

A Study on the Reuse Modes and Renovation Strategies of Contemporary Chinese Urban Industrial Buildings

Youfa Chen^{1*}, Jingdong Hu²

¹Shanghai Academy of Fine Arts, Shanghai University, Shanghai 200072, China

²Department of Architecture, Shanghai University, Shanghai 200072, China

*Corresponding author: Youfa Chen, a958438337@163.com

Copyright: © 2022 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: With the progress of urbanization in China, the pace of urban renewal is accelerating. Various factors have prompted the transformation of industrial buildings in the city. Following the transformation, old industrial buildings have shown a new look with diversification and modernization. This article briefly describes contemporary China. The background of industrial building renovation and the analysis of the redevelopment and utilization modes as well as renovation strategies in conjunction with case studies provide a summary and enlightenment for the renovation of industrial heritage buildings in the city.

Keywords: Industrial building; Reuse; Renovation strategy

Online publication: July 27, 2022

1. Introduction

In past decades, many industrial buildings have been built in cities to meet the needs of economic development and industries. As urban renewal accelerates with the progress of urbanization and with the upgrading and change of urban industrial structure, old industrial buildings in cities have ushered in functional transformations. Redeveloping and utilizing old industrial buildings are challenges to the city and its people, so it is particularly important to learn from past experiences for future reconstruction.

2. Background of reusing and transforming urban industrial buildings

Industrial architecture is an important branch of the architecture field and an important component of urban appearance. In terms of industrial construction and reform abroad, after centuries of development since the industrial revolution and the height of urbanization, leading to the design of industrial architecture and recycle development being ahead of China, and large industrial buildings are located within the city due to limited space, such as the UK industrial buildings along the Thames River, the importance of reuse is realized. Compared with foreign countries, the development and reuse of old industrial buildings in China are rising with the overall changes of economic society in recent decades, having made great achievements in a short period of time.

2.1. Exploring the value of old industrial buildings in cities

China's old industrial buildings in the past have always been regarded as incredibly significant functional

buildings. The first industrial production that emerges at the thought of such architecture is a mechanical, industrial landscape, which neglects artistic expression. Although existing studies have shown that the renovation of industrial buildings did not generate positive externalities to the property values in the vicinity ^[1], the development of modern architecture design concepts and people's aesthetic ideas under the background of diversification play important roles. People are beginning to re-examine the characteristics of old industrial buildings and extract the value contained in them, in order to make them functional once again. This change in concept and value discovery are important factors for redevelopment.

2.2. Orientation of urban renewal policies

Urban renewal is an inevitable process of urbanization. The specific task is to repair and update the elements of people's living environment to create a comfortable and livable environment. Therefore, urban renewal measures are important for cities with developed economy. In order to promote the implementation of these measures, national and local governments have issued relevant incentive policies for urban renewal. Taking Shanghai as an example, Shanghai Municipal Government introduced several measures for the implementation of urban renewal in 2015, putting forward specific requirements for urban renewal; on June 2, 2021, 80 billion urban renewal funds were established as investments for the renovation of old urban areas and urban renewal related projects. Old industrial buildings, as urban elements with superior historical, humanistic, social, and economic values, have garnered special attention in this process, and the guidance of urban renewal policies has played a crucial role in promoting it.

2.3. The rise of renovation wave and the incentive effect of typical cases

The successful cases of old industrial building reconstruction serve as an encouragement for other cities to also undertake the reconstruction of industrial buildings. In the wave of renovation of old industrial buildings, the emergence of a number of successful cases, such as Beijing's 798 Art Zone (**Figure 1**) and the renovation of the original Nanshi power plant as Shanghai Museum of Contemporary Art (**Figure 2**), have gained praise from the society and brought economic benefits ^[2]. These are certainly a shot in the arm for other cities.



Figure 1. Beijing's 798 Art Zone



Figure 2. Shanghai's Power Station of Art (PSA)

3. Characteristics of industrial buildings in cities

Industrial buildings in cities have unique characteristics due to their location in the urban environment and their own objective particularity. These characteristics are factors that architects consider in the reconstruction of buildings, which affect the direction of the overall reconstruction.

3.1. Urban attributes

The existence of a building is associated with geographical factors, such as climate, economy, and culture. It has obvious characteristics of old industrial buildings in the city because of the demand of the city, which is dense with city properties and reflects the characteristics of the times. Hence, the renovation of old industrial building actually reveals the city's industrial culture to the people ^[3].

