

Research on the Protection of Modern and Contemporary Urban Industrial Architecture Heritage in Shanxi

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ABSTRACT

Shanxi's modern industrial development has gone through a long period of time, and the industrial architectural heritage resources are rich and of high value. However, due to the acceleration of the urban development process, the industrial architectural heritage has not been protected and utilized in a timely and reasonable manner, and the historical information of the urban industrial civilization construction has gradually been forgotten. By sorting out the process of industrial heritage protection and development in China and foreign countries, and analyzing the status and heritage value of Shanxi's modern industrial architectural heritage, this paper proposes multiple model cases for the protection and renewal of the industrial heritage of modern cities in Shanxi under the guidance of the idea of the "symbiosis of the old and the new", and strives to provide ideas for the protection of the industrial heritage of modern cities in Shanxi.

Keywords: *Industrial architectural heritage, Heritage value, Protection and renewal, "Symbiosis of the old and the new".*

1. INTRODUCTION: OVERVIEW OF THE DEVELOPMENT OF INDUSTRIAL ARCHITECTURAL HERITAGE

Industrial architectural heritage is a new type of subject left by the Industrial Revolution to human history. As the progress of the times continues to accelerate, the industrial revolution is constantly banned by the new information technology revolution, and the buildings, workshops, and equipment left over from the industrial production period have become "relics" of the special era. In particular, urban industrial architecture also occupies an important position in the composition of urban space and the context of urban development. It can be said that industrial architectural heritage is a "derivative product" of the industrial revolution, which is not only a

witness to urban development, but also a carrier of urban memory. As stated in the Nizhny Tagil Charter: Industrial heritage is the remains of industrial civilization with historical, social, architectural or scientific value.¹

The protection of industrial heritage originated from the British archaeology in the early 19th century, the earliest "industrial archaeology". The discipline emphasizes the recording and protection of industrial relics and relics during the industrial revolution and the great industrial development period. This is the initial exploration of the protection of industrial heritage by mankind. In the

1. The International Federation for the Protection of Industrial Heritage passed the "Nizhny Tagil Charter" on July 10-17, 2003 in Nizhny Tagil, Russia. The International Federation for the Conservation of Industrial Heritage (TICCIH) is a world organization for the protection of industrial heritage and a specialized advisory body for the International Council of Monuments and Sites (ICOMOS) on the protection of industrial heritage. The charter was drafted by TICCIH and will be submitted to ICOMOS for approval and finally approved by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

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1970s, with the establishment of the International Industrial Heritage Protection Committee (TICCIH), promoting the protection of industrial heritage has gradually become a topic of common concern in the world academia. In 2000, the International Council of Monuments and Sites and the International Industrial Heritage Protection Committee signed a partnership agreement in London, determined to work together to protect the industrial heritage. It is also from this moment that under their promotion, UNESCO has organized a series of scientific seminars on the protection of industrial heritage to promote industrial heritage to occupy a place in the "World Heritage List." In July 2003, at the International Industrial Heritage Protection Committee meeting held in Nizhny Tagil, Russia, the "Nizhny Tagil Charter" for the protection of industrial heritage was passed, and it was proposed that "for the future use and benefit, in the spirit of the 'Venice Charter', we should conduct research on industrial heritage, impart its historical knowledge, explore its significance and make it clear to the world, and identify, preserve and maintain the most significant and characteristic examples". Since then, the theme of "International Day of Monuments and Sites" in 2006 has also been positioned as "Protection of Industrial Heritage".

The most direct manifestation of the reuse of industrial heritage is the reuse of industrial buildings. The Birkenhead Park built in 1943 in the United Kingdom was an exploration of the protection of industrial heritage, especially the initial practice of the transformation of industrial building heritage, which had a positive impact on the image of the city at that time. In the 1970s, as the industrial structure moved towards the tertiary industry, the functional structure of the city had undergone great changes. Industrial archaeology is widely spread in Western capitalist countries, and the transformation and utilization of old industrial buildings have raised a new level. In 1974, the Rowell Heritage State Park was successfully renovated. A large number of industrial buildings and sites that lost production functions were transformed and reused. The renovation of the Rowell Textile Mill is a successful example of the period, and the rational transformation and optimization of the functional design has become its main demand for rejuvenation. In the new design, its function is transformed into an architectural complex, including houses dedicated to the elderly and low-income groups, nursery schools dedicated to surrounding communities,

reception centers, restaurants, administrative offices, and museums for economic considerations. The original factory square was transformed into a central courtyard for activities and exchanges, and the factory area realized a leap from "waste" to "prosperity". From the late 1980s to the 1990s, the transformation of industrial architectural heritage entered a relatively mature stage, and the types of transformation also developed diversified. The scope of transformation was expanded from single buildings to industrial plant areas and blocks, and heritage assessment and theoretical research also tended to perfect. Many excellent renovation design cases have emerged: such as the Citroen Park in Paris, France, the Landscape Park of North Eastbourg in Ruhr, Germany, and the renovation of the Seattle Gasworks Park in the United States.

