UNIVERSITAT DE BARCELONA

Creative Strategies to Recover Urban Land in Disuse

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Tesi Doctoral

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Abstract

Industrial land in disuse is a dual carrier of crisis and revitalization of mining cities facing decline. On the one hand, it is an object that carries urban crisis, which has many negative effects on the urban environment, economy, and society. On the other hand, it has the advantage of reuse and can be transformed into a positive factor for urban revival. The main starting point of this research is to explore the value of industrial lands in disuse and their reuse to promote China's mining cities out of their difficulties.

The existing research on industrial lands in disuse lacks a holistic and systematic view and has insufficient knowledge of the overall value of industrial lands in disuse and inadequate refining of their core values. This has led to a series of problems such as “islanding” renewal, “destructive” protection, and convergence of appearance. On account of these problems, this research applies landscape character theory to the conservation and renewal of industrial lands in disuse by using literature research, field survey, typology, comparative study, and systematic analysis, and analyzes the regular characters of industrial land in disuse clusters in China in time and space, so as to explore a more effective way for the deep excavation and scientific expression of the value of industrial lands in disuse. This research is highly interdisciplinary and exploratory. The main research conclusions:

1. This research unravels the mining cities in China as the research background, clarifies the definition, classification, regional distribution, and spatial structure of mining cities, discusses the characters and laws of the formation and development of mining cities, and summarizes the problems and

countermeasures. Then, the concept of industrial land in disuse is proposed. Its causes are analyzed and classified, and the main problems in the protection and renewal of industrial lands in disuse in China are analyzed.

2. Based on the evaluation of the value of industrial lands in disuse and their morphological and structural laws, the "unit-piece-chain-domain" landscape character structure system is proposed, so that any complex industrial lands in disuse cluster can be quickly decomposed and combined under the guidance of this system. Based on this structure system, coupling miningcity spaces, industrial lands in disuse cluster, and green space, the effective way for transformation and characters shaping of mining city and high-quality human living environment construction is explored.

3. An object-oriented landscape character classification model is established, and the extraction method of landscape character of industrial lands in disuse is proposed. Based on the results of the extraction, the information is genetically encoded, a landscape character information base is established, and a landscape character atlas is mapped.

4. This research proposes a conservation method and creative strategy for industrial land in disuse based on the landscape character. In the protection stage, it focuses on the protection of the authenticity and integrity of the landscape character of industrial land in disuse. In the urban renewal design stage, it focuses on the benign recombination and functional grafting of the landscape character of industrial land in disuse. Three creative strategies of recombination and grafting are proposed: landscape character juxtaposition, landscape character translation, and landscape character symbiosis. The space of industrial land in disuse, which is contradictory and conflicting due to cultural heterogeneity and spatial and temporal

differences, is reconstructed to create a landscape with regional characters.

5. Huangshi city is a representative mining city in China, with a large number and many types of industrial lands in disuse, which has temporal continuity and spatial integrity. Based on the evaluation of the value of industrial lands in disuse in Huangshi city, using landscape character theory, this research constructs the landscape character structure system of "unit-piece-chain-domain", and builds the spatial layout of coupling urban space, industrial lands in disuse clusters, and green space. Taking Tonglushan piece and Hanyeping Railway chain as examples, this research maps the landscape character atlas. Based on the landscape character atlas, protection of authenticity and integrity, recombination, and grafting measures are proposed to revitalize industrial lands in disuse.

Keywords

industrial land in disuse, landscape character,
character atlas mapping, creative strategy, huangshi

Resumen

El suelo industrial en desuso y abandonado comporta una doble coyuntura: acarrea crisis económica y ecológica y a su vez puede servir para revitalizar las zonas mineras en declive, concretamente en ciudades de China. Por un lado, es un objeto portador de crisis urbana, que conlleva muchos efectos negativos sobre el medio ambiente urbano, la economía y la sociedad. Por otro lado, tiene la ventaja de una posible reutilización, pudiendo devenir un factor positivo para la revitalización urbana de estas zonas depauperadas.

El principal punto de partida de esta investigación es explorar el valor de los terrenos industriales deshabitados y plantear su reutilización para promover que las ciudades mineras de China salgan de estas situaciones de abandono y pobreza superando dichas problemáticas.

La investigación existente hasta este momento de los terrenos industriales en desuso, consideramos que carece de una visión holística y sistemática y tiene un conocimiento insuficiente y anticuado del valor global de los terrenos industriales dejados y una percepción y visión inadecuadas de los valores fundamentales que estos poseen. Ello ha dado lugar a tres problemas básicos para una adecuada recuperación del actual suelo industrial como son: la renovación "insular" (renovación de una zona sin hacer una renovación aplicada a todo el sistema envolvente), la protección "destructiva" (en la que una propuesta errónea de protección puede provocar una destrucción aún mayor) y por último, la “convergencia fingida” (obteniendo resultados similares a los errores anteriores y que estos continúen sin valorar las características propias del terreno, manteniendo los errores). Teniendo en cuenta estos problemas de planteamiento metodológico, esta investigación aplica la teoría que podríamos denominar como las “características tipológicas del paisaje” para generar propuestas de conservación, mejora y renovación de los terrenos industriales estropeados,

mediante la aplicación primero de una investigación bibliográfica, de antecedentes, continuando con el estudio de campo, estableciendo la tipología de casos, el estudio comparativo y el análisis sistemático, para así examinar las características regulares y predominantes de los grupos de terrenos industriales “quemados” en China en el tiempo y el espacio, con el fin de explorar y conseguir una fórmula más eficaz para el conocimiento más completo y definir los rasgos científicos de los valores de estos espacios industriales. Esta investigación se basa por tanto en un planteamiento altamente interdisciplinar, de sondeo e indagación exploratoria.

Las principales conclusiones de la investigación prevista son:

1-Esta investigación propone un análisis previo y selección de aquellas ciudades mineras de China afectadas por esta problemática como antecedente de estas tesis, establece por este orden la definición, clasificación, distribución regional y estructura espacial de estas zonas y ciudades, examina los caracteres y los patrones de formación y desarrollo de estos espacios, compendiando los problemas observados y a partir de ello planteando posibles contramedidas.

A continuación, se propondrá y definirá el concepto de “suelo industrial en desuso”. Para ello será necesario averiguar y clasificar sus orígenes y causas y detallar los principales problemas que se pueden hallar en la protección y renovación de los terrenos industriales en China.

2-A partir de la evaluación del interés por los terrenos industriales en desuso y de sus principios morfológicos y estructurales, se propone un sistema de estudio ascendente la configuración paisajística de estas zonas, de forma gradual y ascendente, que denominaremos como "unidad-eslabón-cadena-entorno", de modo que cualquier agrupación de terrenos industriales complejos pueda descomponerse y combinarse rápidamente bajo la aplicación de este método. Sobre la base de este sistema de estructura, acoplando los espacios de la ciudad minera, los terrenos industriales en desuso y los espacios verdes, se explora la forma más efectiva y beneficiosa de reconvertir, revitalizar y dar nuevo sentido a los rasgos característicos de las ciudades mineras, así como para la construcción de un nuevo entorno vital humano de mayor calidad.

3-Estableceremos un modelo de clasificación de las propiedades del paisaje, orientado a diversas materias (ambientales, de diseño, arquitectónicos, culturales, artísticas y otras propiedades), y se propone un método de análisis de las características y peculiaridades del paisaje de los terrenos industriales despojados. A partir de los resultados extraídos, se codifica genéticamente la información, se establece una base de información de las propiedades del paisaje y se elabora un mapa que catalogará las propiedades más representativas del paisaje.

4-Esta investigación propone un método de conservación y protección mediante estrategias creativas aplicadas a estos terrenos industriales basada en las cualidades y naturaleza esenciales del paisaje de China. La fase de conservación, se centra en la protección de la autenticidad y la integridad del carácter del panorama del suelo industrial.

La fase de diseño de la renovación se centra en la recombinación conciliadora con la implantación propia de las características paisajísticas incuestionables del suelo industrial. Se proponen tres estrategias creativas de recombinación e inserción: Fusión de las propiedades del paisaje, Traducción del carácter del paisaje y Simbiosis de las singularidades del paisaje. Con ello, el emplazamiento del suelo industrial abandonado, contradictorio y conflictivo, marcado por la heterogeneidad cultural y por las diferencias espaciales y temporales, se reconstruye para crear un paisaje que enfatice sus propiedades territoriales y regionales.

5-La ciudad de Huangshi pertenece a la provincia de Hubei, se trata de una ciudad de economía fundamentalmente minera (hierro, manganeso, oro, cobre, tungsteno, molibdeno, zinc, plomo, cobalto, plata, galio y talio), su proximidad a Wuhan, capital de dicha provincia, y su especial ubicación a lo largo de grandes líneas ferroviarias y del río Yangtse hace de Huangshi

una ciudad importante, representativa de la China actual, con un gran número y diversidad de terrenos industriales olvidados, pero que mantiene una continuidad temporal e integridad espacial. Sobre la base de la evaluación del valor de estos espacios de la ciudad de Huangshi y utilizando la valoración de los atributos del paisaje, esta investigación propone el “sistema de estructura de las características del paisaje de unidad-eslabón-cadena-entorno", y explora la disposición englobadora de un espacio urbano de integración, de los grupos de terrenos industriales destruidos y del espacio verde con el fin de revitalizar suelos industriales en desuso.

