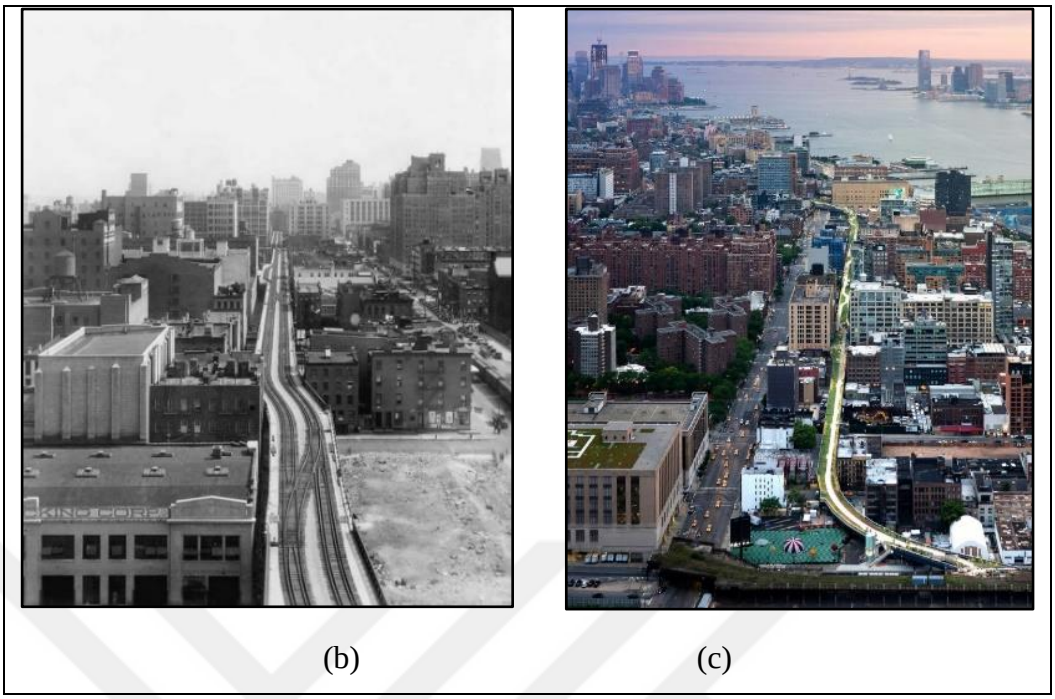
(b)

Figure 4.92. (a) The interior view, (b) the exterior view, both showing the optimized space quality created by the architects, [67]

Figure 4.93. The outside view showing homogeneity and heterogeneity, [67]

4.11. THE NEW YORK HIGHLINE BY JAMES CORNER, AND SCOFIDIO AND RENFRO

(a)



(b) (c)

Figure 4.94. The New York rail way (a) & (b): in 1930s, (c) The high line Park in 2009 [68]

Table 4.11. Table of High line Park before being recycled and after

Before	**After**
Function: Rail way	*Function:* Linear city park
Architect:	*Architect:* JAMES CORNER; Diller Scofidio+Renfro
Location: New York City/ USA	*Location:* New York City/ USA
Year: 1930s	*Year:* 2006-2014

Figure 4.95. Map of the rail way, 1995 (left); and the map of the high line Park, 2017 (right)[68]

- ***Length***: Approximately 1.5 mile long.

Built in the beginning of the twentieth century to facilitate the transportation of goods like foods, raw materials and manufactured ones in Manhattan, the New York rail way is located in the western part of Manhattan, in Gansevoort Street, in Meatpacking district (Figure 4.95). The elevated New York rail way played a great role in the twentieth century, and especially in New York. The former rail way operated until 1980 when it closed due to economic changes. Today the high line is located in the down town of Manhattan, an area with lots of commercial, residential, transportation, art, manufacturing, mixed use, open and close facilities (Figure 4.96a). The elevated former New York rail way gives a great view of the city of New York. Many important places and monuments can be perceived from there, including the Empire State Building, the Statue of Liberty, and the Hudson River. The new designed linear park can be accessed from many different point, and stairs, elevators and wheelchair access are constructed to enable people to access the high line from the street level (Figure 4.96b). The converted project is a perfect combination of nature, ecology and urbanism; and it's a redevelopment project for the historical district of Meatpacking in Manhattan, in New York.

The architect of the project was inspired by the gloomy and alienated charm of the high line rail way. A former urban infrastructure that has become obsolete and disused, an industrial area that has given away its industrial life to a natural one where natural plants and grass grow. The nature has taken back an essential chunk of industrial urban infrastructure. The high line park is an "agri-tecture"[10] technic that mixes organic and construction materials, and all adjusted to the environment and nature of the area. A green platform that opens to walkable areas, boardwalks, areas for rest, etc. has been designed on the conserved remaining metallic structures and rail supports. According to the author of the project:

> The high line "will be converted into lineal gardens a mile and a half long, next to the sky, a place where time stands still and nature acquires a new relationship with the town.

The linear high line project is an eternally incomplete and ongoing project that is doomed to require flexible and sustain changes, and growth over time. A beautiful outdoor with beautiful views of the Hudson river, skyscrapers and a green environment made out of plants and vegetation that grew over time between abandoned rail tracks and artificial green. This project has been done so far in three different phases (Figure 4.97).

- *The First Phase*: The construction of this phase started in 2006 and ended in 2009. This line starts from Gansevoort Street to the 20th Street.

- *The second Phase*: The construction of this phase ended in 2011. This line is the extension of the first phase and extended up to the 30th Street.

- *The third Phase*: This one was inaugurated in 2014. It prolongs the high line up to the 34th street, and in 2015 a short junction was extended from the 10th Avenue to the 30th street (Figure 4.98).