However, China's attention to industrial heritage is mainly from the second half of the 19th century to the birth of modern industry, and then to modern times, which has passed a long time span. It can be said that China's national industry since the Westernization Movement, foreign capital industry during the semi-feudal and semi-colonial period, and modern industry since the founding of the People's Republic of China have jointly established the development process of China's industry, and their distinctive industrial remains constitute the main body of industrial heritage in China. However, it does not rule out the pre-industrial period, the embryonic period of the industry, or earlier industrial remains. Compared with European and American countries, the time of China's industrial revolution is about half a century late. Therefore, the practice and theoretical exploration of the renewal and reuse of old industrial buildings has entered the initial stage from the 1990s to the beginning of the 21st century. Especially with the continuous deepening of reform and opening up, the adjustment of the national industrial structure, the gradual loss of vitality of heavy industry enterprises, a large number of idle factories have appeared in cities, and the country has begun to transform and utilize industrial sites, parks, factories and other buildings and environments. Many designers have also set their sights on the regeneration of industrial heritage in the city. In 2006, the first China Industrial Heritage Protection Forum was held in Wuxi, China. Representatives and experts from relevant cities and cultural heritage departments unanimously adopted the "Wuxi Recommendations" that "pay attention to the protection of industrial heritage during the period of rapid economic development". It marked the

beginning of the protection of China's industrial architectural heritage, and it also issued a call to all sectors of society. Industrial heritage is an important part of the entire human cultural heritage and should be properly protected in the accelerated process of urbanization. In November 2010, the Industrial Architectural Heritage Academic Committee of the Architectural Society of China was established in Beijing. It is the first academic organization on the protection of industrial heritage in China. It has promoted the protection and renewal of China's industrial heritage, and a number of outstanding examples of heritage transformation have also emerged.

For example, the Beijing 798 Artist Factory, whose predecessor was the 718 electronic factory built with the aid of the former GDR, has Bauhaus modern design style from architectural design to structural function and detailed decoration. After 2000, with the decline of the economic benefits of the company, the original industries in the factory moved out one after another. A large number of artists focused their attention on this and began to transform and utilize them, innovating from an artistic perspective combined with the current situation of the site, and designing an art exhibition space with a strong artistic atmosphere and an artistic creation paradise, forming a "SOHO-style art settlement" spatial form. While respecting and protecting the original style of the factory, each independent artist's studio or gallery innovated with industrial architectural elements as the design origin, injecting new vitality into the park. Now, 798 Art Park has become an excellent case of Chinese industrial heritage transformation, and it also provides a new urban space integrating leisure, sightseeing and art appreciation for urban residents and foreign tourists. At the same time, there are also the Shanghai Cultural and Creative Center "No. 8 Bridge", formerly the workshop of Shanghai Automobile Brake Factory, Beijing Ocean Art Center, formerly known as the spinning workshop of Beijing Cotton No. 3 Factory; Kunming "Chuangku" Art Center, formerly known as the machine mold factory workshop; Changchun No. 1 Automobile Manufacturing Plant Community Activity Center, formerly known as the old factory building; Qishan Park Industrial Reuse Project, formerly known as a shipyard, etc. As nearly 20 years have passed, the first batch of industrial heritage renovation projects in China have been launched, and they have produced good social benefits, effectively preserving the historical information of urban development, and giving new

vitality to the originally abandoned industrial heritage.