3.2. Features

Industrial buildings have diverse forms and different features according to their functions. People can appreciate the characteristics of various forms of old industrial buildings in the city, such as steel structure with metal texture, frame structure with strong structure, concrete texture, and so on. The diversity of industrial buildings in the city gives rise to unique features, which stand out from their surroundings and have deep symbolic meanings. At the same time, the city's industrial architecture characteristics to some extent differ from those outside the city. In addition to its style and cultural characteristics, its construction quality and level are much higher than those of industrial buildings outside the city. Industrial beauty is added to strengthen their value, and the characteristics of the style are given more weight.

3.3. Characteristics of property ownership

The majority of industrial buildings in cities belong to collectives or state-owned enterprises, and their public and collective nature poses a guiding effect on future reconstruction. For example, publicly owned buildings may be inclined to the functional positioning of public service nature in the future, whereas private enterprises may be inclined to commercial or industrial types to obtain economic benefits. The characteristics of property ownership in the city also determine the diversity of industrial buildings following future transformation.

4. Redevelopment and utilization modes

In order to select the best redevelopment mode for old industrial buildings in cities, it is important to take into account public benefits, economic benefits, cultural effects, and urban environment factors in combination with the building locations and positioning requirements. Moreover, in the long-term reform of industrial architecture, people have also accumulated certain experience and developed several highly productive development modes. There are four main types including industry-oriented, public-oriented, commercial-oriented, and multivariate-mixed ^[4].

4.1. Industry-oriented

The main representative types of the industry-oriented category are creative industrial park, cultural industrial park, and other industrial parks with cultural, scientific, and technological creative industries as the main content, such as software development, video and audio media, design, and so on. Most of these industries are creative emerging industries that are vigorously supported and promoted by the State in recent years. The characteristics of science and technology are consistent with the inherent characteristics of old industrial buildings. At the same time, the spatial layout of industrial buildings is used to meet part of the demand for entrepreneurial office space. The development mode of this kind of industrial building transformation can meet the actual needs of a portion of the society while creating economic value for them.

4.2. Public-oriented

The public-oriented development mode is mainly characterized by public welfare. It does not pursue high economic feedback but emphasizes on the value of public service for the society. Most of such redevelopment modes appear in cities with strong economic strength and focus on improving the overall

public cultural level of the cities. Guided by the goal of public welfare, such as urban industrial parks and art museums, in order to supplement the life of citizens and improve their cultural literacy, transformation positioning has been introduced. The transformation of Shanghai Yangpu Riverside Industrial Rust Belt is a typical representative of the public-oriented category (**Figure 3**). In the 1990s, Yangpu Riverside Industrial Park was officially retired from use since many industrial buildings have been emptied following Shanghai government's long-term planning and transformation as well as the generation of public space and public buildings for replacing and reshaping the space. Yangpu Riverside was redeveloped from an abandoned industrial area into a world-class urban waterfront landscape belt, providing a high-quality living and leisure space for people in the city.

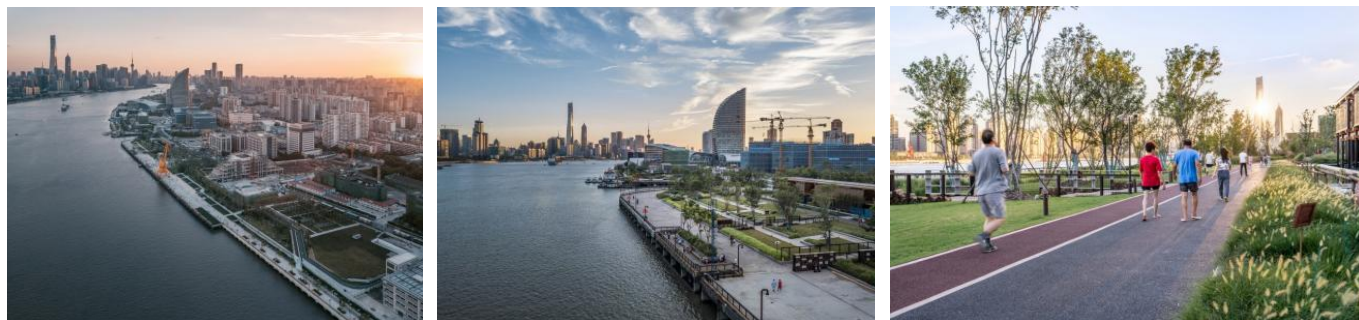


Figure 3. Shanghai Yangpu Riverside public space

4.3. Commercial-oriented

The commercial-oriented redevelopment mode aims at pursuing economic value, and the reconstructed industrial buildings tend to be recreated as urban creative business experience centers. From the basic conditions of industrial buildings, the old industrial building space form is suitable for a variety of commercial forms. The original construction of the large space and its ability to serve as a commercial storage facility make it possible to create a commercial block. Therefore, it is easy to convert old industrial buildings for commercial use. In creating a new commercial environment, they also meet the basic requirements of a commercial space. This mode supports commercial complex, consumption experience center, fitness and leisure entertainment, as well as other commercial contents. Industrial buildings can be meticulously polished to become recognizable commercial landmarks with specific characteristics in the city.