[10] The term agri-tecture by wikiarquitectura, refers to a combination of organic plants with rough building materials in construction [https://en.wikiarquitectura.com/building/High-Line-Park-in-New-York/].

(a) (b)

Figure 4.96. (a) Functional Analysis of the New York High line Park and surroundings, [68]; (b) Access point to the linear park, [69]

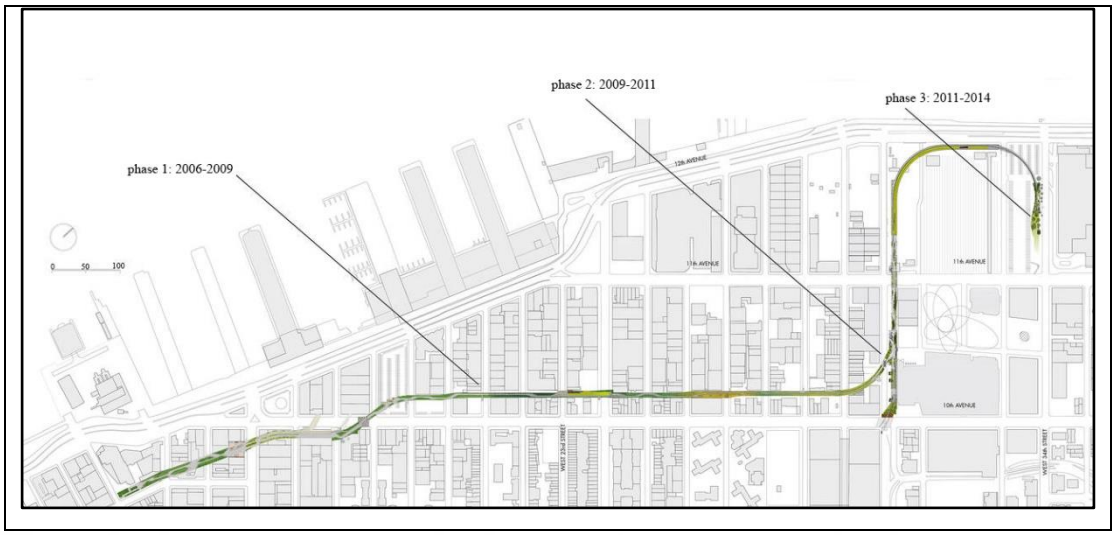


Figure 4.97. Construction phases of the linear high line project [70].

Figure 4.98. Plan of the third phase [70]

All elements of the former railway (steel rails, gravels, earth, wastes and the first layer of the previous concrete) were first wiped out in order to reach the steel structure of the old railway. Necessary repairs and maintenance of the steel structures, and water insulations were done, and then the drainage systems were installed on top of the old structures.

Sustainability on the high line park: The architects used the same technics of the green roof on the high Line's landscape, making it a "living roof" system. The converted linear park is environmentally sustainable, this sustainability created by the combination of the city urban fabric and plantings and vegetation which create shade, release oxygen, and house birds and insects. The converted linear park is made up of several layers, which are:

- *A perforated black plastic "egg-crate" drainage panel*: This material has the function to retain water, to aerate the soil and to provide drainage [69],
- *A layer of crushed pea-gravel*: This material has the function to safeguard, and regulate the speed of draining water [69],
- *Woven filter fabric*: This one has the function to prevent soil particles from blocking the drains [66].
- *A layer of coarser, clay-based subsoil* [69],
- *A layer of finer, more nutrient-rich topsoil* [69],
- *A top layer of gravel mulch:* this layer aims to protect the soil against deterioration and corrosion caused by wind, and to assist in retaining water [69].

Materials: All new materials used in the high line project were chosen according to their durability and life-cycle costs in order to lessen any replacement or material disposal demand. For instance, the wood used on the project is an FSC-certified ipe sustainable timber hardwood, it's known to last up to 100 years.

Planting the high line: The unique landscape of the high line park was designed by the Dutch planting designer Piet Oudolf and the landscape architects James Corner. The Dutch planting designer was inspired by the existing landscape and plants that grew on the disused New York high line network. Many different types of plants have been selected, varying from grass, bulbs, perennial trees, and shrubs to tropical trees and plants. Precast concrete and ipe timber are used on the pavement, and aged steel on the side walls of the access stairs.

Drainage system: The pathway of the linear park was designed in such a way to lessen storm water runoff and to reduce the amount of water brought in for the plants [69]. Pathways are constructed with open-jointed concrete planks which enable rain water to run off through the concrete planks into the adjoining planting beds. Drains are located at low levels in the planting beds, which inflate the flows of water through the planting beds and lessen the amount of drainage.

Lighting system: The energy-efficient LED lights are incorporated in the fabric of the high line park to safely illuminate the lane, sidewalks and planting areas during the night without causing any glare or energy waste. These lights are placed at the ground level, and also in the bottom, between the beams.

In this project, the transformation of the train rail way is a very striking example of transforming a structure (rail way) into a park. The New York Highline Park is visited by many people, changing life in that environment.

