Research on Industrial Heritage Renovation Design: A Case Study of the Second Chemical Fertilizer Plant in Jincheng

Yijie Liu, Qi Jia*, Chaoyu Zhang

Zhengzhou University of Light Industry, Dongfeng Road, Zhengzhou, China

*Corresponding author

Keywords: industrial site reconstruction, landscape rebirth, activated surface building renovation, the second fertilizer plant

Abstract: In recent years, with the construction of industrial community from the perspective of micro life and the enhancement of human awareness of environmental protection, the transformation of urban enterprise economy leads to the increase of abandoned factories. On the basis of the historical economic and cultural value guiding and industrial creative heritage activity research in waste chemical enterprise ruins, this paper expounds the active trend of the present small and medium-sized cities industrial site transformation, and investigates the shortcomings of the budding industrial transformation and the feasibility and control of the future sustainable development of the active transformation. Under the background of landscape rebirth and activation transformation, industrial heritage such as industrial landscape, axis, landmark buildings, characteristic structures and machinery in industrial sites are given reasonable design strategies. The design is carried out from the form, texture and style of the building itself, and the landscape activation design of the abandoned factory is carried out. These tall chimneys and old industrial equipment left over are the symbols of industrial civilization. The combination of modern artistic language in the landscape renewal design, the collision of new artistic elements and design techniques with old industrial symbols will produce a new dynamic industrial landscape.

1. Introduction

With the continuous improvement of the urbanization of our country, the old industrial base still in the old urban areas of the city ushered in new development opportunities. In recent years, the practice of the reconstruction of abandoned factories has been deeply studied, and the consciousness of historical culture and economic value generated by it has become more and more profound. The reconstruction and reuse of factories have also been continuously explored and improved. Among them, the transformation mode of the abandoned factory is usually carried out by the function replacement type, the function continuation type and the ecological restoration type, and the profit return is realized through the cooperation between the government and the market. Reasonable protection and utilization of the old industrial base can not only effectively manage and restore the regional ecological environment, but also bring growth to the development of urban economy and people's livelihood. The old industrial base has witnessed the development of a city. It is an urgent problem to carry out reasonable regeneration and utilization of the industrial heritage resources and effective management of the surrounding environment.

In this study, the functional continuity model is adopted, and the second fertilizer plant is taken as the case to carry out the transformation practice, and the green ecological concept runs through every link of the design. Using this method to revitalize the industrial heritage landscape planning not only adheres to the concept of sustainable development, but also solves the problem of the basic activity place of the old community. This transformation mode is conducive to promoting the economic and cultural development of Jincheng city and even the whole Shanxi Province. Taking the second plant of Jincheng Fertilizer Plant as an example, this paper discusses the new ideas and views of the old plant transformation. Finally, the concept of landscape regeneration combined with the old site of industrial heritage provides sufficient multiple guarantees for the development of

post-industrial transformation from the enlightenment stage to the renewal stage.

2. Project Overview

2.1. Location Analysis

The second fertilizer plant is located in Jincheng City, Shanxi Province, just 3.3 kilometers from the city center. There are many old communities around, such as the Second Fertilizer Plant community (Tianze small District), Wangchuanlou Community, etc., which is located in a convenient location. The old district and factory district form a sharp contrast with the surrounding government replanning buildings, making the old factory district more historical and vicissitude. Looking at the history of Jincheng City, it is an ancient city with rich history and culture. Folk opera culture, Gaoping dough sculptures, Zezhou Yangko Dance and other cultural inheritance have absolute advantages.

2.2. Natural Condition

2.2.1. Climate

Jincheng has obvious characteristics of four seasons. Located on the Taihang Mountains, Jincheng has a long sunshine time and is in a position of perennial irradiation. According to statistics, the annual average sunshine time is about 2000 to 2300 hours, and the annual average sunshine time is about 2400 hours. In summer, Jincheng, which is located between several mountain ranges different from the Central Plains, is rainy and humid. The hot season is mainly concentrated in July and August. In autumn, poets often describe the characteristics of crisp autumn, and in winter, cold air returns to be cold and dry.

2.2.2. Geological landform

The whole plane of Jincheng looks like an egg contour, the city's overall topography shows the bottom of the middle and southwest and the north of the high situation. The whole area of the city is calculated by the whole unit, some plains, mountains, hills are 13 percent, 60 percent, 30 percent respectively. The average elevation of the whole city is 590 to 690 meters, among which the lowest elevation is the lower reaches of the Qinshui River, the average elevation is close to 290 meters. The highest point is Shun Wang Ping, at 2,300 meters above sea level.