La investigación toma como foco la zona minera de Tonglushan (una mina de cobre china ubicada en la provincia de Hubei, dicha mina es operada por la empresa China Daye Non-Ferrous Metals Mining Ltd., conocida por sus extracciones ilegales y por los numerosos accidentes de trabajo) y la cadena ferroviaria de Hanyeping, este estudio traza la cartografía de los valores y esencias de estos paisajes, basándose en el mapeo de las propiedades de estos territorios, se proponen medidas de protección de su autenticidad e integridad, de recombinación y de inserción para revitalizar los terrenos de Huangshi y que estas propuestas puedan ser extrapolables al resto de zonas similares de China.

Palabras clave

terrenos industriales abandonados, características del paisaje, cartografía del mapa de propiedades, estrategia creativa, Huangshi

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This research is a phased achievement of my exploration in the field of sustainable design. In the future, I will firmly work in this direction and create more high-quality products in theoretical research and design practice. It is hoped that this study will be helpful to the renewal and utilization of industrial land in disuse and the protection of industrial heritage, and make a modest contribution to the construction of ecological civilization.

Contents

Chapter 1

Introduction

Chapter 1 INTRODUCTION

1.1 The raise of questions

Mineral resources are an important source of raw materials for human production and living, and are an important physical and chemical basis for sustaining human survival and promoting economic development and social progress. Industrial Revolution has promoted the development of productivity and science and technology as well as the demands of human beings on material life. This led to tremendous growth in the ability and extent of exploitation of mineral resources. In the world area, based on regional advantages such as natural resources and city transportation, those mining cities built or developed rapidly relying on mineral resources have played a decisive role in the national economy. However, due to the obvious resource directivity and strong resource dependence, those cities are affected by the non-renewable and limited storage of mineral resources, showing the periodic evolutionary pattern. According to American geologist M.K. Hubert (1971), mining cities have to go through four stages of the life cycle in their development process: reserve period, growth period, maturity period, decline period or transition period. As the infinite exploitation of resources has caused resource depletion and environmental contamination, those mining cities that cannot successfully implement the transformation of industrial structure will inevitably face the dilemma of recession. History shows that the phenomenon of recession is a common problem in the development of mining cities all over the world.

In the process of industrialization, many developed countries in Europe and America have established a group of regions and cities with coal, metal, oil and other resource extraction and processing as their leading industries in the process of their industrialization development. For example, the Ruhr industrial Base in Germany, the U.S. Midwest Heavy Industry Region and Oil City Huston in the U.S., the West Midlands of the United Kingdom, Lorraine in France, Kitakyushu in Japan, and Baku in the former Soviet Union all have played an active role in promoting regional and national economy. But since the 1950s and 1960s, obvious recession has appeared in most of those cities and regions, characterized by: a decline of industries dominated by mineral resources development, related business closures, a decline in industrial output, slow economic growth, soaring unemployment, a large outflow of talents and funds, serious environmental pollution, etc.

With the large-scale development of mineral resources, a large number of mining cities have been built based on mining base construction. These cities were built and thrived because of mineral resources. The exploitation of mineral resources not only drives regional economic development, but also plays a strong supporting role in accelerating modernization and promoting industrialization (James R. Escott F，2011). However, after decades or even more than a hundred years of intensive mining, many mining cities have entered a period of stable production or decline. Under the influence of resource exhaustion, economic globalization, slow technological renewal, rising production costs, product demand changes, backward management systems and other factors, they have gradually fallen into the dilemma of recession (Liu, 2006).

1.1.1 Industrial land in disuse as the bearer of mining urban crisis

Industrial land in disuse is produced in the process of industrialization development, and it has evolved into the externalization, manifestation, and main bearing object of urban crisis. Its negative effects are shown in the following aspects:

(1) Land resources destruction and geological disasters induction

On the one hand, lands in disuse formed by resource extraction and the unique mode of production of primary industry occupies and destroys a large number of land resources (Huang, 2020). According to the statistics issued in 2019 by the Ministry of Natural Resources of the People's Republic of China, about 4 million km^2 of lands in disuse have been damaged, collapsed, occupied, and abandoned by mining and industrial construction in China. On the other hand, some lands in disuse with favorable location conditions in the city center are still occupied for free and are idle due to the high cost of the complete withdrawal for some enterprises on the verge of bankruptcy. Pollution control and reuse of the lands are not carried out, at the same time, new industries matching the potential values of the lands are developed, resulting in the waste of land resources.

The geological disasters induced by lands in disuse mainly include mining subsidence areas and open-pit mining. It's easy to cause landslide, collapse, collapse earthquakes, debris flow and a series of secondary geological disasters (Figure 1.1); Geological problems such as landslide and collapse may occur in gangue mountains; high pressure water injection for oil production will aggravate the deformation of the strata, and lead to geological subsidence, ground uplift, cracks, water outburst and other geological anomalies.

Figure 1.1 Cocoanut Sea Pit. Image Credits: ©Huangxin Cheng, 2018.

(2) Environmental pollution and ecological degradation

The industrial waste accumulated in the open air inside and outside the industrial plant is washed and leached by rain and surface runoff, thus the toxic components infiltrating into the soil, resulting in soil acid and alkali contamination, organic matter pollution and heavy metal pollution. When these pollutants exceed the absorption and self-purification capacity of the soil, they will be deposited in the soil and change the composition structure and function of the soil. Under the action of the biogeochemical cycle, soil pollution also migrates to the outside world, which reduces the environmental quality of nearby areas and poses a serious threat to the health of creatures, especially human. (Figure 1.2).

Figure 1.2 Polluted land. Image Credits: ©Keranmu Ai, 2018.

Water pollution——There are toxic minerals and radioactive substances in the dredged water, pit water, leached water of waste ore and mineral processing wastewater produced in the process of resource exploitation, which will pollute the surface water and groundwater.

Atmospheric pollution——Wind erosion and dust pollution will occur in gangue hill and tailings yard under the action of wind; Pyrite and carbon substances in coal gangue are prone to spontaneous combustion and discharge toxic gases into the atmosphere.

Soil erosion——The underground mining and drainage of a large amount of groundwater leads to the decline of groundwater level, resulting in soil impoverishment and vegetation degradation, forming a large area of bare lands, which is easy to be washed by rain and surface runoff; the surface loss caused by open-pit mining and the accumulation of soil and tailing ore form large undulations and grooves on the ground, which increase the velocity of surface water and increase the intensity of soil erosion.

Soil degradation——The loss of soil nutrients and the decline of ecological carrying capacity are caused by the excavation and removal of surface soil by open-pit mining, the destruction of vegetation, the secondary soil salinization caused by ground subsidence and water logging, the soil pollution caused by the accumulation of solid wastes by leaching, and the soil fissure caused by the decrease of groundwater level.

Biodiversity loss——Soil erosion, soil degradation, environmental pollution, and vegetation destruction make industrial lands in disuse soil quality poor, soil nutrient elements lack, and biological productivity declines. These factors cause ecosystem degradation and biodiversity reduction.

(3) Urban economic and social development restriction

1) Idle land resources restriction on the development of urban economy

Land is a resource with value of being used and a certainfunction effect. It has two kinds of basic uses: the first is as agricultural production materials and production factors; and thesecond is as the carrying space of urban operation activities, notas production factors. Industrial land in disuse is a special land resource, which realizes neither of the above two kinds of uses as being in an idle state. Most of the industrial land in disuse in the urban areas was allocated to state-owned enterprises before they were abandoned. After the cessation of industrial production activities, the asset character of land is not revealed through the market mechanism, and the optimal allocation of land resources is not realized, which is contrary to the scarcity of urban land supply and restricts the development of new industries in the city in terms of bearing space. The industrial lands in disuse caused by resource production technology are mostly formed based on occupying and destroying rural collective lands. Therefore, the waste of land resources caused by industrial lands in disuse has become one of the main factors restricting the development of the urban economy in China (Figure 1.3).

Figure 1.3 798 Industrial Zone, Beijing.
Image Credits: ©Zhuo Zhang, 2015.

2) Environmental degradation restriction on the development of urban economy

First of all, the contaminated soil of industrial lands in disuse will be transmitted to the outside world under the influence of the biogeochemical cycle, threatening the health and safety of residents, thus only coming into use after pollution control. Pollution control will increase the cost of land use, prolong the cycle of project construction or land reclamation, and raise the difficulty of the reuse of industrial lands in disuse. Moreover, the land with soil pollution in urban areas will not only decrease its value, but also bring about the devaluation of surrounding lands. Secondly, the deterioration of environmental landscape quality and the damage to urban facilities caused by industrial land in disuse greatly reduce the attractiveness of external investment and become an obstacle to the introduction and development of new industries. Thirdly, the phenomena of ecosystem degradation such as soil erosion, soil degradation, and biodiversity reduction are irreversible. The restoration and reconstruction of the degraded biological system is a complicated and long-term process, which needs the investment of a large amount of manpower, material resources and capital in the implementation process, which objectively retards the urban economic development.

3) Social load problem

The emergence of the social problem caused by industrial land in disuse fundamentally reflects the contradiction in the man-land relationship, namely the contradiction between population and the economy and environment. Resolving the conflict between man and land requires intensive use of land resources, including the reuse of industrial land in disuse. Therefore, the reuse of industrial land in disuse is carrying the mission of developing the economy and solving employment and re-employment problems for unemployed workers. If the new industries developed in the reuse of industrial land in disuse cannot absorb enough labor employment, then the contradiction between man and land will still exist, and thus the potential threat of the accumulation of social problems and the outbreak of social crisis will not be eliminated (figure 1.4).

Figure 1.4 Declining industrial communities.
Image Credits: ©Qipeng Liao, 2019.