Some technical drawings and pictures

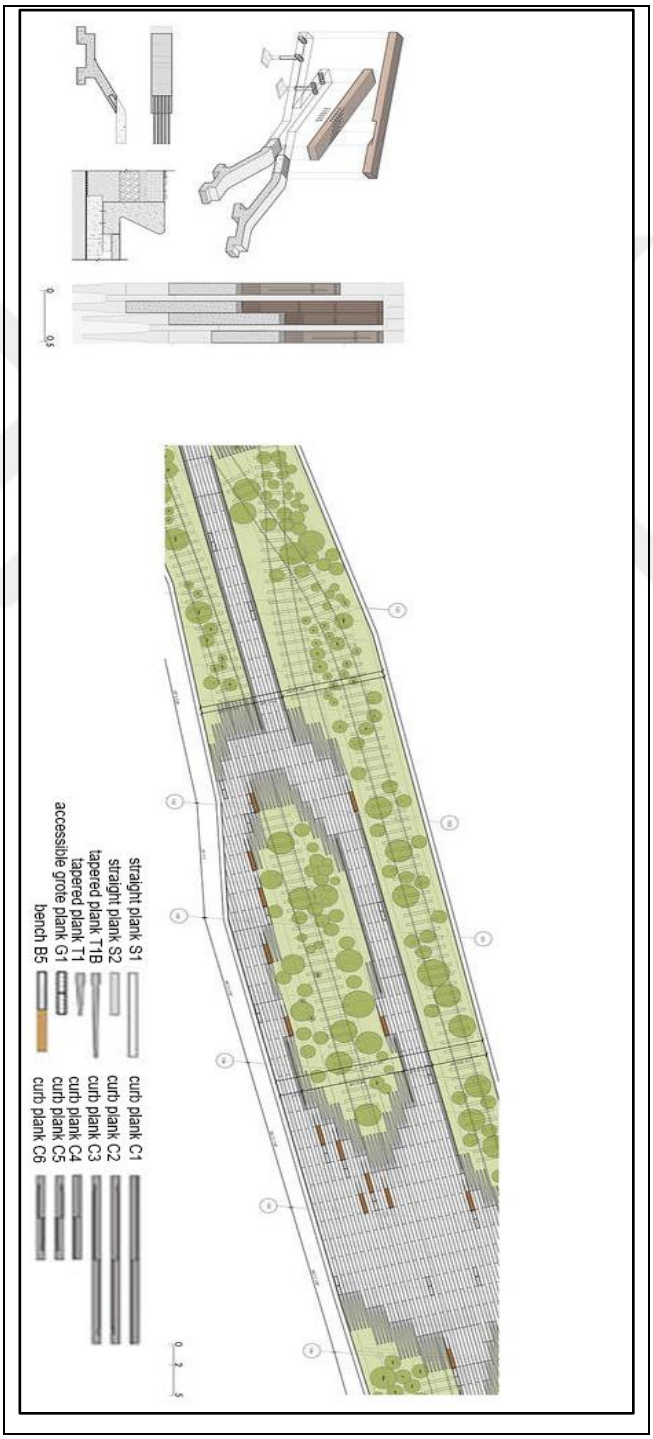


Figure 4.99. Details and materials [70]

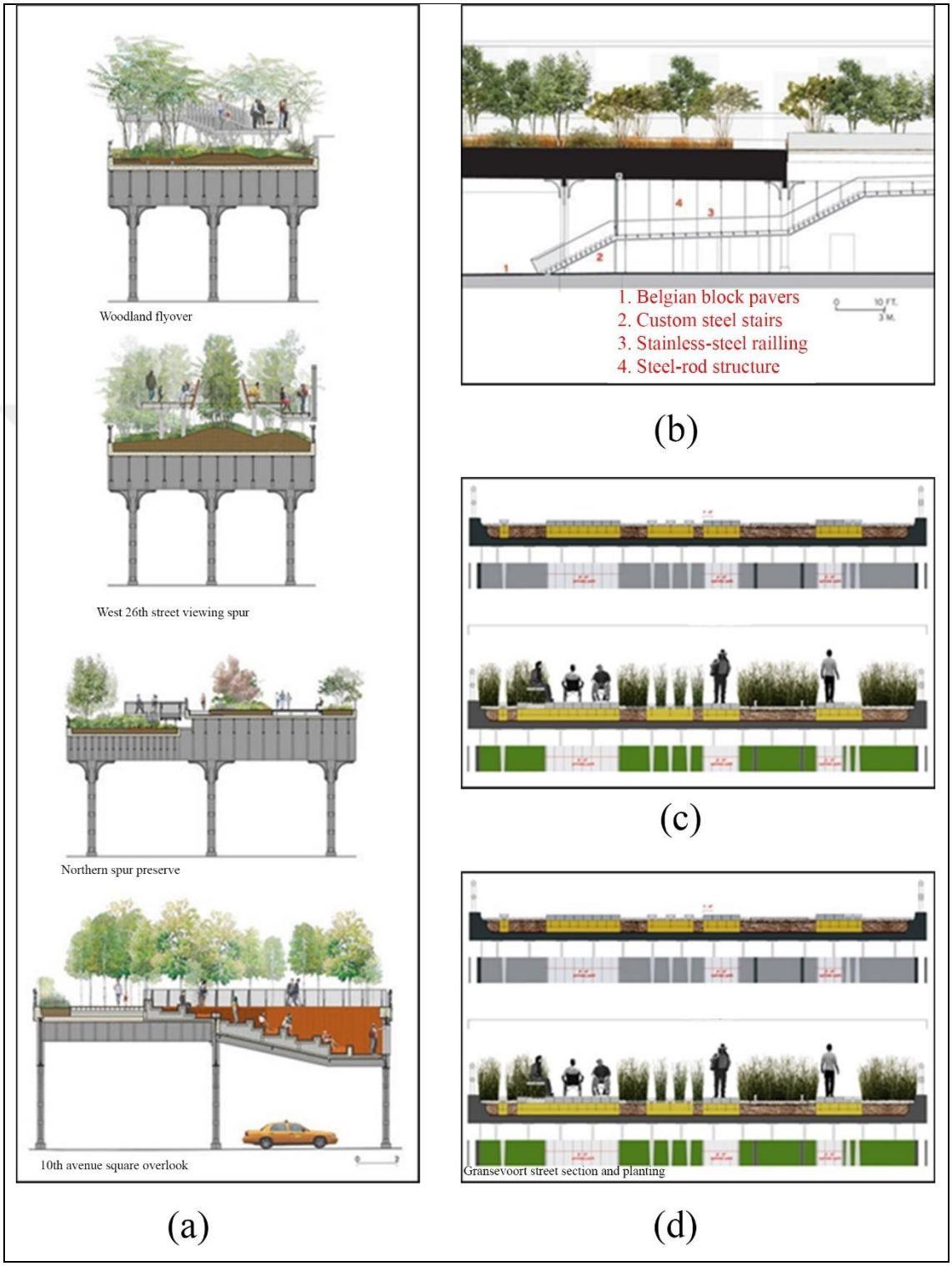


Figure 4.100. (a), (b), (c) sections of the high line; (d) the Gansevoort street section and plantings [70]