2.2.3. Biological resources

Jincheng City of Shanxi Province contains extremely rich animal and plant resources, and has the reputation of "Shanxi biological resources". There are more than 1000 species of precious plant species in several nature reserves in the mountain group, and more than 15 species belong to the national protection document. There are two national nature reserves in the city, namely Lishan Reserve in Qinshui and Mang River Nature Reserve in Yangcheng.

2.2.4. Minerals and energy

Jincheng contains extremely rich mineral resources, copper and iron resources, thus has the reputation of "coal city". There are more than 30 state-owned coal mining enterprises. With the transformation and development of enterprises and the rise of industrial manufacturing industry such as chemical fertilizer, chemical fertilizer plants also gradually rise, bringing huge revenue for local industrial tax. The restoration of industrial relics is based on the premise that the original industrial building remains are not completely demolished[1].

2.3. Socio-economic Development

2.3.1. Historical evolution

The rise of the local fertilizer manufacturing industry, a large number of fertilizer plants also supported a generation. The Tianze Coal Chemical Company in Shanxi, formerly known as the Second Chemical Fertilizer Plant, was the largest chemical fertilizer manufacturer in Shanxi

Province in the first two decades. The site site of this design scheme was built in the 1980s, with a huge area and real estate scale. The raw materials required for synthetic ammonia and ammonium bicarbonate can add up to 4000 tons, which shows the former glory of the factory. In the late 1990s, the industry was restructured and renamed Jincheng Coal Gasification Co., LTD.followed by the annexation of the People's Liberation Army Factory No.6013. The old living quarters here are used by the employees of the fertilizer plant and their families.

2.3.2. Industrial heritage

Shanxi Jincheng city has opened many large-and medium-sized industrial enterprises reserve. Especially in recent years, the focus of the transformation of state-owned enterprises has shifted, and the idle old factory in the prime location of urban areas has become more and more concerned. In addition to the precious industrial heritage visible to the naked eye, there are other historical traces and memories of the industrial heavy industry recorded before and after the national transformation. The responsibility of our generation is not only to preserve the visible industrial heritage, but to repurpose the abandoned factories, to really preserve the memories of both generations that have the flavor of The Times and the look and feel of the history. In the era of the rise of post-industrialization, these factories have highly inspiring characteristics and have a strong demonstration significance in leading and protecting the activation and utilization of landscape in the country. The design and transformation of the site should be considered from various aspects such as city, architecture and landscape, including connecting various infrastructure. The construction of new urbanization will promote the upgrading of the demand side[2].

2.3.3. Intangible cultural heritage

In the past 20 years, we have slowly started the study, evolution and beginning of some intangible cultural heritage on human civilization. Intangible cultural heritage refers to the cultural heritage that is not based on or cannot be covered by existing physical objects, such as fairy tales widely spread among the folk, Shangdang Wooden Clappers in folk culture, performance activities, traditional handicraft paper-cutting, embroidery and other traditional skills,which cover a wide and deep range.The digital economy stimulates industrial green transformation by promoting natural resource use in the east-central part of China[3]. Each region of Jincheng has its own local ethnic customs and culture, and ethnic native products have strong regional cultural traditions. For example, Jincheng Lucun millet, Yicheng sweet potato, sea buckthorn, millet pancake and other native products are exported to other provinces. Jincheng has very important resources.

2.4. Site Status and Functional Zoning Analysis

The current site status of Jincheng Second Fertilizer Plant is divided into the main entrance of the auxiliary office area, the main fertilizer production process area, purification cycle area, etc. The auxiliary office area in the main functional area includes security room, office staff work area; Fertilizer production process area includes coal treatment and refining system, packaging production process system, coking system, coolant treatment system, etc. Purification cycle area includes water filtration, purification system, sewage discharge system, cinder fertilizer recycling system processing and treatment system. In addition, two production systems (storage off-site distribution system, plant process processing system) to assist. The principle of development is based on the principle of ecological protection, which establishes the interdependent relationship among human, architecture and environment.

