Investigation on the Building Remains of Baiyun Chemical Plant in Wuhai City and Value Analysis about the Integration Protection

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Abstract. With the industrial structure adjustment and the surrounding natural resources depletion in Wuhai, the industrial regions are facing the issues about how to transform and develop. The industrial heritage being the material carrier of industrial civilization, protecting the industrial heritage is conducive to preserving the continuity of the material space environment and history of the city, and preserving people’s sense of identity and belonging to the culture of the place. The protections about Baiyun Chemicals, the typical regional industrial heritage in Wuhai, not only reflected the characteristic of the single construction, and more important focused on the portfolio of the group construction, are representing and expressing industrial culture and place spirit, and are worthy of careful analysing and elaborating. Therefore, it is necessary to effective screen the building part and non-building part of the industrial heritage, and to discuss the way of effective protection and reuse based on the screening results.

1. Introduction
Wuhai city is a traditional industrial city in Inner Mongolia Autonomous Region, connected Ningxia Yinchan Plain in the south, Bameng Hetao irrigation area in the north, Ordos Plateau in the east, Alashan grassland in the west, the bridge and connection of North-West China, being one of the main implementation areas within the development strategy “Two Belt and One Region” (TBOR) - Railway Belt and Resource Enrichment Belt in Inner Mongolia Autonomous Region, as well as the West Shift of National Development Strategy (WSNDS) and Boarder Strategy (BS). Wuhai is rich in resources and convenient transportation, with the reputation of “Black Gold Sea” and “Yellow River Pearl”, and has great development potential and broad perspectives.

The chemical and building materials industry is one of the pillar industries in Wuhai city. Since 1958, established Xizhuozi mountain cement factory, followed by constructed series branch plants, such as Wuhai city cement factory, ash sand brick factory, building ceramics factory and Haibowan glass factory, the cement branch plant of Qiangang, the quick coagulant factory of Haibowan mining...
bureau as well as the glass brick factory afterwards. Since 1990s, with the introduction of the national policy of "Retreating from the Second to the Third" (RST), economy mode changed. With the adjustment of industrial structure of heavy industrial cities and the gradual depletion of natural resources around cities, traditional heavy industrial cities and industrial zones are facing with the problems of how to transform and develop.

The industrial heritage being the material carrier of industrial civilization, protecting the industrial heritage, is favorable to the preservation of city material space environment and historical continuity, conversing the sense of identify and belonging about the city. Wuhai has a long history of industrial development, but due to the weak sense of protection of the city's industrial heritage, in the past, industrial heritage has been repeatedly destroyed in urban renewal. Wuhai city has made some explorations on the protection of industrial architectural heritage from top to bottom, and has made outstanding achievements. Among them, the representative works are: Zhang Pengju, School of Architecture, Inner Mongolia University of Technology A team led Professor, which completed at the foot of Haibowan Dongshan District of Wuhai City, is an abandoned ferrosilicon factory to transform into the Inner Mongolia Wuhai City Youth Creative Industrial Park, as well as the design and construction of the Wuhai city is the Yellow River chemical plant renovation project. In the past, the protection of industrial heritage focused on protecting objects design, for example, major on a single building protection and reuse, the design only concentrated on the building shape of the industrial heritage in local area, lacking of external space and environment considerations, which cannot really protect the industrial heritage from industrial history and city context points of view continually. Though the Baiyun chemical factory in Wuhai as the representative of the regional industrial heritage, not only in the single building has its own characteristics, but in the building group combination, the whole building group represents and reflects the industrial culture and the spirit of the place, also deserves our careful analysis and deliberation. On the basis of the effective screening of both the architectural and non-architectural parts of industrial heritage, the effective ways of conservation and reuse should be explored.