1.1.2 Industrial land in disuse as a positive factor in the revival of mining cities

From the above, the actual situation of industrial lands in disuse reflects the serious urban environmental, economic, and social problems, which are unavoidable for the state, local government, and relevant enterprises. However, from a positive perspective, since the renewal and utilization of industrial land in disuse is imperative, it should be transformed into an opportunity and carrier for the environmental optimization of mining cities, the transformation of industrial structure, and the healthy and stable development of society (Katia Talento, Miguel Amado &José Carlos Kullberg，2020). Based on this, the reuse advantages of the following industrial lands in disuse are worth attention.

(1) Rich reserves of land resources

After land consolidation and pollution control, the industrial lands in disuse can be reused through reasonable and effective disposition. On the one hand, mining subsidence areas, open mining pits, industrial waste yards, and other industrial lands in disuse have huge reclamation potential. According to data released by the Ministry of Natural Resources of China in 2019, the potentially arable land to be replenished through the reclamation of abandoned industrial land is about 15,000 square kilometers, including 4,000 square kilometers or so of contiguous land. In addition to being partially used to replenish arable land, these land resources can also provide carrier support for the development of new agriculture such as aquaculture, animal husbandry, fruit and vegetable cultivation, flower cultivation, etc., the development of tourism and the construction of urban ecological safety networks. (Yang Boyu & Bai Zhongke,2019). On the other hand, in the early stage of industrialization, China has been adhering to the urban construction policy of taking the industrialization road with the secondary industry as the mainstay. Some industrial enterprises preferentially occupied the central areas of cities when choosing sites. After the bankruptcy of industrial enterprises or location migration, the industrial land in disuse with advantageous location conditions can develop new industries with a high degree of intensification, high land yield, matching with high land rent and beneficial to environmental protection (tertiary industry, high-tech industry, information industry, etc.) (Bosák Vojtěch, Nováček Alexandr & Slach Ondřej,2018). Some positive results have been achieved in the ecological restoration of industrial lands in disuse in China. For example, through promoting pit restoration, environmental management, cultural injection, and industrial development in the region, the Lianhuashan Mine in Danzhou, China, which used to be in a state of devastation, has been built into a 4A-level scenic spot with good ecology, cultural integration and flourishing industry and "the second batch of National Forest Health demonstration Base", and has taken a transformation path of regional green development. Another example is the ecological restoration of the coal mining collapse area of Pan'an Lake in Xuzhou, China, which has transformed the devastating collapse area into a national wetland park with a wide lake and beautiful scenery, and led to the transformation and upgrading of the regional industry and rural revitalization, with the full realization and enhancement of the value of the rights and interests of natural resource owners (Figure 1.5).

Figure 1.5
Up: Current situation of coal mining subsidence area in Pan'an Lake
Down: Reconstructed Pan'an Lake
Image Source: xz.gov.cn.

(2) Unique industrial cultural backgrounds

Industrial lands in disuse are a companion and historical evidence of the country's driving mining cities industrialization. As resource production bases, mining cities have played an essential role in the formation and development of China's modern industrial civilization. Industrial culture is a characteristic culture that has been developed in mining cities during their development history. A large number of industrial sites and facilities left on industrial lands in disuse serve as carriers of industrial culture, and witnessed the origins, glory, decline and changes of this culture. There is much to be said for using these sites and facilities to explore and present industrial culture and technical aesthetics (figure 1.6)

Figure 1.6 Landscape Garden Duisburg in Germany
Image Source: gardenvisit.com.

1.2 Definition of some important concepts

1.2.1 Definition of industrial land in disuse and comparison with related concepts

(1) Definition of industrial land in disuse

At the 19th IAA Congress in Barcelona in July 1996, under the theme “Present and Future: Architecture in the City”, “land in disuse” was one of the five sub-themes. In French, land in disuse is called terrain vague and in English, it is “land in disuse”. Report of this congress defined “land in disuse”, that is, lands abandoned by industries, railroads, docks, or due to violence, retreat from residential or commercial activities, or deterioration of buildings; riversides, dumps, mines, etc.; low-use areas due to inaccessible motorways; residential edges with restricted use for conservation purposes, etc. The concept of land in disuse broadly describes a variety of decaying, idle, and inefficiently utilized sites in the city involving industrial, commercial, residential, and transportation uses. However, residents oppose the adoption of programmatic design methods and construction means to simplistically renew the vague lots into a seemingly rational and efficient urban spatial network, but they prefer to preserve such vague, undefined and free spatial form as a perceptual carrier of the city’s memory in urban renewal, reflecting the desire and attitude of the post-industrial era to interpret, experience and protect the identity properties of special urban fragments from the level of the spirit of place.

The concept of land in disuse is not clearly defined in the category of land use, but the multiplicity of values embedded in it triggers a reflection and critique of the conventional urban renewal approach that deserves attention in the study of industrial land in disuse.

Industrial land in disuse in this study is one of the main forms of industrial land in disuse refers to the unused land and the facilities on the land that have lost their original functions due to the direct impact of industrial production activities. Industrial activity impact refers to the termination of industrial activity or the use of resource production techniques and methods in the process of industrial production. In terms of extension category, land in disuse includes abandoned industrial land, abandoned storage land specially used for industrial production, external transportation land and municipal public facilities land, as well as mining subsidence land, abandoned open-pit quarry land and industrial waste yard land formed by using resource production technology and methods (Table 1.1).

Table1.1 Industrial land in disuse epitaxial category table.

Impact of industrial production activities	**Name of industrial land in disuse**	**Industrial land in disuse content**
Cessation of industrial activity	Industrial land in disuse	Land used in abandoned industrial factories and mining areas. It consists of production area, auxiliary production area, storage facility area, power facility area, transportation facility area, public works facility area, public activity area, land reserved for development and sanitary protection zone and other functional areas.
	Abandoned land used for external transport for industrial production	It refers specifically to abandoned land for transportation facilities used fortransporting coal, oil, and natural gas
	Abandoned land dedicated to industrial production for municipal utilities	Abandoned land for supply facilities, transportation facilities, environmental sanitation facilities, etc.
	Abandoned storage land used for industrial production	Warehouses, storage yards, packing and processing workshops and ancillary facilities of abandoned storage enterprises
	Abandoned industrial and mining communities	Community abandonment due to the termination of industrial production activities and the departure of industrial and mining employees
Use resource production techniques	Land used in mining subsidence area	Land used in mining and oil mining subsidence area
	Abandoned strip mining sites	Abandoned open-pit coal mines, metal mines, non-metal mines stopes
	Industrial yard land	Dump land
		Tailings site
		Land for gangue heap and gangue hill
		Waste ash and slag yard, waste slag mountain land

(2) Compared with similar concepts

1) Industrial land in disuse and old industrial zone

The old industrial zone is also called the old industrial zone, which has a broad and narrow sense. In a broad sense, old industrial zone refers to geographical and economic areas where heavy industries are concentrated, similar to the concept of the old industrial base. In a narrow sense, an old industrial zone refers to where industrial concentration has been built in a city for a long time, including the material environment and social economy. On the level of the material environment, it means that the relevant facilities constituting the industrial zone are old, backward and lack configuration, which cannot meet their own development needs; on the social and economic level, it means that the industrial zone does not meet the needs of the sustainable development and industrial structure optimization andupgrading of the region or city in terms of technological level, product type, resource allocation, production mode, layout characteristics, spatial location and many other aspects, so it is facing renewal and adjustment.

The difference between industrial land in disuse and old industrial zone lies in connotation and denotation significance. In terms of connotation, the old industrial zone is facing renewal and adjustment due to the decline of physical form and function, but the termination of industrial production activities and the abandonment of original land and facilities are not emphasized. In terms of denotation significance, the denotation of the old industrial zone is basically in line with the abandoned industrial land in the industrial land in disuse, so measures for the renewal of the old industrial zone still have important referential significance for this research.

2) Industrial land in disuse and brownfield site

Brownfield site “refers to land and aboveground structures that are polluted to a certain extent, and abandoned or underused because of pollution” (Niu, 2001). According to a clear definition from the US Environmental Protection Agency (EPA), brownfield site means “real estate that could be complicated by the expansion, redevelopment, or reuse of known or potentially hazardous substances, sources, or pollutants” (Gardner & Xiao, 2017).

The connotation of brownfield site emphasizes that industrial pollution is the main cause of the abandonment or underutilization of land and facilities, and pollution control is the primary factor for the renewal and utilization of brown land.In terms of environmental status, a certain degree of pollution isthe main feature of a brownfield site, but it is not a necessary condition for an industrial land in disuse. In terms of land use function, “brownfield site” includes both industrial land and commercial land. As mentioned above, industrial lands in disuse include industrial, storage, transportation, municipal and public land, but do not include commercial land.

3) Industrial land in disuse and industrial heritage site

Some scholars have proposed, to reflect the current rational perception of the industrial landscape, and conform to the open development of the concept of “legacy”, industrial relics (sites and facilities) that have ceased industrial production and related activities and are of great importance to cities, regions and even countries should be called “industrial heritage sites”. (Li, etc.2006). Compared with the concept of abandoned industrial land, it can be seen that industrial heritage site is a special type of industrial land in disuse, and the main problem it faces is the protection and reuse of the important facilities (industrial buildings, industrial structures, industrial equipment, etc.) and the overall environment on the site.

1.2.2 The concept of landscape character and landscape character atlas

A landscape character is defined as a unique and recognizable characteristic that can be found in a particular landscape type. The purpose of landscape characterization is to identify what distinguishes a regional landscape from other areas, thus giving the area a unique sense of place. There are several key words to be deciphered as follows.