2.5. Current Road System Analysis

The Second Fertilizer plant now has a Grade I road of 6 meters and a Grade II road of 3 meters. The main road system is divided into three grades. The first-level route is 6 meters, including two east-west routes for the disposal of pollution fragments-north and south, and the route to rainbow gallery following the purification system to the east-west roads and the main entrance route of the office area. The main road in the factory is 4 meters, and the pavement material is mostly cement pavement. Most of the roads are in good condition, and a few roads are badly damaged and need to

be repaired.

2.6. Current Industrial Landscape System Analysis

The industrial landscape in the second fertilizer plant is mainly composed of five levels: the central axis running through the plant, the industrial high point, the landmark structure and the characteristic industrial device landscape. The characteristic industrial landscape of the original industrial structures in the chemical fertilizer plant is well preserved and the characteristic of the industrial landscape is better.

The towering granulation tower, shaft furnace and fertilizer plant are mainly composed of five basic contents: axis, the highest point of the factory, surface structures and industrial landscape left in the factory. Some industrial equipment, industrial buildings and industrial structures left in the factory are relatively preserved, and most of the industrial facilities on the site of the old factory are in good condition. Here they have a better landscape and the most representative post-industrial site style. The highest point of the factory he vertical furnace, the granulating tower and the towering chimney in the pipeline system are all the highest points in the landscape of the factory.

Landmark building-granulation workshop and storage system interior, with its unique appearance, in the chemical fertilizer plant industrial relics is very important and has a certain iconic structure.

Characteristic structure - The characteristic structure of fertilizer plant includes overhead piping system. On top of each factory, a variety of industrial corridors shuttle back and forth to form a very characteristic of a good industrial landscape. From the pipe, the material color of the corridor, we can see the sense of upgrading of the factory, the old alternately.

2.7. Analysis of Current Pollution Situation

From the current point of view, the site is faced with a serious problem of purification, acing a major ecological restoration work. The pollution of soil and water in the site mainly comes from coal cinder and fertilizer. Abandoned for 10 years, pollution levels at the plant are very low. The area around the shaft furnace requires proper land treatment using recycled materials such as cinder blocks.

2.7.1. Current Structure Analysis

The existing buildings in the factory area of the second Fertilizer Plant are well preserved as a whole, with distinct industrial construction characteristics, good restorable value and recycling orientation.

The protection and reuse of industrial heritage should respect the historical characteristics and cultural connotation of the heritage itself, rather than simply referring to specific transformation forms, and absolutely understand the changes of the chemical fertilizer plant and its surrounding environment in recent years. For the chemical fertilizer plant itself, the industrial heritage contained in the surrounding has a myriad of relationships, and the characteristics and connotation of the heritage should be truly integrated into the urban development. In a place where there are two generations of memory of industrial sites, the whole design scheme of the second Fertilizer Plant is endowed with the unique memory of the old structures and buildings. The factory has some special time imprints as a function, as if the stories and pictures with temperature and meaning are reconstructed in series. It tries to create a creative park with temperature and memory of two generations, where community residents can have open communication at ease, and visitors can learn and exchange industrial culture to form an open space for exchange of industrial sites.

2.7.2. Existing Development Pattern

At present, domestic and foreign industrial reuse research has made a lot of achievements. Based on the transformation development mode, it can be divided into five transformation development modes:urban industrial park, industrial museum, industrial expo, business tourism development and comprehensive development. In the transformation of development mode, pocket parks and sponge cities have extremely important cultural content and economic development, which can effectively

strengthen the development of the environment in the factory and surrounding communities, and add some necessary play and rest Spaces for the elderly and children in the city in sequence, as well as effectively and timely protect the industrial buildings and structures. In the face of urban economic supply shortage, compared with Jincheng, Jincheng faces more serious industrial restructuring and transformation than other cities. The second transformation development mode is the urban creative industry cluster area.

Generally speaking, those who want to enter this kind of creative industry cluster will have higher requirements, as well as higher requirements for the development of the whole city and the relative demand of the creative industry that needs to be gathered. From the current development situation, the development of Jincheng has not its due conditions.

2.7.3. Suitability Analysis

When industrial buildings and structures are dense, large landscape nodes are set accordingly. The landscape axis forms a new landscape axis by connecting large landscape nodes and connecting small landscape nodes(Figure 1).