2. THE INDUSTRIAL DEVELOPMENT OF SHANXI'S MODERN AND MODERN CITIES AND THE STATUS QUO OF ITS ARCHITECTURAL HERITAGE

Since modern times, Shanxi has always focused on industrial development. The Westernization Movement initiated the industrial revolution in modern China, and it was also the beginning of the modern industrial revolution in Shanxi. According to historical records, "Hou Budao and Xu Guifen were appointed as the general office of the Taiyuan Machinery Bureau, with 4.8 million taels from the bank and 50,000 taels from the rectification of Guihua (now Hohhot) customs of the previous year to purchase 38 mu of waste land in the Thousand Buddha Temple (now the site of the 247 factory) in the Cypress Garden, outside the north gate of Taiyuan City, as the address for the establishment of the Taiyuan Machinery Bureau. The project was started in May, with two new western-style structural workshops and one office building, totaling 22 rooms. The real hall of the Thousand Buddha Temple was also used as a dining hall and an auditorium [1].²" Since then, Taiyuan Machinery Bureau has developed. In the following decades, government-run enterprises and private enterprises in Shanxi developed simultaneously, laying a strong foundation for the industrial development of Shanxi. Modern and modern government-run enterprises established during this period include: Taiyuan Match Bureau (1892),³ Taiyuan Machinery Bureau (1898), Shanxi Tong Province Craft Bureau (1898), Taiyuan Printing Bureau (1906), Jiangzhou Textile Factory (1907) etc.; Private enterprises include Shanxi Pinglu Mining Company (1906), Baojin Company (1907), Taiyuan Electric Light Company (1908), Yucheng Yong Iron Factory (1910), Fangshun Iron Factory (1910), Zhenyuan Iron factory (1912) etc. During this period, investment was concentrated in the construction of heavy industrial factories such as coal, textiles, and iron industries. Most of the factories were transformed by temples and private houses. The construction technology was relatively

2. Shanxi Chronicle of History, The Commercial Press, 1999, p724.

3. In 1892, it was the time for the establishment of Taiyuan Match Bureau. The time in parentheses is the time when the enterprise factory was created.

simple, and the majority of them were brick-wood structures. There are few existing buildings, and there is no special difference between the architectural style of the factory buildings and the residential buildings.

The 1911 Revolution had broken out, and the country was severely divided. In order to consolidate their power, local warlords concentrated their efforts to set up military industrial enterprises. Shanxi at this time has entered the period of the Yan Xishan warlord's rule. In nearly 40 years, a large number of military industrial enterprises in Shanxi have developed rapidly. Government-run enterprises such as: Yucai Iron and Steel Factory (1924), Yucai Machinery Factory (1924), Shanxi Gunpowder Factory (1926), Taiyuan Arms Factory (1927), etc., focus on serving the military, providing materials and machines for munitions and weapons. The scale was ahead of other regions in the country at that time; Private enterprises include: Jinhua Company (1911), Daixian Baoyuan Gold Mine Company

(1913), Jincheng Nancun Coal Mine (1914), Pingyao Jinjing Match Company (1916), Yuci Jinhua Textile Factory (1919)) ("Figure 1"), Xinjiang County Dayi Textile Factory (1922), etc. Most of these enterprises came from the remains of government-run enterprises of the Qing Dynasty and were reorganized and expanded, which became the basic guarantee for the construction and rapid expansion of the Northwest Industrial Company in 1933. During this period, the scale of construction workshops has been expanded several times compared with the end of Qing Dynasty, and the construction space has also been greatly developed. New concrete structures have been introduced. The architectural form has changed from traditional Chinese forms to a combination of Chinese and Western forms. A small number of existing office buildings, factories, and functional buildings have been reorganized and reconstructed by modern enterprise factories. Until the full outbreak of the Anti-Japanese War in 1937, Chinese industrial development entered a state of stagnation and gradually declined.



Figure 1 Jinhua Textile Factory (Image source: Internet).



Figure 2 Northwest Industrial Company in 1933 (Image source: Internet).

After the founding of New China, national construction gradually recovered and entered a stage of comprehensive development. As the first batch of industrial construction provinces, Shanxi carried out large-scale urban and industrial construction. The Northwest Industrial Company ("Figure 2") built during the Yan Xishan period became an important foundation for Shanxi's industrial construction in the early days of the founding of New China. Most of the industrial buildings were remodeled and updated, and some buildings and structures are still preserved, such as the chimney of Taiyuan Electric Light Company and Taiyuan Iron and Steel Co. Diaolou, water tower of Jin'an Chemical Plant, etc.