Landscape, a word derived from the German word "landschaft", can be traced back to the European school of landscape geography. This school emphasizes the division of landscapes and their elements, focusing on the study of natural and cultural landscapes, while recognizing the importance of the human role in landscape formation. Landscape as a term of geographic study is inextricably linked to other geographical concepts such as region, environment, place, landscape, and topography (Morin, 2008). The study of modern landscape is both a phenomenological study of physical geography and a study of the composite forms created by historical human production and social activities, with more emphasis on the integrated processes of natural and human sustainability.

Character is used to describe an object or a group of objects of a certain or certain characteristics of the results, each different object, or some objects they show a variety of characteristics, we can generalize from its common characteristics of a given nature, then this nature can be defined as a character.

Landscape character: mainly consists of two aspects: spatial character and cultural character, and the two are inseparably linked. Landscape character is defined in the UK as "the unique and recognized form of elements that occur consistently in a particular landscape type. The main role of landscape character is to distinguish the "here" from the "elsewhere" and to protect the uniqueness and diversity of the landscape through the description, identification, analysis, protection, and enhancement of landscape character.

Hierarchical structure of landscape character: Landscape character are subjective and objective together. When describing a landscape object, we usually use its objective existence characters, plus the intervention of our subjective information, and finally arrive at a systematic perception. The landscape is an integrated and holistic entity and is territorial and diverse, which determines the complexity and difficulty of studying individuals at a large-scale level. Hierarchical structuring of landscape character is the construction of clear correspondence between symbolic systems and complex landscape phenomena. It is the process of structuring and systematizing the overall and overarching entity landscape phenomena based on the fuzzy and abstract understanding of the landscape.

1.3 Research Status

1.3.1 Research status of industrial land in disuse

Theoretical research and practical exploration of the renewal and utilization of industrial land in disuse in mining cities involve many professional fields such as economics, ecology, art, landscape, and architecture.

(1) Economics—research on economic structure transformation in mining cities

The formation and evolution of mining cities gain direct or indirect influence from many kinds of economic theories, such as the "regional unbalanced development theory", including growth pole theory, cumulative causation model, Core and Periphery Theory, gradient advancement theory in the field of regional and urban economics, "industrial structure theory", including industrial structure evolution law, industrial structure configuration, and industrial structure policy, "economic layout theory", including location theory, productivity layout theory, regional production complex theory, and spatial investment theory, etc. Among them, the industrial structure theory has an important guiding significance for the economic structure transformation of most mining cities in China.

(2) Ecology—research on ecological restoration and reconstruction of industrial land in disuse

The research and practice of ecological restoration and reconstruction of industrial lands in disuse in Europe and the United States started earlier than that in China. As early as in the 1920s, the United States began the restoration of green vegetation in mining lands in disuse, and by the 1950s, the research work has been systematically launched across the country. In 1977, the first national law, *The Surface Mining Control and Reclamation Act*, on ecological restoration of land was promulgated, and the ecological restoration rate of mines in the United States reached 90% in the 1980s. The ecological restoration in the United States does not emphasize the restoration of farmland, but the restoration of the topography and ecosystem before the destruction, and has accumulated mature experience in soil improvement of industrial land in disuse, comprehensive use of waste such as coal gangue and plant selection and cultivation. In 1969, the British government promulgated and implemented *The Mine and Mining Site Act*, formulated the standards of ecological restoration and the corresponding management methods, and set aside special funds for ecological restoration compensation funds. After years of theoretical research and practical summary, the UK has made remarkable progress in ecological restoration of coal mining subsidence areas, open pits, and coal gangue mountains. The Ruhr region of Germany is a relatively concentrated area of industrial lands in disuse in Germany and even the whole Europe. The government has accumulated rich experience in ecological restoration of industrial land in disuse using institutional setting, regulation control, planning, special fund allocation, and technical procedure preparation, and the ecological restoration rate of the completed mining-damaged land reached 53.5% by 1996.

Chinese scholars have carried out research and practices from a multidisciplinary perspective for pollution management, environmental protection and restoration, and ecological restoration of industrial lands in disuse in mining cities. The main achievements include the theory, methods and operational techniques of ecological reconstruction of degraded land in large open-pit coal mines (Bai, 1997); the types and characteristics of ecological damage in mining areas and the basic principles and technical system of ecological reconstruction in mining areas (Bian, 2010); the research on the ecological restoration potential and land use structure optimization of coal mining subsidence sites (Li, 2018); the comprehensive sustainable use of coal mining subsidence sites landscape types (Zhang, 2019); the ecological restoration and practice of typical waste dumps and quarries in China (Zhou, 2019); system analysis of ecology, economy and culture in the renewal of industrial lands in disuse (Wang, 2020).

(3) Art—research on art and landscape transformation of industrial land in disuse

The artistic and landscape transformation of industrial lands in disuse was initiated by artists creating earth art in the 1960s. Artists used industrial lands in disuse to create a series of earth artworks with profound implications (Figure1.7). Post-industrial landscapes gradually emerged under the influence of various art schools such as geodetic art and ecological thinking. Through the successful application of landscape architects Haag M., Latz P., Hargreaves G., etc. in the classic projects of landscape transformation of industrial lands in disuse, the design ideas, creation methods, technical measures and representative works of the post-industrial landscape have made an international difference; Weilachen, O. (1999), in *Between Landscape and Landart*, describes the theory and practice of art and landscape transformation for industrial land in disuse with examples; in 1998, the Harvard University Graduate School of Design held the conference of *Manufactured Sites*, a landscape conference on site technologies for contemporary practice and published a collection of papers in 2001. The book provides a comprehensive overview of design strategies and technical measures for the regeneration of abandoned sites by experts from various disciplines; the interlacing and overlaying of ecology, culture, and history as landscape layers is also applied to the study of industrial land in disuse (Swart, 2017).

Figure 1.7 Double Negative
Image Source: Michael Heizer, 1968.

The earliest industrial land in disuse regeneration in China began at the end of the Qing Dynasty. Shaoxing East Lake, with a history of quarrying for more than 2000 years, was gradually transformed into a famous scenic area (Figure 1.8). Since the 21st century, China has introduced a large number of European and American concepts, technologies, and techniques for the renewal of industrial lands in disuse. Wang Xiangrong (2002) discusses the ideas and techniques of post-industrial landscapes, the application of earth art in industrial landscapes, and ecological landscapes in Europe and the United States; He Qian (2012) studies the Pop landscape design of landscape designers such as Schwartz M. and explores the combination of industrial land in disuse renovation and Pop art. Chinese designers and artists have also proposed localized theories and design methods through extensive practice. By focusing on the perceptual expression of industry and culture, Zhao Jiameng (2016) explores the significance of display spaces based on functionally diverse industrial achievements based on Shougang's culture and process flow. Zhu Yufan et al. (2012) regenerates the mine pit of Chenshan Botanical Garden into a tourist attraction based on ecological restoration and cultural reshaping; Zheng Xiaodi (2015) demonstrates the feasibility of aesthetics and landscape art intervening in the whole process of land restoration; Liao Qipeng (2018) proposes four design methods for the renewal of Chinese regional cultural heritage in industrial land in disuse, which provides an effective way to solve the current problem of the loss of regional characteristics in the spatial creation of industrial land in disuse.

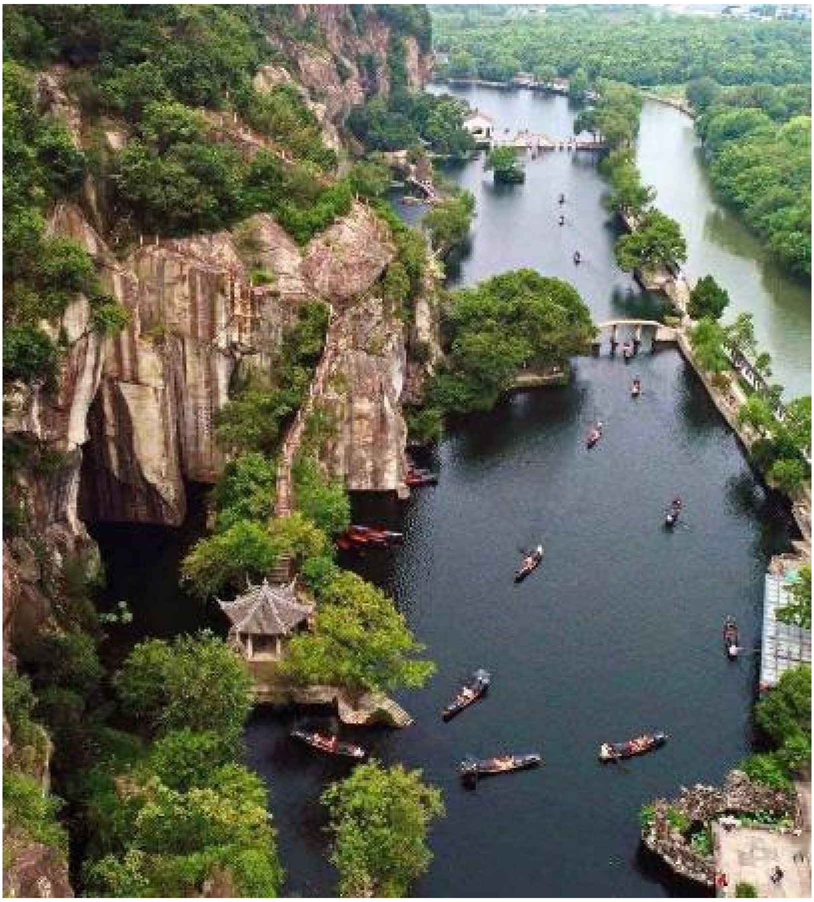

Figure 1.8 Shaoxing East Lake Scenic Area
Image Credits: ©Rui Huang, 2013.