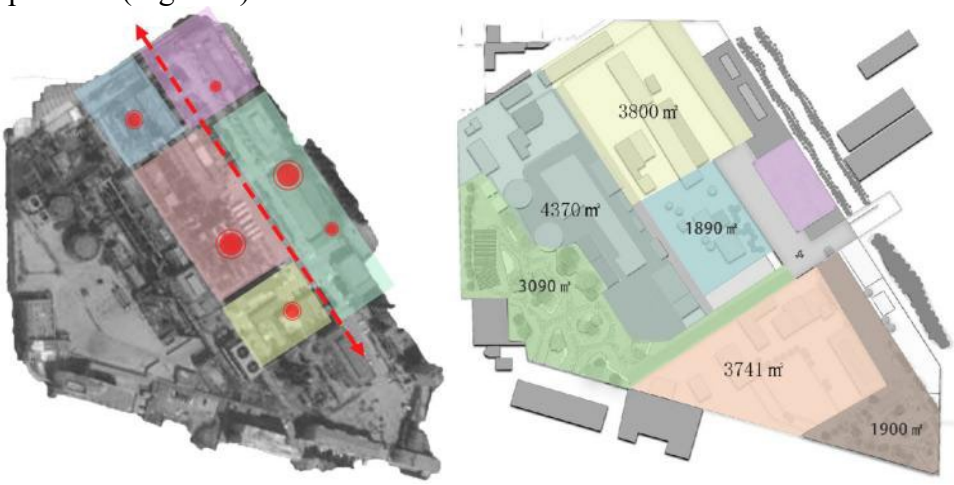

Figure 1 Initial landscape axis and road assumption Source: Self-drawn by the author.

Because of this particularity and exclusivity, it is difficult to be compatible with other functions and Spaces in the city, and it cannot be used for other purposes in response to crises, and it has a great risk.

3. General Plane

Figure 2 Color flat picture Source: author's own drawing.

Before the transformation, the base is a complete industrial land for the second Chemical Fertilizer Plant, with a construction area of about 18000m^2. The original fertilizer production system and transportation in the plant are intact. The overall planning of the plant mainly describes the history and culture of chemical fertilizer enterprises in Jincheng and draws excellent cases at home and abroad for positioning and prospects of the plant planning. When planning and designing landscape gardens, we should pay attention to grasp the integrity and conduct in-depth investigations[4]. According to the current pollution situation of the factory, corresponding measures should be taken to restore and treat the environment in the area. As shown in Figure 2.

3.1. Functional Zoning Planning

The final fertilizer plant is mainly composed of four functional areas: the exposition area, the regional cultural experience area, the comprehensive service area and the ecological leisure area. Integrating AI with industrial design, applying new ideas and technologies in AI to industrial design[5].

The Expo area is located to the southeast of the factory, and contains the main pavilions, public facilities and other functional sites needed for the Expo. Among them, the main fertilizer production exhibition hall in the factory was rebuilt from the old abandoned industrial production area. The key auxiliary functional areas are Shanxi Northern Folk Custom Research and protection Center, large outdoor theater, etc. Key areas include outdoor theater, industrial exhibition area, etc. The ecological leisure experience area is located in the production auxiliary area on the west and south sides of the factory. Plant planning is mainly to restore the original damaged land, improve the construction of recreational facilities, so that the plant has ecological and farmland theme landscape, convenient for surrounding residents and tourists.

3.2. Road System Planning

Periodic road: The northwest and south sides of the site are adjacent to the planned municipal road. Plant road planning as far as possible to retain the original road shape. Car entrance: There are two vehicle entrances in the northwest and south of the site. The north is the main entrance and the south is the secondary entrance. The main area includes a visitor service center and bike parking. In the process of urban construction, a large number of hard impermeable pavements are used, so that more and more natural land is replaced by impervious pavement[6].

Although structural factors such as poverty, concentrated disadvantage, and residential instability present significant barriers for positive social interactions[7].Interior walking sightseeing: It mainly connects the four functional areas(Figure 3). From the entrance square, there are three different tour routes: east, southeast and south.