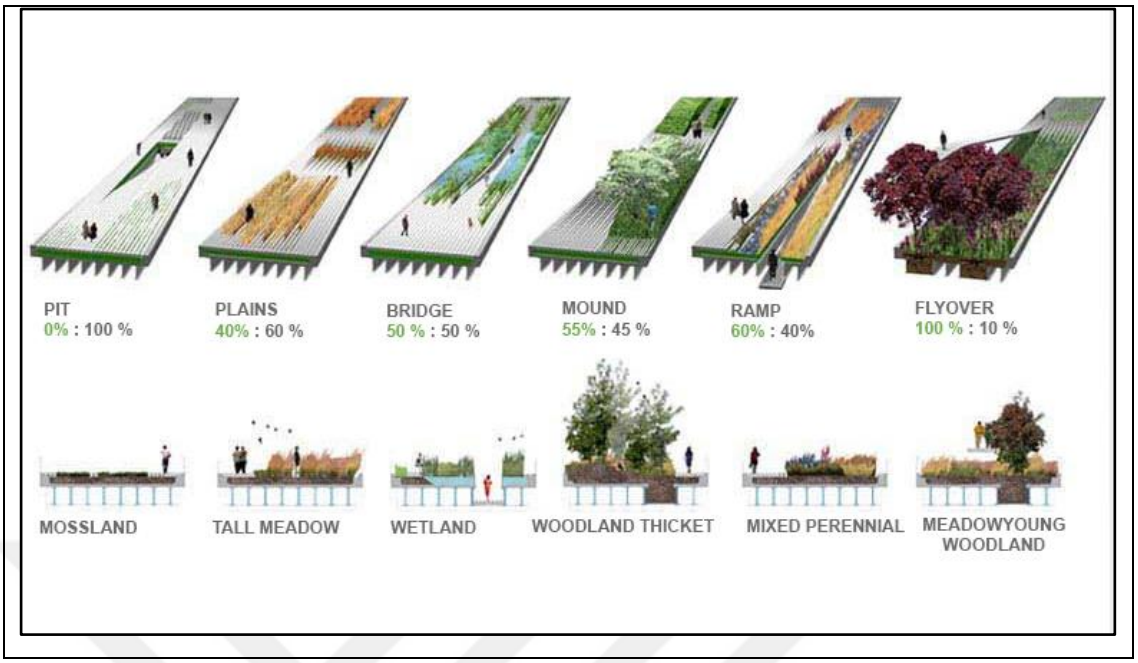


Figure 4.101. Detail and possibility sections of the ramp, flyover, bridge, plains, pit, and mound [70]

Figure 4.102. The perspective of the vertical circulation [70]

Figure 4.103. The places for rest and sunbathe, and LED lighting integrated in the fabric to illuminate at night [70]

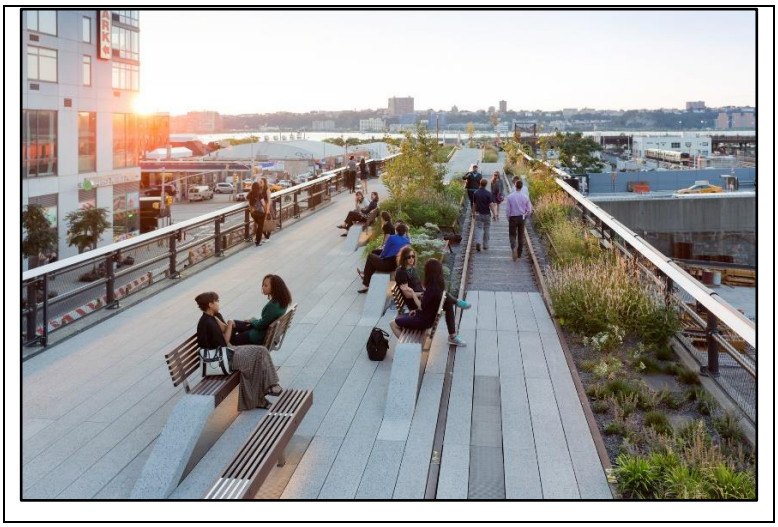


Figure 4.104. The natural vegetation that grew on the abandoned railway next to planted vegetation [70]

4.12. FONDAZIONE PRADA BY OMA

(a)

(b)

Figure 4.105. (a) Picture of the Distillery factory, (b) picture of the Fondazione Prada after conversion [72]

Figure 4.106. Location of the Fondazione Prada

Table 4.12. Table of the Fondazione Prada before being recycled and after

Before	**After**
Function: distillery factory	*Function:* contemporary art exhibitions
Architect:	*Architect:* OMA
Location: Milan, Italy	*Location:* Milan, Italy
Year: 1910s	*Year:* On going

The project is conversion of an abandoned distillery factory into a contemporary art exhibition museum. The new Fondazione Prada has different diversity of spatial environment. The conversion is made by adding three new buildings to the existing factory, which are: a ***large exhibition pavilion***, a ***tower***, and a ***cinema***.