(4) Architecture--research on the adaptive reuse of disused industrial buildings

International research on the adaptive use of old industrial buildings began in the late 1950s. In the mid-1970s to late 1980s, driven by the new wave of urban renewal, the adaptive reuse of old industrial buildings was widely promoted in Europe and the U.S. As developed countries entered post-industrial society, traditional industries declined and tertiary industries emerged, and thus the adaptive reuse of old industrial buildings received more attention. In 1979, Australia released *The Burra Charter*, which interprets the concept of adaptive reuse and advocates the accommodation of new functions in architectural heritage. The Barcelona 22@ project replaces traditional labor-intensive industries with emerging knowledge- and technology-intensive industries. Through the project, the industrial land in disuse in the coastal area, which is dominated by factories, warehouses, and containers, is transformed into a port with new functions. A large number of valuable industrial buildings are preserved in the transformation, and the social issues of residents and foreigners are also taken into consideration. Later, influenced by economic globalization and cultural diversity, the adaptive reuse of old industrial buildings has more diverse types and scales, and more diverse modes and methods.

The practice of adaptive reuse of industrial buildings in China began in the 1980s. Wu Liangyong (1983) puts forward thetheory of organic urban renewal, which guides the development of China's urban renewal theory and promoted the theory and practice of renovation and reuse of old industrial buildings. Shenyang University of Architecture Institute of Architecture (2003) presides over the scientific research project "industrial culture and reuse and re-creation of old industrial buildings in the process of transformation of Shenyang Tiexi Industrial Zone" systematically proposes a method of old industrial building reuse; Wang Jianguo (2010) explores the significance, basic content and realistic technically relevant renovation design methods for the study of the conservation adaptive reuse of industrial historic buildings and lots; Deng Xuexian (2019) studied the development and reuse of old factory buildings. Liu Boying (2019) explores the implementation of urban industrial lots renewal from the perspective of location and scale, land use nature conversion, site renewal drive, industrial building reuse, and landscape shaping.

1.3.2 Research status of industrial heritage conservation

（1）The origin of industrial heritage conservation

The industrial heritage conservation movement originated from industrial archaeology in the United Kingdom. As early as the end of the 19th century, the concept of industrial archaeology emerged in Britain, the birthplace of the industrial revolution, but it has not received much attention. It was not until in the middle of the 20th century, after the World War II, during the post-war period of massive urban reconstruction in Britain,some knowledgeable people began to pay attention to the preservation of industrial heritage out of their interest in industrial heritage, with the main purpose of calling for the preservation and maintenance of the production system and living relics of the Industrial Revolution. The industrial heritage conservation movement originated from industrial archaeology in the United Kingdom. As early as the end of the 19th century, the concept of industrial archaeology emerged in Britain, the birthplace of the industrial revolution, but it has not received much attention. It was not until in the middle of the 20th century,after the World War II, during the post-war period of massive urban reconstruction in Britain, some knowledgeable people began to pay attention to the preservation of industrial heritage out of their interest in industrial heritage, with the main purpose of calling for the preservation and maintenance of the production system and living relics of the Industrial Revolution.

（2）The history of foreign industrial heritage conservation

The first phase is the budding phase (the 1950s). It was characterized by early bottom-up census research and theoretical articles by civil society groups. In the mid-20th century, civil society groups in the UK began to study industrial heritage after the Industrial Revolution, conducting systematic surveys of industrial heritage and writing research reports. From then on, articles on industrial heritage began to appear sporadically. The American scholar Mumford L. (1934) explores the extensive impact of machinery, cities, regions, people, and technology on human culture in his book *Technologies and Civilization*.

The second stage is the early development stage (the 1960s-1980s). During this stage, industrial heritage conservation work had already reached a certain scale and organization, and the concern for industrial heritage transitioned from private organizations to official groups and professional institutions. In 1964, the British scholar Hudson was invited to lecture at the Smithsonian Institution in the United States, introducing the achievements of British industrial archaeology and the status of related research to representatives of industrial technology and related museums around the United States. In 1968, the voluntary organization, Industrial Archaeology Recordings, an important group for private industrial archaeology, played an active role in promoting industrial heritage protection; in the very same year, the third International Conference on the Conservation of Industrial Monuments was held at the Ironbridge Valley Museum, the site of the world’s earliest and famous iron bridge, and this conference brings industrial heritage to the attention of a wide range of countries around the world. In 1964, the American Society of Civil Engineers (ASCE) established the History and Heritage Committee and launched the Historic Civil Engineering Landmarks Program. In 1966, the *National Histories Preservation Act* was enacted, which led to a new era in the preservation of America's historical and cultural heritage. The Society for Industrial Archaeology (SIA) was founded at the Smithsonian Museum in November 1971, and in 1976 it promulgated the important historical document of *Historic Preservation Standards and Guidelines*. In Australia, the Industrial Archaeology Council (IAC) was established in 1968, the Conservation du Patrimoine Industriel (CILAC) was founded in France in 1979, and the International Committee for the Conservation of the Industrial Heritage

hosted an international conference on industrial heritage in Lyon, France in 1981. In 1978, the Third International Congress of Industrial Monuments was held in Sweden, where the International Committee for the Preservation of Industrial Heritage was established, leading to a wider recognition of the importance of industrial heritage. In 1980, the Committee of Industrial Archaeological Society in Japan completed the compilation of the *Guidelines for National Industrial Heritage Records*, which emphasizes the technology, skills, knowledge, and experience ofworkers, as well as the living conditions and working environment of production and labor in a specific period. Unlike other countries, in addition to the survey of hardware and equipment such as machines and structures, Japan has conducted a detailed survey of the working conditions and feelings of the workers themselves.

The third stage is the stage of broad consensus (1990-2005). During this stage, the UNESCO (United Nations Educational, Scientific and Cultural Organization) World Heritage Committee began to pay comprehensive attention to the balance, representativeness, and credibility of World Heritage categories. And in 1994, it promulgated the *Global Strategy for a Representative, Balanced and Credible World Heritage List* as an important document, and also released a series of important reports on world heritage, all of which have contributed to the future development of industrial heritage conservation and reuse positively. These reports include The World Heritage List: Filling the Gaps--An Action Plan for the Future, the Synthesis Periodic Report for the Asia-Pacific Region (2003), Identification and Documentation of Modern Heritage (2003), etc. The Nizhny Tagil Charter states that “the industrial site itself”, “buildings”, “components”, “machines” and “installations” are the main elements of industrial heritage, and also cover intangible aspects such as documentation and memory transmission. The Nizhny Tagil Charter suggests that the value of industrial heritage consists of four components: 1) industrial heritage is the witness of industrial activities, which have an important impact on the life and production of future generations; 2) industrial heritage itself has a certain social value by carrying people’s life memories, and at the same time has a certain technical value in terms of production and construction works, and the skills of its creation have a certain value, therefore, industrial heritage is the comprehensive embodiment of these three values; 3) at the same time, industrial heritage is recorded in the written archives as part of the memory of production life, and also has part of the intangible memory and perception, which has the characteristics and value of immateriality; 4) the site or industrial landscape formed by the special production process is the historical memory of a specific period of historical development and is scarce itself in nature. This aspect of the value of industrial heritage also greatly enhances the special nature of the value of industrial heritage itself. The European Route of Industrial Heritage (ERIH) is a cross-regional European Industrial route founded by 32 European countries. It links the industrial heritage of most

European regions as a unified whole of action for conservation and exploitation. The route has more than 1850 sites, of which more than 100 are "anchor points" of special historical significance in terms of industrial heritage and offering a high-quality visitor experience, as well as "Regional Routes", which provides more detailed information on regional landscapes heavily influenced by industrialization. The European Industrial Heritage Routes has promoted the preservation of Europe's industrial heritage, the transformation of industries and economic development in the region.

Currently, there is no clear concept about landscape genes. The studies related to it focus on cultural genes (meme) and morphogenesis genes. The term "gene" was introduced by the American biologist Morgan T.H. (1917). It means that the chromosome, which is the carrier of genetic information, copies the relevant information to the offspring and makes the next generation also have more similar characteristics to the previous generation. The original concept of "cultural genes (meme)" was first proposed by the famous American anthropologists, Kroeber A. and Kluckhohn C. (1952). They used the concept of biological heredity in biology to point out that local cultures formed based on different geographical environments also have similar genetic genes like in biology, and that cultural genes gradually accumulate and develop in a mutually divided spatial area. In this context, many scholars have conducted studies on cultural genes. Dawkins R. (1976) introduced the concept of the cultural gene (meme) formally and argued that meme is the basic unit through which culture is transmitted. Blackmore S.J. (2000) made a similar argument in her book *The Meme Machine*, where she used the concept of meme to describe various types of cultural landscapes, stating that cultural genes are similar to genetic genes in living organisms, both in terms of function and in terms of role. The positioning of the definition of cultural genes by Dawkins R. and Blackmore S.J. further enriches the connotation of cultural genes by trying to divorce them from the narrow biological metaphor, so it has also been pointed out that meme does not only possess the genetic function of DNA, but also plays an important role in the transmission of cultural information. Wilson E.O. (2004) in works such as *On Human Nature* proposed the argument that genes and culture are co-evolved, i. e. as an integral part of human social life, culture has similarities to biological evolution. Genetic inheritance is selective, with interactions and interactions between genes and local culture, and genes that are incompatible with the underlying cultural environment will be eliminated.