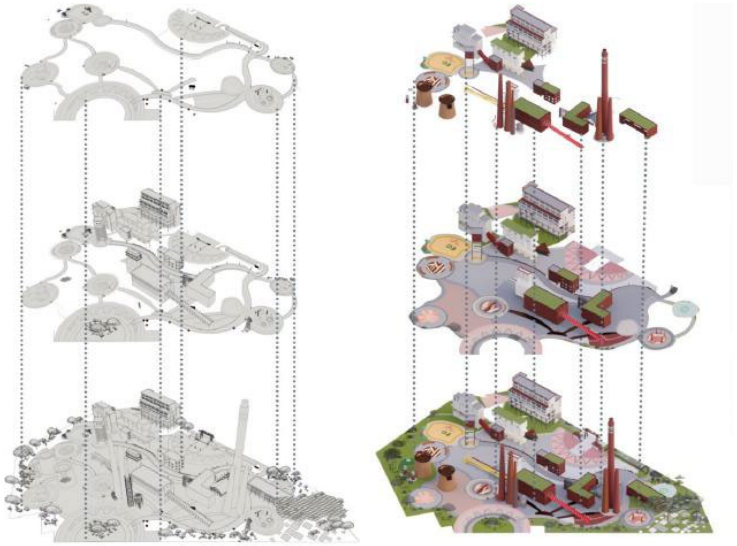

Figure 3 Vertical analysis of structure road Source: Self-drawn by the author.

3.3. Green Space System Planning and Ecological Restoration

The introduction of eco-industrial landscape design ideas generates a major shift as well as changes the city's image[8]. The industrial site has a strong industrial atmosphere, towering structures, relatively small landscape, green space scope, in the later planning and plant greening restoration, the first is to ensure the preservation of the existing vegetation in the original plant, the detection of pollution-free areas for greening restoration.

3.4. Partition Plant Configuration

(1)Local plant Demonstration are -- The advantages of this area are that it is close to the main road and has perfect regional functionality. It is a key area for human flow development. The current situation is as follows: under the premise of keeping the original vegetation unchanged, the green area in the factory is expanded, and a large number of fruit trees with practical ornamental value are planted to create a good green environment.

(2)Garden plant area: In this area, trees and shrubs grow well and cut plants develop very quickly. In terms of planting, combinations and matches should be made in different ways, such as wolftail, Persian chrysanthemum, okra and so on.

(3)Hanging Garden Plant Exhibition Area-This area was originally a sewage treatment tank and now has a small garden with good ecological value. The original high and low water reservoir is used as a feature plant, which is designed to allow visitors to further contact with some of the treasured flowers, as well as stroll over the top of the pool.

(4)Tree square factory -- tree square field chooses straight and straight, tree array square chooses straight and colorful ginkgo as the main tree species. The ground has low flowering plants such as bluegrass, February blue, white clover and dandelion. The combination of height and plant height creates a comfortable middle-level living space.

(5)Farm Plant View -- This area is a large open space with the least amount of plants in the factory. After reconstruction, the area was used for underground vegetation restoration. The scheme uses a low amount of tree planting to create a farmland landscape. Wheat and sunflower seed rotation, Xinjiang poplar and ash as auxiliary tree species, maintain the original spatial flavor of the region.

4. Design Scheme

4.1. Recreation System Planning

According to the functional characteristics of the fertilizer factory after reconstruction, three routes are proposed: exhibition tour route: the main tour route for tourists to carry out landscape display. Main parking lot, gas storage tank renovation theme pavilion, office building at the entrance, Jincheng intangible Cultural Heritage Exhibition, main pavilion (shaft furnace), theme 1 pavilion (fertilizer tank), theme 2 pavilion (coke tank), farmland landscape area.

West entrance of the base, reception area at the entrance, fertilizer processing area, ecological theme landscape, fertilizer product display area (Jincheng local products exhibition), farmland landscape area, other areas of interest, south parking lot.

4.2. Planning of Supporting Service Facilties

Parking and visitor services are located near the main entrance to the base. Tourism service center includes sales office, ambulance station, toilet, bus stop sign, industrial square large screen, interpretation display station, to provide tourists with a full range of public services. Each functional area has recreation, entertainment and interpretation areas for visitors to visit and rest. Waste collection points are set up on the main roads of the factory, and classified collection is adopted to ensure a clean and beautiful park environment. It is suggested to set up bus stops at the main entrances and exits on the north and south sides of the park to facilitate public access to the park.

4.3. Phased Construction Planning

This paper argues that there is a process of landscape design by which the designer evaluates the requirements of a design brief against the capacity of a site to ensure that the impact of the inevitable changes are accommodated with minimal environmental disruption[9]. The first phase is mainly based on the main routes of work, including the entrance of the creative park, office buildings and building fire climbing; The second phase is based on the tour route, the entrance of the creative park, sewage purification and treatment system, repair of vertical furnace, maintenance of granulation tower, and repair of cooling ladder of large water tower. The third phase mainly focuses on restoration of landscape design and restoration of landscape vision. Pollutants in the updated industrial plant area should be screened. Large entertainment facilities and squares should meet the needs of certain people.