> The Fondazione is not a preservation project and not a new architecture. Two conditions that are usually kept separate here confront each other in a state of permanent interaction – offering an ensemble of fragments that will not congeal into a single image, or allow any part to dominate the others. [72]

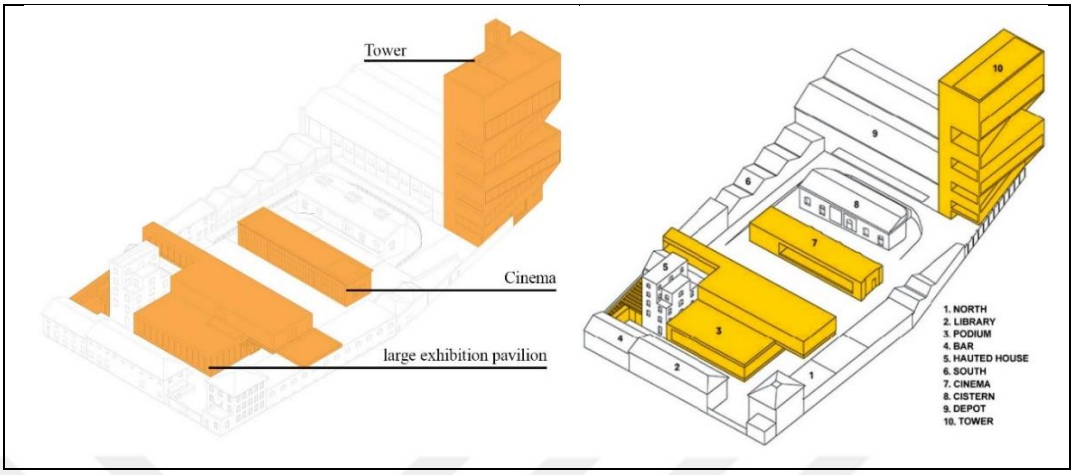


Figure 4.107. Concept of Fondazione Prada [72]

The remaining old building is kept as it was, and it's combined with the new buildings, creating a heterogeneity between the old and the new, without enabling any dominance from either the old or the new design. The Fondazione Prada is defined by the introduction of many contrasted variables created between the old, the new, vertical, horizontal, wide, narrow, black, white, enclosed, etc. These variables set up a variety of oppositions in the project.

The intervention made in this project is the addition of special variables, which transformed the previous distillery factory into a contemporary art exhibition. This is an example of the preservation defined by Rem Koolhaas in his book "Preservation is over taking us" [1], where preservation is defined as not just keeping exactly as it was, but adjusting the past into the present, reusing and recycling the past.

This project is a very striking transformation of an industrial building into an art exhibition. The intervention used in this project is addition of elements or buildings into the existing buildings, creating a mixture of the past and the present. It's a good example of preserving and adjusting into the present.

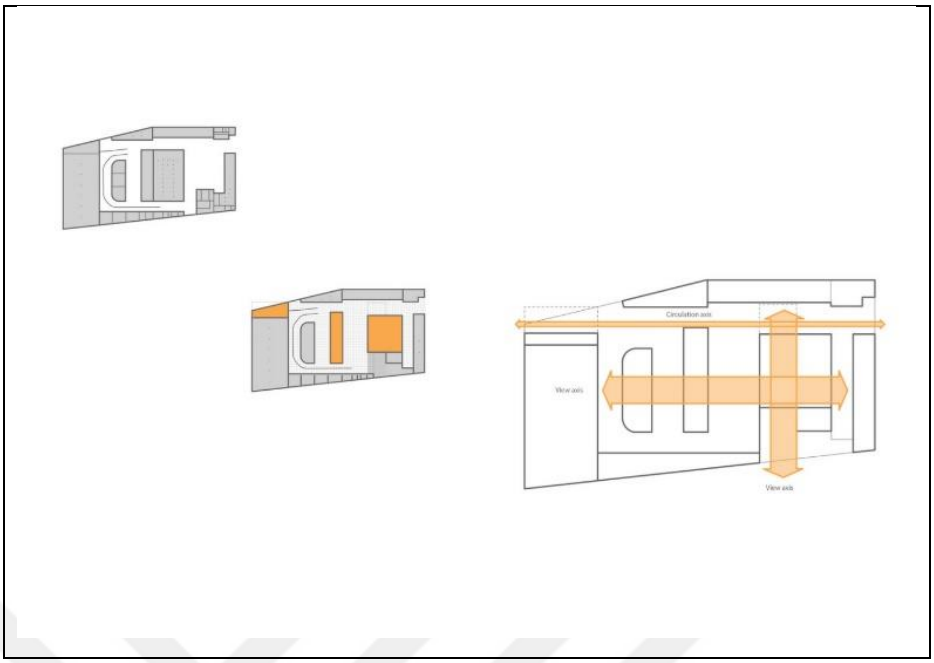


Figure 4.108. Circulation in the Fondazione Prada [72]