Schlüter O. (1899) in Germany was the first to research "morphological genes". Conzen M. R. G. applied morphological genes to the study of historical landscape morphology and spatial layout of town settlements and proposed the following conceptual approaches: plan unit, morphological period, morphological regions, morphological frame, plot redevelopment cycles and fringe belt. His research formed the Conzenian School in England. James K (1995) classified cultural landscapes into three levels: ecosystem, species and morphogenesis. James K (1995) classified cultural landscapes into three levels: ecosystem, species and morphogenesis genes. Whitehead H (2019) explored the approach of using genetic analysis to seek characteristics of village spatial morphology, and distilled morphogenesis genes by comparing village morphology in different spaces.

The landscape gene-related research in China mainly focuses on the field of traditional village conservation and renewal. The main research results include the following aspects: principles and methods of cluster gene identification (Sun, 2020), methods and means of cluster gene extraction (Wang, 2019), framework and system of cluster gene identification indicators (Qi&He, 2018), and models for comparative gene identification (Yang, Fang & Wang, 2019). In addition, Chinese landscape genes have also been applied to the field of traditional village tourism, such as the typical traditional settlement of Wuyuan in Jiangxi Province as a model to frame a "core-point-axis" tourism experience development approach based on the genetic system (Wang, Zhang, Long & Cao, 2019), and genetic routes and landscape narrative expression as a tourism planning model in the study of Jinggang Ancient Town (Cao&Deng, 2018). At present, research on landscape genetics in China is still in the exploration stage. In addition to the expansion of research objects and application scope, the enhancement of technical means such as gene extraction and identification is also an important direction of current research. The intervention of big data (Hu, Liu, & Chen, 2009), the application of parametric means (Li& Yi, 2020), and the use of GIS for data analysis (Hu Deng, Liu & Peng, 2020) are all technical attempts.

1.4 Objectives

1.4.1 Main objective

To explore the potential value of industrial lands in disuse and solve the dilemma of the renewal of China's industrial lands in disuse, a multi-scale landscape character atlas model and a creative strategies based on landscape character were established.

1.4.2 Secondary objectives

(1) Excavating representative landscape characters of industrial lands in disuse and establishing the corresponding gene atlas will establish a certain paradigm for the study of industriallands in disuse in China.

(2) It provides theories, methods and materials for character protection, prototype mining and creative strategies of industrial lands in disuse in different regions of China.

1.5 Research Method

1.5.1 Literature research method

The literature research method is the most basic research method. The theories and methods of “biological gene”, “semiotics” and “typology” have inspired this study to propose a theoretical framework of landscape gene. Among them, the relevant basic literature mainly involves the literature of UNESCO, ICOMOS, various national or regional governments and other organizations, as well as the academic monographs, articles and online materials of relevant scholars.

1.5.2 Field research method

For the research that will eventually guide the practice, field research is a very important method to obtain information. Combining theory and research is the only way to finally propose a method and apply it to practice. The elaboration of landscape gene theory, the proposal of the landscape genetic structure system and the mapping of the landscape genetic atlas in this study are largely based on the field research of a large number of cases, among which the key places are Huangshi, Wuhan, Pingxiang, Xuzhou and Datong in China (Figure 1.9), Catalonia in Spain, Ruhr Industrial Base in Germany, the Nord-Pas de Calais Mining Basin in northern France, etc.

1.5.3 Typological method

The typological method is mainly to group and categorize complex things into relatively clear systems. This method of classification allows things to be covered and described in a complete and non-repetitive way, and at the same time establishes connections between various complex phenomena to assist further analysis and interpretation. In this study, the typological approach is used extensively in the research of industrial land in disuse to shape the hierarchical classification criteria of industrial land in disuse landscape genes by exploring the tangible and intangible links between different types. The typological method plays an important role in the construction and application of landscape gene theory.

1.5.4 Comparative research method

The method of comparative research is to use two or more objects with certain similarities, consider them according to certain specific criteria, and compare them to find thesimilarities and differences, so as to summarize the universal laws and discover the special laws. This study includes both diachronic and synchronic comparative studies, focusing on the comparison of things from different times in the same space and the comparison of things of different spaces in the same time respectively.

1.5.5 Systematic analysis method

The method of systematic analysis emerged along with systems science, which requires a comprehensive view and analysis of objective reality from a systematic perspective to find solutions. It is a strategy that can bypass the black box and quickly determine the nature of the problem and make holistic judgments when there is still much uncertainty about the problem. The systematic analysis method used in this study is also in line with the holistic research approach emphasized by the gene theory.

Figure 1.9 Fieldwork and interview photos
Image Credits: ©Qipeng Liao&Huangxin Cheng. 2018-2022.

1.6 Structure of the thesis

The thesis consists of 6 chapters.

Chapter 1, introduction. This chapter clarifies that the mining city facing decline is a dual carrier of crisis and revival. The concepts of industrial land in disuse and landscape character are defined. The current research status on industrial land in disuse, industrial heritage, and landscape character is reviewed, and the problems and development trends are analyzed.

Chapter 2, background interpretation. This chapter analyzes the causes and classifications of industrial lands in disuse based on interpreting the characteristics of Chinese mining cities, and the main problems in the conservation and renewal of industrial lands in disuse in China.

Chapter 3, theoretical framework. It constructs the theoretical framework of landscape character based on the epistemology of typology and hermeneutics and the methodology of design language and semiotics, with the landscape character structure system and landscape character atlas mapping as the core.

Chapter 4, landscape character structure system. Based on the evaluation of the value of industrial lands in disuse and its morphology and structure laws, the “meta-piece-chain-domain” landscape character structure is proposed. Coupling the mining city space, industrial lands in disuse cluster and green space, it explores the effective ways for the transformation of mining cities, the shaping of mining city characteristics, and the construction of high-quality human living environment.

Chapter 5, landscape character atlas. An object-oriented landscape character classification model is established, and the extraction method of landscape character of industrial lands in disuse is proposed. Based on the results of the extraction, the information is encoded, a landscape character information base is established, and a landscape character atlas is mapped.

Chapter 6, conservation methods and creative strategies. The conservation method, and creative strategies of industrial lands in disuse based on the landscape character are proposed. And an empirical study is conducted with the example of the Tonglushan and Hanyeping Railway.

1.7 Methodology

Although the used methods will differ for each part of the thesis, there are some methodological aspects that are common throughout the research's approach. The method of third typology and interpretative Anthropology run through the whole thesis.

The first two typologies rationalize architecture by making analogies with products other than nature or architecture. The third typology is different from the first two typologies in that it focuses more on the city and architecture itself. This operation of juxtaposing contents from different historical periods is the process of transforming transience into synchrony. It is the idea of structuralism and the ideological basis of typology to study the process of urban time accumulation with corresponding parallel space. We cannot closely trace the long history of a city, but we have a large number of spatially juxtaposed historic cities in their current state. Therefore, this research views the present historical land in disuse as a kind of synchronic expression or achievement. Then it analyzes and constructs the historical land in disuse in mining cities to understand it with the framework of structure and type.

Under the concept of interpretative anthropology, the fundamental task of theoretical construction is no longer to sort out some abstract laws, but to try to make thick description possible. The author thinks that this way of thinking is not to cross the individual, but to generalize and explore methods in individual cases. It should be advocated by urban historical landscape as a new research method and concept of urban and cultural heritage. Each of the city cases we analyze through thick description may have a different history and may have a variety of structures or types. But what is unified is the deep meaning of the method, that is, the way in which the theory is applied. The cognitive models and paradigms behind them are the same. It is an epistemology that is analytically oriented rather than therapeutic or corrective. Its starting point may be small and straightforward, but through a compact set of case facts, coupled with logical and brief reasoning, the conclusions to be drawn may be enormous and profound. Therefore, when solving the problems related to industrial land in disuse, the author always emphasizes the importance of having a relatively well-developed cognitive system. The first is a deep understanding of the past and the present, and then it is possible to try to make future-oriented guidance when applied to the conservation and design of industrial land in disuse.

The methodological aspects that are specific to each part of the thesis are subsequently described.

Chapter 2 Overview of Mining cities and industrial lands in disuse in China. This chapter clarifies that the mining city facing decline is a dual carrier of crisis and revival. The concepts of industrial land in disuse and landscape character are defined. The current research status on industrial land in disuse, industrial heritage, and landscape character is reviewed, and the problems and development trends are analyzed.

Solid fieldwork and rich literature research are the basis of this chapter. The author systematically investigated more than 20 mining cities in China and conducted in-depth interviews with local residents and managers. Using the third type method, this paper analyzes the spatial form of more than 20 mining cities and more than 70 industrial lands in disuse in China, and draws conclusions on the classification, spatial distribution characteristics and structural types of mining cities. On the basis of these investigations and analysis, using the methods of induction and deduction, this paper obtains the causes and difficulties of China's industrial land in disuse.

Chapter 3, theoretical framework. It constructs the theoretical framework of landscape character based on the epistemology of typology and hermeneutics and the methodology of design language and semiotics, with the landscape character structure system and landscape character atlas mapping as the core.

When studying the basis of epistemology and methodology, the author studies a large number of relevant international and Chinese literature, and analyzes the literature by inductive and deductive methods.

Using the interdisciplinary method, introducing the method of biogenetics, combined with the analysis of typology, and on the basis of summarizing the characteristics of more than 20 mining cities in China, the author puts forward the structural system of unit-piece-chain-domain.

The methods of typology and geographic information system are used in landscape character recognition, extraction and landscape character atlas mapping. The abstract landscape characters are displayed in the form of vision and given their spatial attributes.