2. background
The existence of modern industrial heritage in space and quantitative situation is quite different from that of ancient heritage. Compared with the isolate, individual, casual existence, industrial heritage is different, with large space area and huge quantity, and shows with completely appearance. The Taipei Declaration on Asian Industrial Heritage, adopted by the International Industrial Heritage Protection Committee in 2012, states the particularities of the Asian industrial heritage as follows: " The process of industrial development in Asia is different from that in the western world. The development of spontaneous production methods and facilities is a part of local history. Industrial heritage should be more extensive in Asia, including the pre-industrial revolution. Most of Asia's industrial heritage was introduced by Western countries or colonists, and factory buildings and facilities were vanguard at that time. Considering the aesthetic and scientific value of local architectural history, as well as construction history or equipment history, first of all, to preserve its integrity as far as possible. The origin of raw materials and transportation facilities contribute to their integrity and therefore should be protected. "

At present, the industrial heritage protection and reuse, only pay attention to the historical heritage value, commemorative value, building value, ignore its unique industrial life form. Industrial heritage is a comprehensive building combined life and production in one, so it is necessary to attach importance to the protection of industrial production facilities, to pay attention to protect living facilities and space form. We should involve physical properties of objects of protection of industrial heritage, also include the industrial heritage which is closely related with the development of industrial society, the industrial production of industrial workers living memory, cultural heritage resources.

In recent years, the concept of recognition and protection of industrial architectural heritage has undergone significant changes in developed countries. The protected objects are gradually changed into industrial sites or whole landscape by specific memorials and sites. The integrity protection is the
basic criterion for protection work. It emphasizes the importance of protecting the site from the surrounding environment and comprehensively reflecting the historical aspect of the industrial area, including the whole appearance of production and life in the current year. This puts forward the protection of the cultural heritage of mankind in the past to the new level and to face different challenges. Therefore, new concepts such as heritage sites and industrial heritage groups have emerged in different countries.

3. investigation
The industrial building is distinguished from civil architecture, and the general industrial building is characterized by large space and mass, simple material, clear construction node, strong "industrial mechanical aesthetic characteristics", strengthens the authenticity of the building structure and expresses the industrial aesthetic characteristics through the super-large space massing and the structural framework with rhythmic feeling. The heritage ontology consists of the buildings, workshops, mechanical equipment, infrastructure and social activities involved in the production. The historical environment consists of the landscape, sight-line corridor and other artificial environment factors closely related to the site selection and process layout. In the general layout of Baiyun Chemical Plant, the site selection is located in the flat belt of the mountain body. Inside the plant, 33 small-sized buildings synthesized into relatively closed independent groups, and the external preservation layer of the buildings, e.g. column, slogan or logo carried historical record. From industrial heritage value discrimination and determination point of view, the protection and utilization should be classified at different level and different categories, respectively.

Figure 1. Plan of Baiyun Chemical Plant. Figure 2. Top view of Baiyun Chemical Plant.

The plane layout of the Baiyun Chemical Plant is related to the topography, and the architectural layout is oriented to conform to the terrain. In the eastern part of the plant, the buildings are organized, whose space is sparse. The surrounding buildings are rich in volume, forming the centre of the plant. The western building group has a compact layout. The overall layout of the building dominated by the single-storey factory building. In the east side group, the buildings circled a square, which mirrored with the entrance. In the group on the east side of the plant, at the end of the line of sight corridor, three sets of chimneys emerged, forming the nodes of the landscape. In the plane structure of the Baiyun Chemical Plant, it can be clearly distinguished. There are not only the scenes of lively production and construction, but also the real life of industrial workers. The explanation is that the location of the plant with remote geographic site, and it is necessary to store production and life functions simultaneously.

Most of the protection planning, pay attention to the historical value of the heritage, the commemorative value and the building value and to neglect the special industrial life form of the industrial building. The Baiyun Chemical Plant is a comprehensive body integrated production with life. The protection and utilization should pay attention to the industrial facilities and the living facilities and forms. In the protection design, not only focusing the space physical property of industrial heritage, but also concentrating the memory of industrial production and the living state of industrial workers.

In the plane composition of Baiyun Chemical Plant, we can see that in the relatively closed and independent factory environment, the integration of working environment and the living environment
through architecture design be related to the rigorous urban functions advocated in the field of modern urban planning. There are conflicts in the concept of partitioning, but it is also a useful exploration and attempt to solve the industrial space of industrial workers in a relatively remote environment. More importantly, in this exploration process, the results reflected in the function and space have a strong integrity. From the aspect of architectural space and form, it is of great value (see Figure 2).

The entrance part of Baiyun Chemical Plant adopts symmetrical design, writing "self-reliance" in the prominent position, with distinct characteristics of the times. The treatment of the entrance leaves a large space, processed into a square, combined with the sculpture with a sense of the times, creating the unique atmosphere of the factory area.