4.4. Multivariate-mixed

At present, the multivariate-mixed type is a popular industrial building redevelopment type, and it is also a redevelopment mode that takes into account all parties. Since the development of old industrial buildings is often not in a single direction, developers should consider various factors in the development in hope that they can maximize project benefits. The mixed mode arises at a historic moment, based on the redevelopment fusion of art experience, business, leisure landscape, and a series of forms, emphasizing on a full range of new experiences. Although the mixed mode to some extent represents a Utopian dream, there will be challenges in actual practice. For example, if it is too mixed, it will trend toward the business mode, thus losing the particularity of an industrial building. Shanghai International Fashion Center (**Figure 4**), located in Yangpu District, is a representative of the multivariate-mixed mode. It is a commercial center with six major functions, including creative office, fashion shows, and serviced apartments. It can be said that it does not lose its features while being multi-functional following renovation.



Figure 4. Shanghai International Fashion Center

5. Principles and strategies

5.1. Transformation principle

Both, urban renewal and the transformation of old industrial buildings will have a huge impact on the society. Hence, it is necessary to consider the positive and negative effects brought about by redevelopment. In order to achieve positive effects, it is imperative to follow certain principles and develop within a reasonable framework. For the transformation of industrial buildings, it can neither be unimaginative nor unchangeable. The key lies in the measurement of the scale, which is focused on re-protection or redevelopment.

5.1.1. “New but not ancient”: Respect the renewal of the original history, but not conservative

As can be seen, old industrial buildings themselves have strong personalities in terms of their own styles as well as the historical and cultural connotations. They have huge potential to look brand-new. Hence the ultimate purpose of modification is to activate vitality and convert them into unique places in the city. Implementing innovative strategies are necessary, but the premise is to fully understand the history of architecture in the past, rationally evaluate the value between the old and the new, extract and retain the parts worth preserving from the original history, as well as treat the parts to be transformed boldly and prudently. Therefore, the idea behind the redevelopment of old industrial buildings should be to strive for the new while also keeping in mind the old.

5.1.2. “Change without changing”: Seek innovation and change, but do not drift into the paradigm

In China, some developers focus on speed instead of quantity, which has led to the “thousand village side error” phenomenon in the past few decades. Although this kind of phenomenon is unusual in the field of industrial building, it is crucial to be alert of the effects of paradigmatic modification. Industrial buildings in cities have their own personalities, and change is an inevitable trend of the future. However, paradigm shifts deprive buildings of their personalities. Hence, it is necessary to prevent paradigmatic change and transformation because when innovation is simply repeated, the urban context of history will lose relevance and significance.

5.2. Specific transformation strategy

The regeneration of space, the reconstruction of image, and the integration of new technologies are the three concrete transformation strategies of contemporary old Chinese industrial buildings. Under each strategy, detailed methods and strategies are discussed.

5.2.1. Regenerating space

Space is the soul of architecture. It can be said that space reconstruction directly determines the internal quality of architecture. This is referring to the reconstruction of internal space. Prior to space reconstruction, the functions should be reasonably sorted out first, and the spatial functions should be cleverly allocated in

combination with the development mode. The spatial redesign should make an appropriate response to the changes in functions. In the spatial transformation of old industrial buildings, the diversity of the original space should be fully respected, and the particularity of the original space, such as the long-span space of industrial buildings, the original industrial manufacturing space, and other space types with industrial characteristics^[5], should be fully utilized, so as to “restore their memory” of the times. Therefore, retaining some original meaningful scenes in the reconstruction of industrial buildings and endowing them with new forms and meanings can be regarded as a feasible scheme for space reconstruction. The holiday inn Cangge (Figure 5) that Beijing Shougang workers wisely chose reflects that the design maximized the retention of original scrap and prepared the demolition of industrial buildings and space, structure, as well as the external morphological characteristics, after evaluating its formation in the decades to remove dirt while retaining the years trace and historical information, thus continuing the historical memory of Shougang Old Industrial Zone. Through the collision of new and old, as well as the interaction of function and form, the poetry and tension contained in the site can be presented, and the dialogue between the new and old space is fully displayed on the site.