In the research of creative strategy, the method of Interpretative Anthropology is used. Through the arrangement of compact design cases and short logical reasoning, the creative strategy suitable for the recover of industrial land in disuse is obtained.

Chapter 4, landscape character structure system. Based on the evaluation of the value of industrial lands in disuse and its morphology and structure laws, the “meta-piece-chain-domain” landscape character structure is proposed. Coupling the mining city space, industrial lands in disuse cluster and green space, it explores the effective ways for the transformation of mining cities, the shaping of mining city characteristics, and the construction of high-quality human living environment.

In this chapter, the methods of field survey, historical drawings and literature analysis are used, as well as the method of Interpretative Anthropology.

Huangshi, a representative mining city in China, is selected for a case study to explore the cognitive model and paradigm behind the case.

Chapter 5, landscape character atlas. An object-oriented landscape character classification model is established, and the extraction method of landscape character of industrial lands in disuse is proposed. Based on the results of the extraction, the information is encoded, a landscape character information base is established, and a landscape character atlas is mapped.

The method of typology is the main method of this chapter. Through the analysis of the characteristics of industrial wasteland, the method of typology is used to identify the spatial characteristics such as environmental characteristics, layout characteristics and buildings, and then combined with the cultural character of industrial lands in disuse to map the character atlas of industrial lands in disuse.

The method of hermeneutics has also been applied. Two typical cases are selected to illustrate the method of mapping the landscape character atlas.

Chapter 6, conservation methods and creative strategies. The conservation method, and creative strategies of industrial lands in disuse based on the landscape character are proposed. And an empirical study is conducted with the example of the Tonglushan and Hanyeping Railway.

This chapter mainly uses the methods of Hermeneutics and art design, and obtains the general creative strategies in the three by analyzing a large number of industrial wasteland cases. Taking Tonglushan wasteland and Hanyeping railway line in Huangshi City as examples, the creative strategies of the three are applied to recover industrial lands in disuse.

Chapter 2

Overview of Mining cities and industrial lands in disuse in China

Chapter 2 Overview of Mining cities and industrial lands in disuse in China

Mining city is a city that emerges or develops from the development of local mineral resources, which causes population gathering and thus forms a city. For cities with mining as the leading industry, their main function is to provide mineral products and related services for society.

2.1 Classification and spatial structure of mining cities

2.1.1 The definition of mining city

At present, global scholars have put forward different criteria for defining mining cities, which can be summarized into the following three categories.

The first standard is the share of mining output value in the total industrial output value of the city.

The National Development and Reform Commission (2002) defined resource-based cities with the output value of extractive industries accounting for more than 10% of the total industrial output value; Zhao Yukong (1992) proposes that the standard should be more than 20% of mining output value in the total industrial output value; However, Yu Binyang and Zhao Jinghai

(1999) set the standards that the secondary industry dominated by primary resources development accounts for more than 50% of the total industrial output value, and primary products dominate the industrial output value structure; Han Fengqin and Wan Shouqiong (2014) propose their criteria that the proportion of strategic resources or energy deposits in national reserves should be greater than a certain value (e.g. 10%), or the proportion of mining output value in GDP should be greater than a certain value on average (e.g. 7%) in recent ten years.

The second standard is the proportion of mining employees in urban employees.

Harris and Nelson have both used this method to define mining cities in the US., C. D. Harris (1943) defines mining cities in the functional classification of American cities as mining workers accounting for 15% of all employees; H. J. Nelson (1955) proposes that mining workers should account for more than 7.63%of all urban workers. Chen Rongping (2003), a Chinese scholar, believes that the resource economy of resource-based cities accounts for more than 40% of the urban economy, and the working population engages in resource development and processing also exceeds 40% of the employed population; Han Fengqin et al. (2014) puts forward that one city should be classified as a resource-based city if in the past ten years, the proportion of mining employees in this city is greater than a certain value (e.g. 5%).

The third kind is compound criteria on defining mining cities.

The compound definition criteria examined in various literature include the scale of mining output value, the proportion of mining output value in the city's total industrial output value, the proportion of mining output value in the city's GDP, the production scale of mining industry, the scale of mining industry employees, the proportion of mining industry employees in the city's total employees, etc. The application of the compound definition criteria includes the following.

Firstly, multiple indicators should be met at the same time. For example, Li Wenyan (1978) proposes that coal mining cities should conform to the following indicators: coal miners accounting for more than 25% of the city's employees, the output value of the coal industry accounting for 15% of the city's total industrial output value, and more than 2 million tons of coal production per year. Wang Qingyun (2003) proposes that four indicators should be met in defining China's resource-based cities: the proportion of resource-based industrial output value in industrial output value (more than 10%), the scale of output value (more than 200 million yuan in prefecture-level cities and more than 100 million yuan in county-level cities), the proportion of resource-based industrial employees in all employees (more than 5%), and the scale of employees (more than 20000 people in prefecture-level cities and more than10000 people in county-level cities). And based on this standard, he selects 118 resource-based cities in China in 1996.

Secondly, a mining city can be designated as only one of the compound indicators is satisfied. For example, Hu Kui (2001) proposes that as if one of the following indicators is met for one city, it can be designated as a mining city: more than 100 million yuan in the mining output value of prefecture level cities, and more than 45 million yuan in that of county and town levels; mining output value accounting for more than 5% of the city's GDP; more than 6,000 people are employed in the mining industry. In addition, famous old mining cities, emerging mining cities with rapid development momentum and cities omitted from statistical data are also listed as mining cities, even though their data are lower than the above indicators. According to this standard, there were 426 mining towns in China in 1999. Shen

Lei (1999) adopts the standard that the proportion of mining employees in all urban employees should not be less than 15% or the output value of the mining industry should not be less than 10%. According to this standard, there were 99 mining cities in China in 1991. The Mining City Working Committee of China Mining Association determined the definition criteria of mining cities at the symposium organized in April 2004 as follows: cities should be prefecture-level or county-level administrative cities; the proportion of mining output value in the industrial output value of the city should not be less than 10%, or the proportion of mining employees in the city should not be less than 15%; and whether the traditional mining function still plays an important role in the city. According to this standard and *The Basic Database of China's Mining Cities* compiled by Hu Kui in 2001, the mining cities working committee determines that there were 178 mining cities in China, accounting for 26.7% of China's 660 cities in the year 2004 (China Association of Mayors,2006).

In the above definition criteria, the single indicator is simple and clear to define mining cities, but it is not comprehensive enough. However, it is inappropriate to use the absolute value of output, employees, and output value as the defining standards, since the values of mineral products output, employees and output value may exceed the defining value in some large comprehensive cities, such as Beijing and Chongqing, which cannot be defined as mining cities. In addition, there are great differences between mining towns and mining cities, so it is not suitable to classify mining towns into mining cities. Therefore, this research takes the definition criteria and the defined mining cities proposed by the Mining City Working Committee of China Mining Association as the research category.

The concepts similar to mining city mainly include resource-based city and industrial and mining city. Resource-based city refers to that with resource development as the leading industry. Resource (see Table2.1 for resource classification) refers to exhaustible but non-renewable mineral resources and renewable forest resources in natural resources. Thus, the concept of resource-based city is more extensive than that of mining city, as it includes not only mining cities, but also forest industrial cities. Industrial and mining city has both broad sense andnarrow sense. Broadly speaking, industrial and mining city has a larger concept than mining city, including processing industrialcities and mining cities. In the narrow sense, industrial and mining city is equal to mining cities as it mainly refers to cities with mining and primary processing of mineral resources as the leading industries.

Table2.1 resource classification

Source: People's Publishing House,2013.

<table>
<tr><th colspan="4">Natural resources</th><td colspan="3" rowspan="3">Social and human resources</td></tr>
<tr><td colspan="2">Exhaustible resources</td><td colspan="2">Non-exhaustible resources</td></tr>
<tr><td>Renewable resources</td><td>Non-renewable resource</td><td>Constant type resource</td><td>Subconstant stereotyped resources</td></tr>
<tr><td>Biological resources</td><td>Coal, oil, natural gas, etc</td><td>Solar energy, nuclear energy</td><td>Wind, water, geothermal energy</td><td>Economic civilization</td><td>The information technology</td><td>The human resources</td></tr>
</table>

2.1.2 Classification of mining cities

The current classification methods of mining cities in China can be summarized as follows.

First, classification in terms of the comprehensive status of mining city development. Bao Shoubai et al. (2000) Bao Shoubai et al. (2000) classify industrial and mining cities into five categories using three parameters such as the degree of mineral resource development, the degree of development of the main enterprises of resource exploitation and the current situation of urban industrial structure: cities in the development period, cities facing a second venture, cities with a high degree of integration, cities with stagnant development of main enterprises and cities with resource depletion.

Second, classification in terms of the development stages. Mining cities can be divided into: mining cities in the initial development stage; mining cities in the development or peak period of resource development; mining cities in urgent need of transformation in the period of resource exhaustion, namely resource-exhausted (or attenuated) cities.

Third, classification in terms of the dominant mineral resources in mining cities. Mining cities can be divided into five types: coal, oil and gas, metal (including iron, chromium, manganese and other ferrous metallurgical mining cities, non-ferrous mining cities, gold mining cities, etc.), non-metal (stone mining cities, chemical mining cities, etc.) and integrated (mining cities with equal shares of several mineral resources). (Table2.2)

Table 2.2 classification and quantity of mining cities in China in terms of resource types.