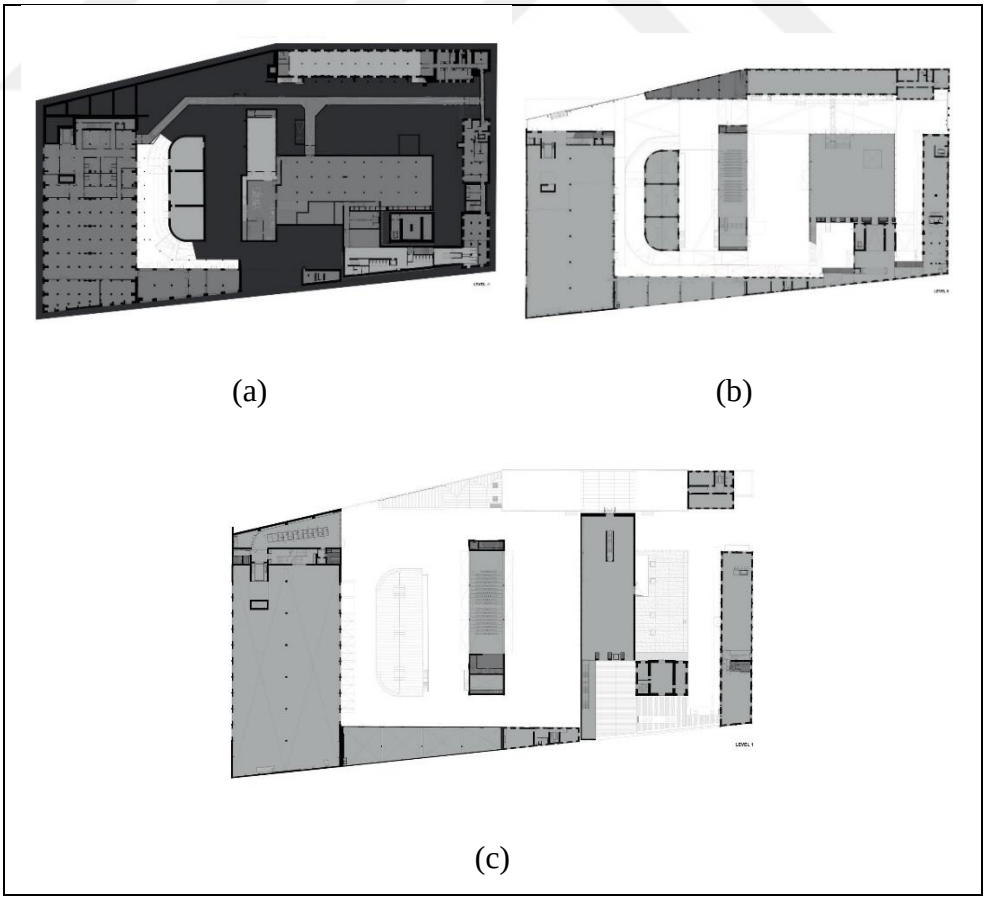
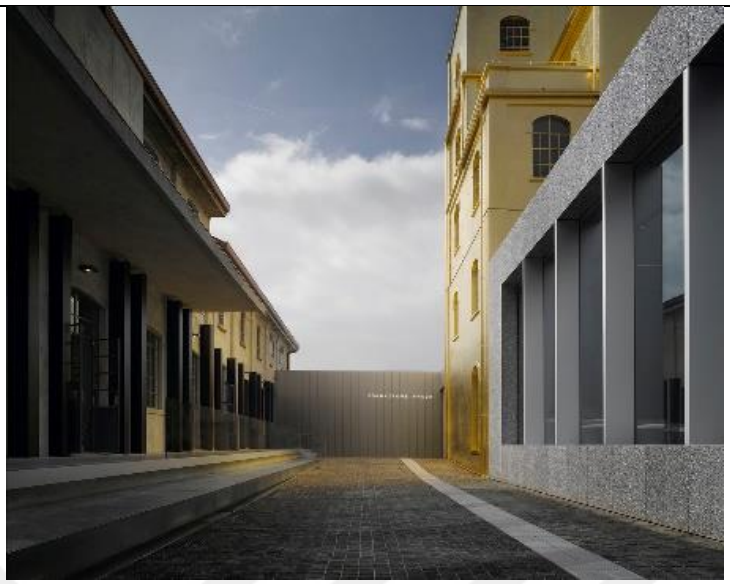


Figure 4.109. Plans of Fondazione, (a) Level -1; (b) Level 0; (c) Level 1 [72]



(a)

(b)

(c) (d) (e)

Figure 4.110. (a), (b), (c) Interior views; (d), (e) exhibition areas [72]

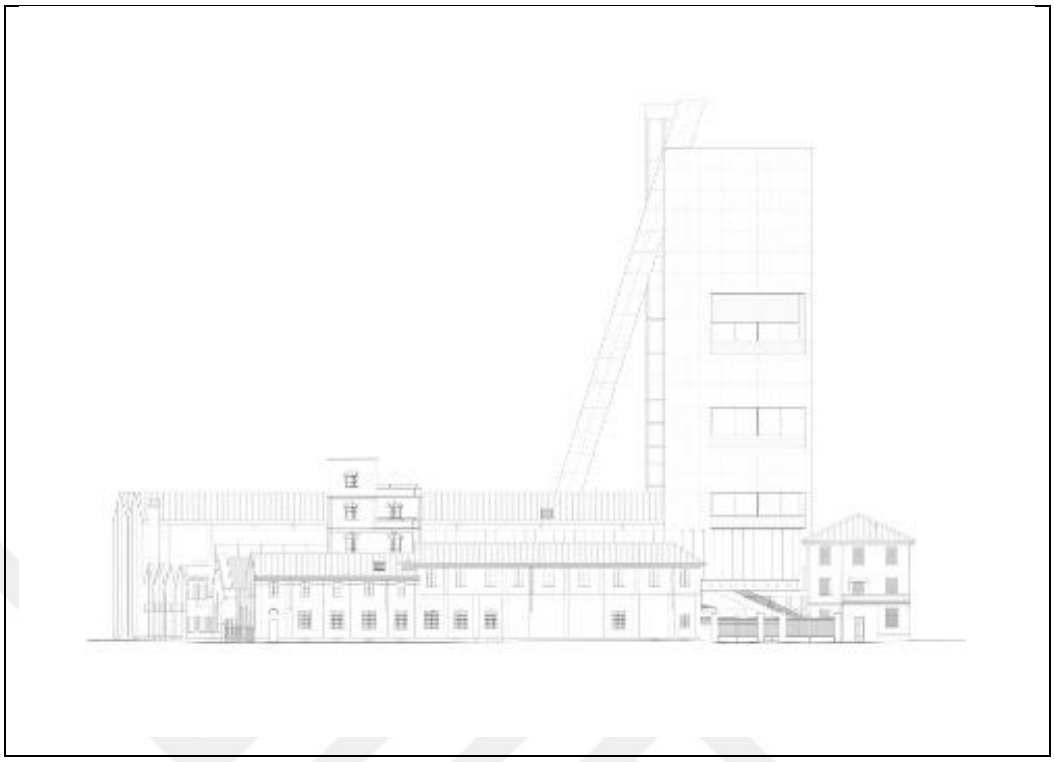


Figure 4.111. Elevation of the Fondazione [72]