In addition, the creation of a new space can form a contrast between the old and new space, inject vitality into the renovation of industrial buildings, and create highlights for the development of such projects. For example, web celebrity in contemporary architecture design space is a concept of modern architecture design. Its essence is to use novel and radical modern design methods, strengthen the sensory function of the space, and achieve the purpose of attracting people. However, it is necessary to have a cautious attitude so as to avoid breaking the links with the original space; otherwise, it will backfire.



Figure 5. Cangge – The design of Holiday Inn Express Beijing Shougang Silo-Pavilion

5.2.2 Reconstructing image

In the reconstruction of industrial buildings, reconstructing image covers everything seen in architecture, including architectural forms, materials, colors, and so on.

The architectural forms of many industrial buildings have rich strength and industrial aesthetics. The architectural strategy of contemporary urban industrial buildings generally presents a reinforcing industrial amalgamation of form and urban landscape. It is the pursuit of industrial character and the interface integration of modern cities, inspiring architects’ desire for morphological operations. Taking the IOMA Art Center (Figure 6) designed by Architecture Studio as an example, a wavy metal glass curtain wall was boldly designed along the street facade of the factory building. It defied the restriction of industrial architectural form, broke through the stiffness in the original form, and established a new language for communication with the city.



Figure 6. IOMA Art Center

The use of materials emphasizes the symbiosis of old and new, blending in opposition. The use of materials is a way to reflect the aesthetic sense of the form. For example, steel itself exudes beauty. Different building materials have different features; stone expresses dignity, wood expresses warmth, glass expresses brightness, and metal conveys resoluteness [6]. Industrial buildings exude a strong sense of industry and machinery, which is impersonal to a certain extent. Therefore, in the process of transformation, the sensible use of materials can transform the character of the building, so as to achieve a refreshing effect. The aesthetic expression of the material form in the transformation of industrial buildings is embodied in the contrast and fusion of old and new materials. Novel and modern materials are used to highlight the barbarity of the original steel structure of industrial buildings without modification and at the same time ensure the harmonious effect of heterogeneous integration. The transformation of Shanghai Baoshan Exhibition Center, a renewable energy center, is a typical case where contrast materials are used (**Figure 7**). The original body is the first steel plant of Baosteel's Shanghai site project and is only in the land of several original steel structure buildings. Lightweight methods were used in designing the framework of the original structure, transforming it into a completely independent polycarbonate material shell. The goal is to preserve the original architectural framework while maximizing the effect of contrast. The plan not only addresses various technical issues, such as waterproofing by incorporating semi-transparent polycarbonate material and maintaining the dust removal pipelines, propylaea support, corrosion of the adhesive tape machine, and a complementary heavy industry image, but also explains how material contrast highlights the aesthetic feelings of industrial buildings.



Figure 7. Baoshan Exhibition Center

The original colors in industrial buildings reflect the qualities of the industrial age of the city; for instance, the brick red color of bricks and tiles, and the gray-green color of steel structure. Modern architects pay more attention to the use of bright colors when considering the use of colors in the transformation of old industrial buildings, so as to eliminate dull industrial colors and form a strong sense of visual impact.

5.2.3 Incorporating new technologies

New technologies here refer to avant-garde architectural technologies in modern architectural design, such as green building technology, digital architectural design technology, and other technologies. These architectural technologies are different from the traditional construction technology. They are forward-looking and have a certain degree of experimental element, greatly expanding the idea of the transformation of old industrial buildings. The field of contemporary Chinese architectural renovation is comparable to a huge experimental field. The renovation of old industrial buildings in cities creates experimental opportunities for the application of new technologies, in which the two complement each other. Taking green technology as an example, the integration of green technology in the transformation can reduce the energy loss of the building, while also improving the comfort of the building. In addition, the integration of technology will affect the modeling of the building to a certain extent, such as the size of windows and the form of skylights. The Shanghai University Yanchang campus-factory renovation (**Figure 8**) is a case where art and technology are combined. Through the innovation in the design of the roof, the indoor lighting effects from the electric sunroof have been adjusted. The indoor cross-bars technical measures have been established^[7], such as the cold and hot air cushion, which regulates the indoor climate and at the same time increases the richness of the interior space. The integration of new technological concepts is not only economic but also aesthetic for architecture.