After field investigation and analysis, classifying the existing buildings within Baiyun chemical plant, determine 8 construction with well-preserved appearance, space integrity, high protection value; 9 constructions with better value, and 10 constructions with value. The core objective of industrial heritage protection is to preserve the original production and life style, rather than just preserve industrial buildings. The inherit culture within the heritage is the key point of the attractiveness.

Among the buildings in the Baiyun Chemical Plant, most of them are brick-wood mixed structures, which are supported by brick walls. The roof is made of wooden frame or wooden trusses. The wooden trusses are mostly double-tilted wooden trusses. The architectural lighting and ventilation are well (see Table 1). Seven buildings are with reinforced concrete beam-column structures, and very few buildings, are with well-beam structures. The building's façade is simple and generous, and five buildings are designed with skylights, reflecting a strong modernist design fashion.

The workers housing being an important part of the industrial heritage is inextricably linked with the industrial and industrial facilities, and with a special heritage value. Residential building of the industrial area is not only the industrial life of the witness, but also inspiring people the industrial memory about the building remains. It is necessary to identify and protect the full range of important industrial heritage.

| No | Exterior | Indoor | Status quo | protection value |
|----|----------|--------|------------|------------------|
| 1  | ![Image](image1.jpg) | ![Image](image2.jpg) | wall damaged structure complete space complete | high |
| 2  | ![Image](image3.jpg) | ![Image](image4.jpg) | structure is well preserved interior space is simple | high |
| 3  | ![Image](image5.jpg) | ![Image](image6.jpg) | structure is well preserved space complete | high |
4. Value analysis

4.1 Urban landscape level

In the era of planned economy, under the background of unified arrangement, unified planning and centralized construction of the central government, and under the influence of the idealism and romantic cultural spirit of the Communists, the layout of many industrial zones is scientific. Grand scale, magnificent architecture, rich in socialist cultural characteristics, has a very obvious cultural value, historical value, aesthetic value, scientific value. In the history of Chinese industry, the signs of the planned economy era can be clearly seen from the existing slogans on the wall of Baiyun Chemical Plant, which is the embodiment of the humanistic spirit and the historical vicissitudes of the factory area.

In the past industrial buildings, though the production function has been highlighted, the transition between industrial buildings and the surrounding environment is very stiff, especially, the surrounding environment of the building is short of rest space. Vegetation greening, landscape sketch and other suitable places for residents to exchange activities. Industrial heritage in the function transformation, the surrounding environment should also be changed. Shape and urban integration, and communicate with the surrounding environment residents. Industrial heritage conservation and reuse should be one of the concerns.

Mark and symbol value, social value, spiritual value, mainly refer to the value of heritage or historical environment for the related groups, such as the community and it provides a sense of belonging for residents, identity, emotional connection, collective memory. The core value of industrial heritage art not only lies in the building itself, which embodies the key point in the specific process under the logical relationship and the overall style, dedicates to the production of railway freight yard, winds, the vicissitudes of the workshop without underlines the unique beauty of the machine. Which seems old, actually romantic art form attracts people that under high pressure.
4.2 Architectural design level

The unique in Baiyun chemical plant, according to the production or life needs built inside industrial plant, which is the relationship graph that the whole building unique bottom that different from the previous industrial buildings, reflecting the characteristics of "industrial building lifestyle", ..., became the symbol of landscape and environment of nodes of the factory, which also has a special aesthetic value of the built environment. The protection of site features and strengthen industrial heritage, respecting the historical conditions, completely expression of the spirit of place of industrial heritage protection, its historical value and industrial characteristics. Keeping and utilizing the spatial structure of industrial buildings, exploring the space usage mode matching with the original buildings, and making minimal intervention on the topography and geomorphology, and retaining its original characteristics.

Baiyun chemical factory layout and none block like blocks, identification of sufficient, the formation of regional groups, are the historical development of the city and the evolution of the evidence, providing inspiration for the original cultural industry. Industrial buildings, with spacious tall, orderly, conducive to the adjustment and transformation function division. Space plasticity with strong and unique style, easy to create artistic atmosphere. Through the construction of public space, landscape and transfer of humanistic care, achieving long-term sustainability of industrial heritage, protection, by shaping the environment, to achieve economic role in promoting.