In addition, during the national "First Five-Year Plan" and "Second Five-Year Plan" period, many

large industrial enterprises were built in Shanxi Province. Taking Taiyuan City as an example, 28 enterprises including Taiyuan Chemical Plant and Taiyuan Fertilizer Plant have successively entered production and development. By 1961, the three industrial zones in the north of Taiyuan city, northwest of Fenhe, central and southern parts of Taiyuan had begun to take shape. During this period, the scale of the factory was large, the functions of the buildings in the factory were clearly differentiated, and the architectural features were distinctive. At present, these factory areas retain industrial buildings and structures such as factories, warehouses, chimneys, and workers' houses, which fully reproduce the historical features of large and medium-sized industrial and mining enterprises in the 1950s and 1960s. (See "Table 1")

Table 1. List of industrial architecture heritage in Taiyuan City

Name of building/construction	Location	Original function	Construction time
Chimney of Taiyuan Electric Light Company	No. 12, Nanxiao Wall, Xinghualing District	Industrial building	1933
Taizhong No. 1 Metal Worker, No. 2 Metal Factory Building	Yuhe Street, Wanbolin District	Industrial building	Around 1950
Administrative Office Building of Jinxi Machinery Industry Group	Heping North Road, Wanbolin District	Industrial building	1955
Staff dormitory of Jinxi Machinery Industry Group (Former Yan Xishan Garrison 8th Building)	Heping North Road, Wanbolin District	Residential building	Republic of China
Fenxi Heavy Industry Office Building 5	Heping North Road, Wanbolin District	Industrial building	1955
Workshops and warehouses of the second factory of Taiyuan Flour Mill (13 locations)	Xiaodongmen Street, Xinghualin District	Industrial building	1960-1980
Jin'an Chemical Plant Water Tower	Jin'an East Street, Dunhuafang, Xinghualing District	Industrial building	1930s
Taigang No. 2 blast furnace	Jiancaoping District No. 2	Industrial building	1930s
Taigang Hangar (4 buildings), watchtower	Jiancaoping District No. 2	Military installation	1930s

a Source: Taiyuan City Master Plan 2008-2020 "Taiyuan City Cultural Relics and Architecture List"

Shanxi's modern industry has experienced more than one hundred years of development and has a complete historical development context. Taking Taiyuan City as an example, these industrial buildings have played an important role in local construction and social development. Although many industrial buildings have lost their original functions so far and have gradually become "relics" of the times, they record the process of urban development. Their values are consistent with the past, present and future, and cannot be ignored.

3. THE CHARACTERISTICS AND VALUE EVALUATION OF INDUSTRIAL ARCHITECTURE HERITAGE IN SHANXI MODERN AND MODERN CITIES (TAKING TAIYUAN CITY AS AN EXAMPLE)

Shanxi's modern urban industrial buildings are constantly formed under the drive of modern industrial development, and their architectural features reflect different characteristics of the times. First, buildings during the Westernization Movement in the late Qing Dynasty mostly showed the characteristics of traditional Chinese architecture, but only adapted to the needs of industrial development in terms of architectural functions. The architectural layout, structure, and detailed decoration were mostly traditional architectural features. For example, Taiyuan Match Bureau, the overall architectural layout is a traditional courtyard style, using hard mountain brick and wood structure, showing the form of traditional Chinese architecture. Second, during the warlord's rule, Shanxi's modern industry developed rapidly and introduced new Western construction technology.

However, the architectural style is not completely Westernized, but presents a style trend of "combination of Chinese and Western", and the detailed decoration is mostly an organic combination of local traditional architectural decoration and the interest of Western styles. For example, in the entrance of Jinxi Machinery Industry Group, traditional Chinese red is used as the decoration of western pillar construction. Applying color to building materials to achieve the decoration of the building is an important feature of Chinese architectural decoration techniques. Third, during the "First Five-Year Plan" and "Second Five-Year Plan" construction period of New China, the "Imitated Soviet-style" architectural style was popular, with strong characteristics of the times. During the "First Five-Year Plan" period, Taiyuan used the Soviet planning model to prepare urban planning for the city. While industrial buildings met the requirements of the production process, they paid attention to the processing of architectural details, such as the application of voucher-shaped window cabinets in the building facade and the segmentation treatment of buildings, etc.⁴ having the style and characteristics of Soviet architecture [2]. For example, the gate of the Taiyuan Pharmaceutical Factory is located in the middle of the entrance and has a large volume. The main structure is composed of four pillars, which is higher than the symmetrically arranged buildings on both sides, and the overall shape is solemn and solemn, which is a more complete expression of the Soviet-style architectural style. Combining the different stages of Shanxi's modern industrial development, sorting out the historical characteristics of Shanxi's industrial architectural heritage in different periods is of great significance for fully understanding Shanxi's industrial architectural heritage and fully understanding the development and changes of modern Chinese industrial architecture. These industrial architectural heritage is a true portrayal of society in a specific historical period, which has special emotional value for local residents and is an important symbol for reorganizing "urban memory".