4.4. Colorful Steel Pipe Gallery

In the reconstruction of the ruins, special attention is paid to the use of Shanxi culture, especially the cultural symbols with northern Shanxi characteristics, to create a strong local cultural atmosphere (Figure 4). The key part of the direct contact between industrial products and people is the operating device[10]. On this basis, the color steel pipe gallery will show the unique and original charm of local culture window. At the same time, it enriches the environmental space of the entrance area.

Figure 4 Effect picture of the Creative Park Source: The author drew by himself.

4.5. Large Theme Outdoor Interpretation Factory

The original intention of the design was to use the striking and shocking visual characteristics of the main shaft furnace to experience the special feeling of the huge background stage. The large outdoor performance venue of an industrial building is placed in the rough part of the theme. The construction of the Loutian Industrial Square provides an open exchange place for the surrounding residents.

4.6. Sculpting Studio

For the abandoned natural buildings and structures in the former chemical fertilizer plant area, the use of internal space is particularly important in addition to the change of the external structure. Within the auxiliary workshop, certain functional structures are provided for the inheritance of intangible cultural heritage, such as the transformation of sculpture art. The inherent architecture is perfectly integrated with the new artwork.

4.7. The Workshop Transforms the Leisure Place

Traditional arts and crafts patterns are overlapped with the surface of the pipeline by means of light and shadow, using the characteristic symbols of Shanxi, especially the northern part of Shanxi, to make them into three-dimensional landscape lines. Compared with the features of the reconstructed place, the leisure place transformed by workshop has more regional cultural flavor. Servicescape being a designed system is expected to encompass design patterns[11].

5. Conclusion

Through the design practice, it can be concluded that factory renovation should be carried out on the basis of adapting to the market rules, and the government should guide correctly and strengthen the local legislation. In addition to proper functional repositioning, the reconstruction concept in most cities should also focus on the concept of green development, which is highly consistent with the current social development. Industrial ruins are a kind of culture of the city, which carries the memory of a stage of the city. As a kind of building, these industrial plants have lost their original function, but it still has its existence value as a cultural landscape.

References

[1] Liu Y, Li H, Li W, Li Q, Hu X. (2011) Value assessment for the restoration of industrial relics based on analytic hierarchy process: a case study of Shaanxi Steel Factory in Xi'an. China. Environ Sci Pollut Res Int, 48, 69129-69148, 2022.

[2] Chunying Li. (2023) Research on the Impact of New Urbanization on Industrial Transformation and Upgrading. Journal of Economics. Trade and Marketing Management, 1, 27-37.

[3] Ran Qiying, Yang Xiaodong, Yan Hongchuan, Xu Yang, Cao Jianhong. (2023) Natural resource consumption and industrial green transformation: Does the digital economy matter? Resources Policy, 81, 1-13.

[4] Tang Yuping, Xuan Yang, Zhu Xiaoyue. (2022) Evaluation of the Application Effect of Virtual Simulation Technology in Rural Garden Landscape Design. Advances in Multimedia, 2022, 1-11.

[5] Zhang Feng. (2022) Design and Implementation of Industrial Design and Transformation System Based on Artificial Intelligence Technology. Mathematical Problems in Engineering, 2022, 1-9.

[6] Sun YunJuan, Jiang Fang. (2022) Garden Landscape Design of Sponge City Residential Area Based on Digital Technology. Mobile Information Systems, 2022, 1-12.

[7] Allison M. Krusky, Justin E. (2015) The effects of produce gardens on neighborhoods: A test of the greening hypothesis in a post-industrial city. Landscape and Urban Planning, 136, 68-75.

[8] Yijie Liu, Xiaoxia Pan. (2014) Ecotope-based Urban Post-industrial Landscape Design. IERI Procedia, 9, 185-189.

[9] Filor Seamus W. (1994) The nature of landscape design and design process. Landscape and Urban Planning, 30(3), 121-129.

[10] Wu Changsong. (2022) Application of Ergonomics in Product Design Based on Computer-Aided Design. Mathematical Problems in Engineering, 2022, 1-8.

[11] Deedee Aram Min, Kyung Hoon Hyun, Sun-Joong Kim, Ji-Hyun Lee. (2017) A rule-based servicescape design support system from the design patterns of theme park. Advanced Engineering Informatics, 32, 77-91.