Figure 4.112. Model of the Fondazione Prada [72]

4.13. ISTANBUL MUSEUM OF PAINTING AND SCULPTURE BY EMRE AROLAT

Figure 4.113. Istanbul Museum of Painting and Sculpture in construction [58]

Figure 4.114. Map of the Istanbul Museum of Painting and Sculpture [58]

The project is a conversion of the remaining of an old antrepot building into a contemporary painting and sculpture museum. The old warehouse of the custom port in Karaköy, in Istanbul; was an isolated area in the heart of Istanbul with less public access since it was

built in the 1960s. The project will house 15 000 arts plus some important Turkish paintings from the Ottoman to the modern time.

Table 4.13. Table of the Istanbul Museum of Painting and Sculpture before being recycled and after

Before	**After**
Function: warehouse	*Function:* Painting and Sculpture Museum
Architect:	*Architect:* Emre Arolat (EAA)
Location: Istanbul, Turkey	*Location:* Istanbul, Turkey
Year: 1960s	*Year:* On going

The conversion is made by keeping the concrete structures, and removing the walls and slabs so that a "3D naked structural grid" is obtained, and then containers will be placed inside the structural grids (Figure 4.115). The containers will house the collection of arts and will be connected to the outside with a network of bridges and ramps.

This is one of the industrial transformation example in Istanbul that is still going on. It shows the urgency and importance given on preservation in Istanbul nowadays.

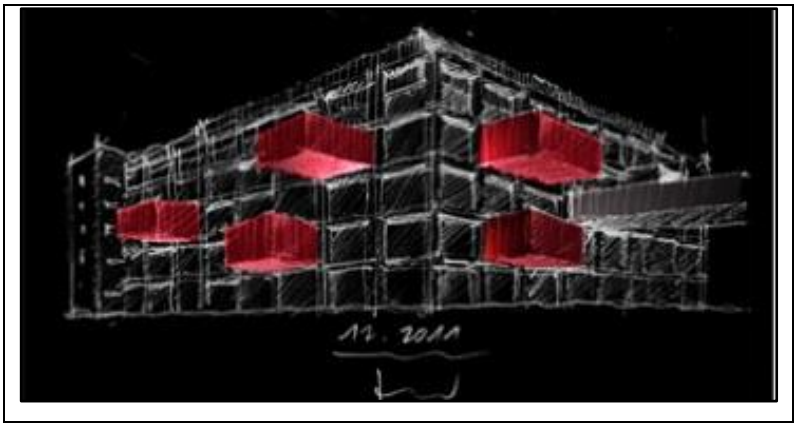
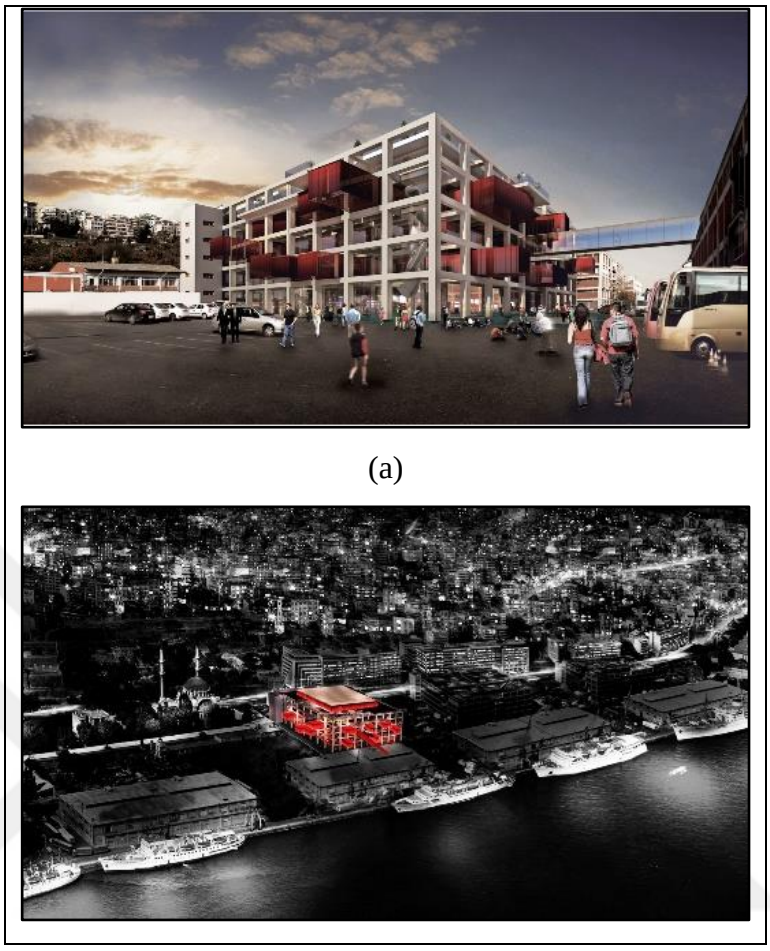


Figure 4.115. Concept of the Istanbul Musem of Painting and Sculpture [58]



(a)

Figure 4.116. (a), (b) Modelling of the Istanbul Muesum of Painting and Sculpture [58]

Figure 4.117. Modelling of the Istanbul Muesum of Painting and Sculpture showing grid materials on the façade [58]

5. CONCLUSION

During the second half of the 20th century, many industrial buildings were abandoned and left unused because of some changes in the production of industries. The reuse of unused industrial buildings is an architectural practice for the transformation of places. It is an architectural redeveloping practice that recovers authenticity of places by combining the existing with the new architectural production. Reuse is a practice that favor preservation of the past. As it was shown in case studies, for instance, in the “conical intersect” piece of art of Gordon Matta-Clark that preserved two historic houses and prevented them from destruction, by just cutting a large hole through the buildings to transform them into an art exhibition (Figure 3.12).