It can be seen from the conditions for the recognition of heritage by international organizations that heritage value assessment is an important basis and prerequisite for understanding and grasping the value of heritage, determining the

object and content of heritage protection, and formulating heritage protection methods and measures. Taking the remains of industrial buildings in Taiyuan as an example, with reference to domestic and foreign cultural relic evaluation norms and related research on industrial heritage value evaluation, the analysis is carried out from five aspects: historical value, scientific and technological value, economic value, social cultural value, and artistic value.

3.1 Historical Value

Taiyuan's industrial development spans a long course of nearly two centuries. It is an important part of Taiyuan's modern urban history. It provides an important basis for conveying urban historical information and interpreting historical events, especially for the study of the origin and development process of industrial activities. During the "First Five-Year Plan" period, Taiyuan City successively established 156 key industrial projects. The era of industrial machinery production kicked off. These industrial production buildings and workshops have witnessed the strong decisions made by the country in the early days of the founding of the People's Republic of China to improve its national strength and solve the problems of people's lives, and laid the foundation for China's industry. Among them, steel mills and textile mills are the most typical architectural forms with large scale and structural design. The overall design of this kind of factory buildings is solemn and simple in style, which powerfully presents the traces of the years of industrial workers' hard-hearted struggle and witnesses their great contributions to the realization of industrial development goals. These all reflect the important historical value of industrial heritage.

3.2 Scientific and Technological Value

Architecture represents the advanced level of construction technology in different periods, and also represents a higher level of multiple scientific achievements in a country/region, such as building structure, building materials, and building technology. Therefore, the industrial architectural heritage is of great significance to the study of architectural technology and the development of architectural science. For example, Taiyuan Heavy Machinery Factory, as the first heavy machinery factory in China, used the advanced pre-stressed

4. Xie Kun, Cui Lingling, A Preliminary Study of Taiyuan Industrial Buildings during the "First Five-Year Plan" [J]. Beijing Planning Review, 2011 (1): 59-61.

concrete structure in its first and second metalworking buildings at the time, and used two-way steel truss to form a span roof truss and form a large-span spatial structure system, which was an outstanding representative of industrial construction technology in the early days of the founding of the People's Republic of China, and embodies the scientific and technological value of the industrial architectural heritage.

3.3 Economic Value

Renewal and reuse of industrial architectural heritage is a direct means to save construction costs, avoid waste of resources, and reduce environmental burdens. Moreover, industrial buildings usually have the advantages of large span, high storeys, sturdy structure, flexible use of internal space, etc., which can be shortened to the greatest extent of construction period. The implementation of many industrial building heritage renovation projects in China and foreign countries has also fully confirmed this fact. For example, the Taiyuan Fertilizer Factory site maintains a complete industrial production space pattern and industrial process conditions. It is an important selection area with the most practical value and long-term significance for the development of industrial heritage parks and the development of industrial art exhibitions. It can be put into use quickly with only a little modification and renewal in the design and transformation, saving construction costs and creating more economic benefits.

Socio-cultural Value Industrial activities have created huge material and spiritual wealth for the human society. As the material carrier of the memories of industrial workers, industrial heritage has a social impact that cannot be ignored [3]. It is the foundation of social identity and belonging. Industrial heritage has witnessed the true process of the development and growth of factories and enterprises, and also witnessed the years of cooperation and struggle by workers' groups. It is the birthplace of enterprise spirit and corporate culture, an important part of regional social culture, and a recorder of regional historical and cultural information. Therefore, the protection of industrial heritage is a respect for historical integrity and human creativity, as well as the protection of regional social and cultural values. For example, the Soviet expert building of the Taiyuan Heavy Machinery Factory built in the 1950s was used exclusively by the Soviet expert team to assist

Taiyuan's construction at the beginning. Now it is used by the factory's employees. These Soviet-style residential buildings are currently the best-preserved Soviet-style residential buildings in Taiyuan. The Soviet-style residential building is a testimony to the friendly exchanges between China and the Soviet Union in the early days of the founding of the People's Republic of China. It is an important place for recording Taizhong Machinery Factory to promote the industrialization of the motherland, and it is also an important part of Taiyuan's industrial society and culture.