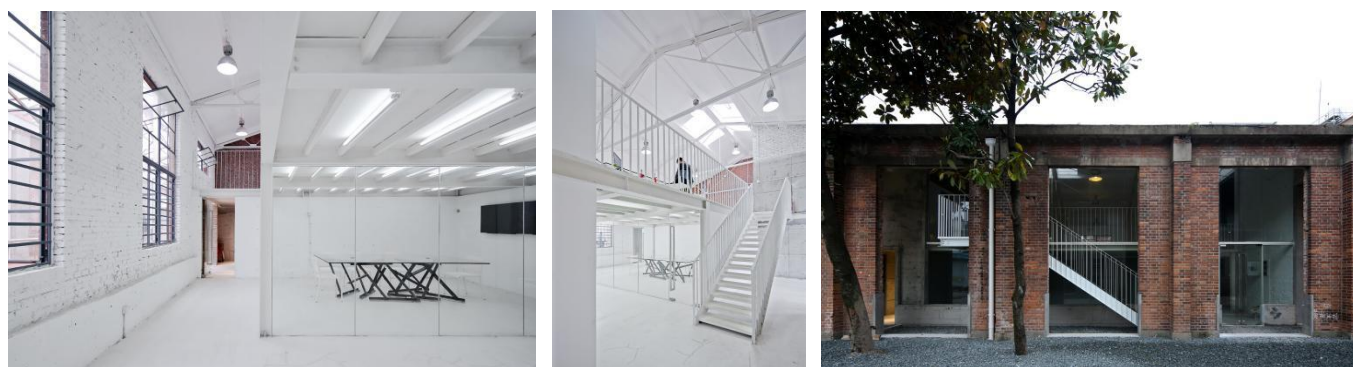


Figure 8. Shanghai University Yanchang campus-factory renovation

6. Retrospect and prospect

Industrial architecture, represented by the city's industrial culture, is an important part of the city spirit. The transformation of old industrial buildings to conform to urban development has promoted the prosperity of urban culture. It is necessary to learn from experience, innovate, and expand the path of urban development of old industrial buildings, while treating rationality, development, and scientific argumentation, as well as putting an end to paradigmatic development modes. In order to provide each old industrial building that is transformed a distinct identity and to establish strategies, let the transformation of old industrial buildings take place naturally in the city.

The reconstruction of industrial buildings is an important aspect in the path of urban renewal. At the same time, the classification attribute^[8] and technical support^[9] of industrial heritage transformation should be considered. Studying and summarizing the redevelopment modes and reconstruction strategies of old industrial buildings are not only beneficial to the development of industrial buildings in the future,

but also provide reference for other aspects of urban renewal.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Mesthrige JW, Wong JKW, Yuk LN, 2018, Conversion or Redevelopment? Effects of Revitalization of Old Industrial Buildings on Property Values. *Habitat International*, 73: 53–64. <https://doi.org/10.1016/j.habitatint.2017.12.005>
- [2] Li W, 2022, Research on Reconstruction and Reuse of Old Factory Buildings Under the Background of Urban Renewal. *Housing*, 2020(22): 1–2 + 38.
- [3] Zhu X, 2019, Green Civil Transformation and Utilization of Industrial Buildings in Urban Renewal. *Urban Housing*, 26(11): 84–86.
- [4] Li J, 2020, Research on Transformation Strategy of Urban Industrial Building Heritage. *Architecture and Culture*, 2020(07): 88–89.
- [5] Li B, 2009, The Investigation on Protective Reuse Mode of Urban – Industry Architectural Heritage. *Industrial Construction*, 39(S1): 4–6.
- [6] Luo R, 2006, Aesthetic Performance of Steel Structure Buildings – On the Technical Beauty of Architecture. *Development Guide to Building Materials*, 2006(01): 66–69.
- [7] Zhou Y, Wang H, Mo H, 2019, Activation Urban Inefficient Space Through Creativity-Transformation Design of 246 Vision Studio in Yanchang Campus of Shanghai University. *Housing Science*, 39(11): 64–69 + 87.
- [8] Airas A, Hall PV, Stern P, 2015, Asserting Historical “Distinctiveness” in Industrial Waterfront Transformation. *Cities*, 44: 86–93. <https://doi.org/10.1016/j.cities.2015.02.002>
- [9] Blagojevic MR, Tufegdžic A, 2016, The New Technology Era Requirements and Sustainable Approach to Industrial Heritage Renewal. *Energy & Buildings*, 115: 148–153. <https://doi.org/10.1016/j.enbuild.2015.07.062>

Publisher’s note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.