5. Conclusion

Concerning the industrial heritage with cultural relics protection background, we should determine the status and value of the industrial heritage under industrial and social point of view, combining different facts, such as the exact time during the industrial development, technological progress, as well as time and region factors, etc. Based on value analysis, the determination of the heritage elements through analysing the core process step about the industrial production, focuses on recording the important remains of the workers at that time, concentrates on identifying the environmental relationship among natural, artificial environment and history, and provides more broader perspective on location analysis determination the elements of heritage environment, as well as considers the factors of rebuilding while extending accompanied development of industrial production and technology progress. Certainly, the valuation distinction and element identification about the industrial heritages, being the primary requirements and necessarily basement about planning and division, evaluating of industrial heritages, moreover, to protect according to different grades, to utilize by different categories, as well as on management and supervision.

Industrial heritage is an important material-space carrier of industrial civilization and an important part of human history and culture. The protection and re-utilize of industrial heritage are conducive to preserving the environmental and historical continuity for urban material entities, preserving people's identity and sense of belonging to the local culture and preserving the diversity of the original social lifestyles. It is also conducive to disseminating industrial culture. The continuation of the pulse, the promotion of the entrepreneurial spirit, will drive the revitalization for the declining city, greatly promoting the prosperity of the entire city's history and culture.

Different from the traditional cultural heritage, industrial heritage often covers a large area. The contradiction between industrial heritage protection and urban development is even more prominent. Therefore, clarifying the core scope of heritage protection and demonstrating the importance and basis of about protection are of particular importance in protecting the heritage of industrial buildings. The division demarcated by the protection plan of cultural relics is to coordinate the development of the city. However, the division of cultural relics under the protection of industrial heritage should make full use of the resource characteristics of the heritage and guide the construction of a city defined by the division within the urban construction and development process.

In recent years, the scope of the research on the protection of industrial heritage by experts and scholars have been gradually expanded. It is no longer solely concerned with industrial heritage buildings and factories. It even breaks through the restriction of administrative divisions and restores
the time from the starting point. When the industrial enterprises were founded, Zoning as a research background, the field of vision to invest a broader range, thus put forward the overall theory of regional industrial heritage protection theory. However, the regional industrial heritage is not only a geographical link, but also a deeper link in the industrial chain which caused various industrial enterprises gathering in the region.

The protection of traditional industrial areas, industrial buildings as well as structures in China has entered the context of the protection of cultural relics and cultural heritage. However, the industrial heritage as a cultural relic protection unit is different from other ancient heritage, its value research and analysis, the selection and identification of the object of protection (heritage elements), the coordination of protection and urban development, the protection and utilization of the relationship. The problems are all-different from the perspectives of reusing industrial heritage and rebuilding industrial buildings in the past, and are needed to be re-sorted and discussed in the new context.

In conclusion, the following points are results of this investigation and the value determinations.

1. The importance of overall design and volume design. A good overall design can combine the production space and the living space to form a whole sense of place.

2. Discovery of the protection and utilization of the Baiyun Chemical Plant. As far as the Baiyun Chemical Plant is concerned, the small courtyard Industrial buildings are designed to meet the functional and process requirements, and the overall design of the building and the building volume design are as important as the public building. building has a courtyard layout with a sense of enclosure, which has certain representativeness and characteristics. This layout method has research significance and value in industrial buildings.

3. The recommendations for Baiyun Chemical Plant utilization. The Baiyun Chemical Plant has the potential to transform existing architectural heritage into an event venue with life features, such as B&B, Friends Club. However, due to its decentralized courtyard layout, it has different characteristics from the high-rise of the traditional industrial building. Therefore, the transformation will have different possibilities and directions.

Acknowledgments
Inner Mongolia Natural Science Foundation for General Funding Projects（Organic renewal of industrial building heritage in central and western Inner Mongolia, Serial number: 2015MS0531）Research Project of Institutions of Higher Learning in Inner Mongolia Autonomous Region（Study on the optimization of energy saving design for the renovation of old industrial buildings, Serial number: NJZY17098）National Key Funding Projects for Humanities and Social Sciences: Research on the renewal of industrial buildings based on the national fitness demand（item number: 18BJR01017）

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