Artistic Value Architectural design is the common result of architectural structure and architectural aesthetics. It embodies the genre, characteristics and style of the architectural art development in a certain period. While industrial buildings meet the architectural functions, they also show the artistic appeal and aesthetic value contained in the industrial construction, mechanical facilities and engineering environment. For example, there are buildings in each factory area in good condition. As small but highly iconic landscape elements, they constitute the interval symbols of the memory of the urban industrial revolution and are an important "rest" that constitutes the urban industrial landscape display area. The existing industrial heritage of Taiyuan City contains numerous tracks, water towers, chimneys, transmission belts, pipes, Soviet-style building gates and other structures, which can be beautified and reused through artistic means, and rationally optimized and utilized through artistic design decoration methods. They can show the public the unique aesthetics of Taiyuan in different periods of the development of urban industrial civilization, and they can also become an important choice for highlighting the urban artistic characteristics of Taiyuan.

4. ANALYSIS ON THE "SYMBIOSIS OF THE NEW AND THE OLD" DESIGN MODEL FOR THE PROTECTION AND RENEWAL OF THE INDUSTRIAL BUILDING HERITAGE IN MODERN AND CONTEMPORARY CITIES IN SHANXI

The exploration of the protection and renewal mode of Shanxi's modern urban industrial architectural heritage is proposed after resource

research and value analysis. Different design specifications are given to different characteristics and attributes of different architectural heritages, so as to maximize the city's characteristics. The "symbiosis of the new and the old" design model is based on the "symbiosis of heterogeneous culture", "symbiosis of human and technology", "symbiosis of the internal and the external", and "symbiosis of human and nature" proposed by the famous architect Kisho Kurokawa in "Symbiosis Thought". The development of "Symbiosis Thought" is the process of gradually applying philosophical thought to urban planning and architectural design. In the process of protection and renewal of industrial architectural heritage, the "symbiosis of the new and the old" model is an important choice to achieve a balance between tradition and modernity. Among the contradictory components, the use of design means to insert the "third space", that is, the intermediary space[4]. Of course, the space here is not necessarily a space with actual functions, it can also be interspersed with elements or symbols, or even non-material. Therefore, under the guidance of the "symbiosis of the new and the old" design model, this article proposes the following ideas as the primary selection plan for the protection and renewal of Shanxi's industrial architectural heritage.

4.1 Expo Center Model

The Expo Center model is to transform the area of the industrial architectural heritage gathering area into a museum to showcase some unique industrial facilities and craft production processes, to show the sense of history and authenticity of the industrial heritage, and to stimulate the public's sense of participation and sense of identity. In addition, it can also be transformed into an art creation workshop, and some art works exhibition activities can be carried out in the form of a stylized art workshop. It is more convenient and vivid to display old objects in museums transformed by such industrial buildings than in traditional museums, and the environment and atmosphere across time and space presented by the exhibition will be more expressive. Combining the advantages of industrial heritage buildings with large spans, heights, open spaces, and flexible changes, the Expo Center model can not only retain the industrial history represented by the industrial heritage, but also make full use of the industrial architectural heritage to realize the "heterogeneous symbiosis" between industrial culture and modern exhibition culture.

Taking the Taiyuan Transformer Factory as an example, in the early 1960s, it was constructed in accordance with the drawings designed by Soviet experts. The construction technology is exquisite and the structure is excellent. After more than half a century of development, although the original factory has declined, but the architectural heritage structure is complete and the building quality is good. There are 1 existing large auditorium and 2 large-span factories, which can meet the architectural space requirements of the expo model. At the same time, it is located in the west extension of Changfeng Street, Taiyuan City, with good location advantages and convenient transportation. If it is rationally planned and designed and transformed into a museum showing Taiyuan's industrial civilization, and the functional design of the old building is completely renovated, it can show a strong artistic tension, optimize resources, save construction costs, and create more value during the transition period of urban construction.