The practice of reuse of industrial buildings put together the old and the new architectural production in a heterogeneous way, so that they can be distinct from each other. This thesis shows that preservation concerns also ordinary buildings. And it goes on showing how important ordinary industrial buildings and structures can be useful to the development of cities. For example, the project of Fondazione Prada, the transformation of the old distillery factory into the contemporary art exhibitions was made by adding three buildings (a large exhibition pavilion, a tower, and a cinema) in the complex of the factory, but still keeping both the remaining buildings aside with the new constructions. In the Fondazione Prada project, the old and the new are permanently interacting each other without allowing any part (neither the remaining existing part nor the new construction) dominate over the others (Figure 4.105).

The reuse of industrial buildings saves from the destruction. For instance in the Kraanspoor project (Figure 4.64), the recycling of the crane way has saved it from the destruction by transforming it into an office building. The recycling process transforms the waste (that was meant to be demolished or destroyed) into architectural resources.

Each projects in the case studies are approached in different ways, according to their context, environment, etc. Reuse of industrial architecture is also contextual like the reuse of any building. There is no strict rules to follow, like it used to be in the past architecture, like with Le Corbusier, the de-constructivism movement style, etc.

Reusing is “scaleless” which means it can be used for objects or buildings of any sizes. Gordon Matta-Clark has shown in his “Garbage Wall” exhibition how we can reuse small things like garbages to make something sustainable. (Figure 4.77). Over all, the goal in reusing remaining industries is to provide a sustainable environment for the present generation without compromising the upcoming ones. Sustainability is a way to urban development, and it is also an essential mixture of the social, environmental, and economic factors [73]. Green buildings are sustainable, but as the study cases and according to Robert A. Young, “the greenest building is sometimes the one that is already built” [73]. In that sense, recycling existing industries leads to sustainable cities and societies.

There are three main factors that contribute to the development and sustainability of recycling industries: *The social, Environmental and Economic factors.*

- *The Social factors*: Reusing industries maintains the social identity of societies. Industrialization being a remarkably important period of history, industrial infrastructures are not only related to the urban fabric but also to history, culture and identity of societies that contain them. Most of industries that were before located in the peripheries are now found in the center of cities due to demographic and economic changes. Destroying them will require more energy to demolish them and keeping them in the city may not be suitable to the contemporary environment and even pollute the atmosphere. Reusing the industrial buildings according to the contemporary need creates more walkability, density, public transit, and diversity in the built environment. There is an emergency of historic preservation, and in many industrialized countries like the United States of America, there is an awareness of preservation and its consideration as an essential sustainability strategy. In the USA, the “*word historic preservation*” refers to: “*preservation, conservation, rehabilitation, and reconstruction*” [73]
- *The Environmental factors:* Reusing industrial buildings is also a far environmental benefit to the society. According to Robert A. Young, reusing an infrastructure helps diminishing growth pressures in the peripheries, decreases the deficiency of natural resources (e.g.: raw materials, nonrenewable energy, etc.), cut short the flow of transformation of demolished building materials into landfills, protects open lands

against "green sprawls"[11], improve the quality of the atmosphere by decreasing the dependence on vehicles or automobiles, and also decreasing the air pollution. Our environment is composed of natural and built environments which are always interacting each other. So the exchange between the natural and built environment should be balanced, so that a sustainable environment in which elements carry the loads charged by other elements would be created [73]. This means that the waste generated by the built environment should be balanced, because the natural environment absorbs those waste generated by the built environment.

Thus, reusing an industrial infrastructure will reduce the waste generated by the demolition of the built environment, which would create a sustainable environment.

- *Economic factors:* In the urban development of societies, the economic factor is a very essential factor that drives more decision making in the built environment of our contemporary world. Many countries have recognized the importance of recycling or reusing existing built environment and mostly existing industries. And since the mid of 1960s, some industrialized countries like the USA have implemented financial incentives for reusing and preserving industries and built environments.

Reusing the built environment saves not only the energy used for demolishing buildings, the embodied energy used for building or replacing the built environment, but also the cost needed for demolition and rebuilding [73]. Even new built green buildings which are designed to consume less energy than the old buildings do not save energy directly until the energy used to construct it is overcome [73]. And according to The *Greenest Building: Quantifying Environmental Value of Building Reuse*,

> It takes between 10 and 80 years for a new energy-efficient building to overcome, through more efficient operations.

[11] The term green sprawl by Robert A. Young, refers to a growing process used in development planning to maintain large wild, or agricultural areas surrounding urban areas, and fosters alternative ways of transportation to decrease the number automobile miles traveled and air pollution, and their impacts on safety, and health in the society [73].

Since industrialization and de-industrialization have played important roles in history, influencing the development of societies; and also impacting the urban fabric and environment we are living in, this thesis fosters to give guiding lines into the development of the urban environment with an observation into the future of recycling industries as a sustainability strategy. There is not only one way of recycling in architecture, but all recycling are sustainable strategies.

This thesis aims to bring awareness of reusing industrial buildings as a strategy of developing the urban environment in cities.

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