4.2 Creative Industry Park Model

The creative industry park model is a development model that transforms industrial heritage sites into modern creative industry bases with original space as the main form through industrial renewal and business adjustments. In this model, factory buildings and industrial facilities are almost completely preserved without changing the spatial structure of the original industrial heritage, but the internal space is rationally adjusted in the division of functional areas and transform it into a space suitable for office, creation, and design that meets the practical needs of the current stage. Through this conversion of functions, the industrial system of the industrial heritage site is reconstructed to meet the needs of new modern service industries and creative industries. This development model is also the most widely adopted choice in the past practice of architectural heritage transformation. Among them, Beijing 798 Factory is a creative park formed by artists' spontaneous design and transformation. Each art space in the park is independently designed by artists, forming independent art studios. Artists carry out artistic creation activities in independent spaces, and organize event exchanges and artistic interactions in public and open spaces. With the help of privacy and openness, artistic creation has become more active and effective.

At present, Taiyuan Dazhong Machinery Factory has stopped production for many years.

There are some workshops and office buildings in the 1950s in the factory area. The original planned structure of the factory area is strict, the architectural style is obvious, the surrounding environment is complete, and it has great protection and utilization value. For example, Jinhua 1918 Creative Industry Park ("Figure 3") is a secondary design based on the original abandoned Jinhua

Textile Factory. The construction of the creative industry park can be completed quickly, and it can be formed to meet the creation, exhibition and exchange of local art workers. In the future, it will gradually develop into an important artistic innovation base in Shanxi Province and realize the symbiotic development of industrial architectural heritage and new industrial models.



Figure 3 Jinhua 1918 Creative Industry Park (image source: Internet).

4.3 Urban Open Space Model

The urban open space model refers to the construction of industrial landscape parks or open public spaces that can be used for leisure and entertainment of citizens on industrial sites with high protection value through innovative transformation. It is conducive to improving the urban environment and optimizing the configuration of urban functions. It is a development model that combines industrial heritage, natural environment and human settlements.

the park can be transformed into landscape sculptures in the park after artistic treatment ("Figure 4"), highlighting the spirit of Taihua (Taiyuan Chemical Fertilizer Factory) and awakening the memory of the past struggles of Taihua Industrial Park. At the same time, Taihua Park is adjacent to Jinyang Lake in Taiyuan City and has a unique location advantage. Joint district planning can form the joint development of industrial heritage parks and urban wetland parks, optimize the urban landscape, and beautify the urban environment.

The industrial site was once called the ugly "steel forest" and was regarded as a scar in the process of urban development. Moreover, the abandoned industrial building sites often experience various "diseases", among which is the damage of plants to the building. The urban open space model can turn this disadvantage into a construction advantage. Taking Taiyuan Chemical Fertilizer Factory as an example, the original green area in the factory area is large and maintained in good condition, which provides the most valuable "green resources" for the construction of urban public leisure places. The original production facilities in



Figure 4 Iron and Steel Art of Taiyuan Fertilizer Plant (image source: Internet).

4.4 Diverse Coexistence Development Model

The diverse coexistence development model is to transform the industrial building heritage into a building group development model that integrates commercial, residential, administrative and entertainment functions. This is the most comprehensive, detailed, and thorough development model for the protection and renewal of industrial architectural heritage, and it is also a model with ultra-high requirements for construction technology. It is an idea that architects have continuously explored for the transformation of industrial heritage for many years. It is of great significance for coordinating the unbalanced urban construction, the uneven urban landscape, and the unreasonable urban planning [5].

Taking Taiyuan City as an example, modern industry has gradually developed along the Fen River. The industrial architectural heritage is densely distributed along the north-southwest line of the Fen River. The functions and nature of the buildings are also diverse and complex, with the new and old buildings staggered. If it is scientifically and rationally planned, renewed, and reused in a variety of coexisting development models, the old industrial architectural heritage can be rejuvenated, achieving the goal of coordinated development between the old and new districts of Taiyuan City, to realize the "symbiosis of the old and the new" in urban development, and the operation of sustainable vitality.

5. CONCLUSION

Heritage has the meaning of "life". Although industrial architectural heritage is a "relic" of urban development, it is also an important component of urban life. Shanxi Province, as the vanguard of modern industrial development in China, with the arrival of the transitional period of economic development, a large number of industrial enterprises are facing reorganization and renewal, and urban industrial heritage has become a very valuable part of social resources. Protecting, reusing, and exploring new development models through design and transformation is a respect for the history of the city, as well as for the development of the city and the emotions of the people.

AUTHORS' CONTRIBUTIONS

Renjun Feng put forward research concepts and ideas, conducted data analysis and interpretation, and revised important intellectual content; Ting Ma wrote the manuscript and contributed to revising and editing.

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