<table>
<tr><th colspan="3">City type</th><th>Quantity</th></tr>
<tr><td rowspan="2">Coal</td><td colspan="2">Prefecture level cities</td><td>31</td></tr>
<tr><td colspan="2">County-level cities</td><td>41</td></tr>
<tr><td rowspan="2">Oil and gas</td><td colspan="2">Prefecture level cities</td><td>8</td></tr>
<tr><td colspan="2">County-level cities</td><td>7</td></tr>
<tr><td rowspan="6">Metal</td><td rowspan="2">Metallurgy</td><td>Prefecture level cities</td><td>10</td></tr>
<tr><td>County-level cities</td><td>9</td></tr>
<tr><td rowspan="2">Coloured</td><td>Prefecture-level cities</td><td>9</td></tr>
<tr><td>County-level cities</td><td>18</td></tr>
<tr><td rowspan="2">Gold</td><td>Prefecture level cities</td><td>3</td></tr>
<tr><td>County-level cities</td><td>7</td></tr>
<tr><td rowspan="2">Non metallic type</td><td colspan="2">Prefecture-level cities</td><td>3</td></tr>
<tr><td colspan="2">County-level cities</td><td>25</td></tr>
<tr><td rowspan="2">Comprehensive type</td><td colspan="2">Prefecture level cities</td><td>4</td></tr>
<tr><td colspan="2">County-level cities</td><td>3</td></tr>
</table>

Fourthly, classification in terms of their administrative level or city size. According to the administrative level, cities can be divided into prefecture-level cities and county-level cities; according to city size, cities can be divided into megacities, big cities, medium cities, and small cities.

2.1.3 Spatial distribution of mining cities

Among the 178 mining cities in China, 54 are located in the eastern region, accounting for 30% of the total number of mining cities in the country; 74 are located in the central region, accounting for 42% of the total number of mining cities in the country; and 50 are located in the western region, accounting for 28%. The specific distribution of mining cities in China is shown in Table 2.3.

Table 2.3 Regional distribution of mining cities in China

Region	Province (city)	Quantity
The eastern region	Hebei	10
	Liaoning	12
	Jiangsu	4
	Fujian	7
	Shandong	15
	Guangzhou	5
	Hainan	1
The central region	Shanxi	14
	Jilin	8
	Heilongjiang	6
	Anhui	6
	Jiangxi	11
	Henan	15
	Hubei	5
	Hunan	9
The west region	Inner Mongolia	7
	Guangxi	5
	Chongqing	2
	Sichuan	7
	Guizhou	6

	Yunnan	4
	Shaanxi	4
	Gansu	5
	Qinghai	1
	Ningxia	3
	Xinjiang	6

2.1.4 Spatial structure characteristics of mining cities

（1） The loose spatial structure

The spatial distribution structure of mining cities has obvious resource orientation. Restricted by the discontinuous and disequilibrium distribution of mineral resources and geological conditions such as mining subsidence area, the spatial layout of the mining area is also scattered and discontinuous. The residential areas in the mining area need to be selected in the coal-free area or the edge of the mining area, and in order to facilitate the commuting of workers, the residential areas are mostly built around the scattered mining area, forming their own independent pieces. The distance between settlements and mines in China's coal mining areas is generally less than 2.5 kilometers. Therefore, the distance between each district is far, and the urban compactness1 is low, which makes it difficult to form spatial aggregation, and also causes the waste of urban traffic and infrastructure. Due to the sparse and loose spatial structure, it is difficult to form a complete urban image in mining cities.

（2） Urban-rural staggered distribution

[1]Urban compactness is expressed by compactness coefficient (IC) = urban built-up area/urban minimum peripheral area.

Due to the scattered urban spatial layout, non-urban landscapes such as farmland, water area and farmstead are interspersed within the city, forming a chaotic scene of urban and rural staggered distribution.

（3） Confusing functional zoning

The scattered layout makes the division of urban functional areas unclear, and the same functional areas (such as education, medical care, culture, sports, entertainment, and other public facilities) are scattered in each area, causing duplicated construction.

2.1.5 Spatial structure types of mining cities

The spatial structure of mining cities in China can be divided into three types: one-city-multiple-towns, polycentric dispersed, decentralized, and concentrated distribution (Figure 2.1).

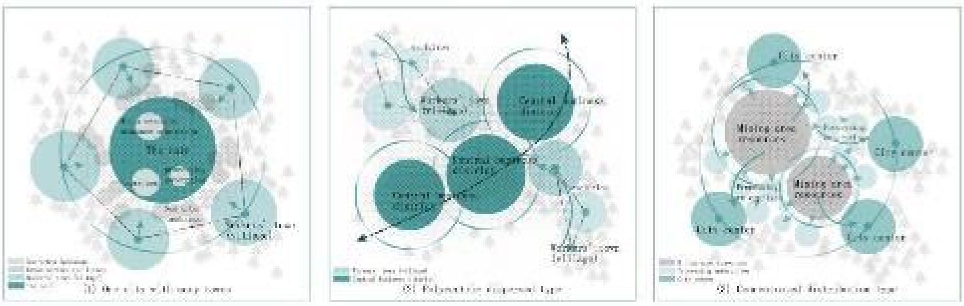

Figure 2.1 Spatial structure types of mining cities
Image Source: painting by author.

(1) One-city-multiple-towns type

The spatial structure type consists of a main urban area and multiple industrial and mining communities surrounded. The main urban area is the administrative, economic, and cultural center of the mining city. It is also the location of the management organization of state-owned mining enterprises. There are also some service industries and processing enterprises distributed in it. It has a large population and a large scale of land for use, and complete construction of municipal infrastructure and public facilities. Industrial and mining communities are developed from scattered mining settlements with small scale and relatively simple facilities. There is a certain distance between those communities and the main urban area, interwoven with non-urban landscapes (Zhao, 2015). Tongling, Gejiu, Datong (Figure 2.2), Hegang, Qitaihe, Huaibei and other mining cities belong to this type.

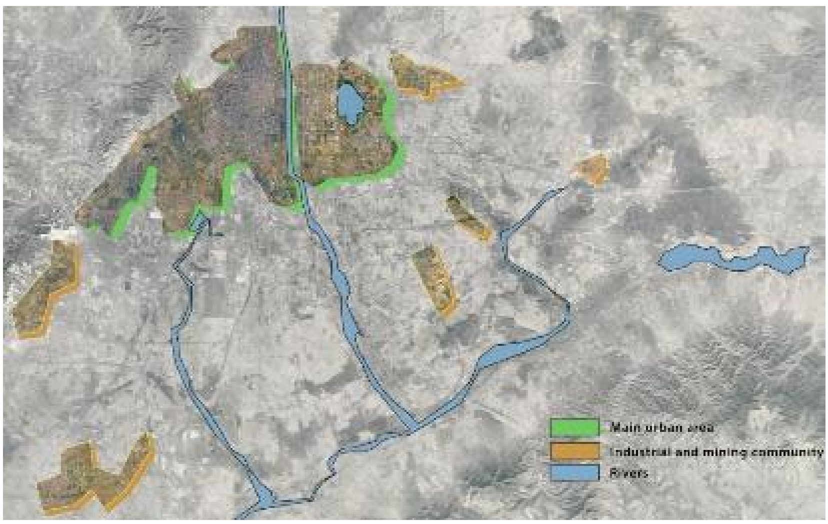

Figure 2.2 Datong, One-city-multiple-towns type
Image Source: painting by author.

(2) Polycentric dispersed type

This kind of city is composed of multiple central districts with decentralized layout and similar scale and functions, mostly in a united area or banded layouts (Zhao, 2015). Some of this spatial pattern is formed at the beginning of mining city construction, while others evolve from “one-city-multiple-town”. With the development of the mining industry, the increase of population scale, and the improvement of the service industry and infrastructure, the communities originally scattered around the main city gradually develop into areas with central functions, forming a “multi-center decentralized” mining city. Mining cities of this type include Liupanshui, Yangquan, Huainan (Figure 2.3), Jixi and Pingdingshan.

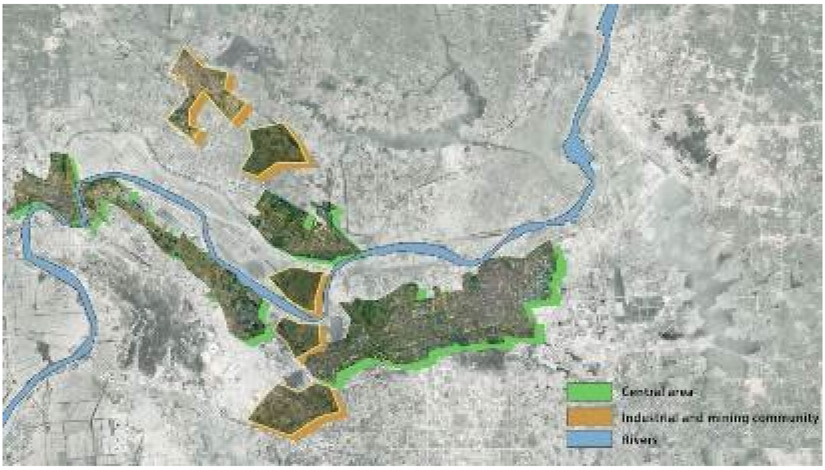

Figure 2.3 Huainan, Polycentric dispersed type
Image Source: painting by author.

(3) Concentrated distribution type

When the mineral resource reserves are large and concentrated, the mining area is compact and some processing enterprises are distributed around the mining area. The layout of urban land is relatively concentrated, the functions and facilities of the urban center are complete, and the scale is large, forming a centralized and distributed spatial structure. Mining cities, like Fushun (Figure 2.4), Shizuishan and Jincheng, all belong to typical centralized and distributed spatial structure.

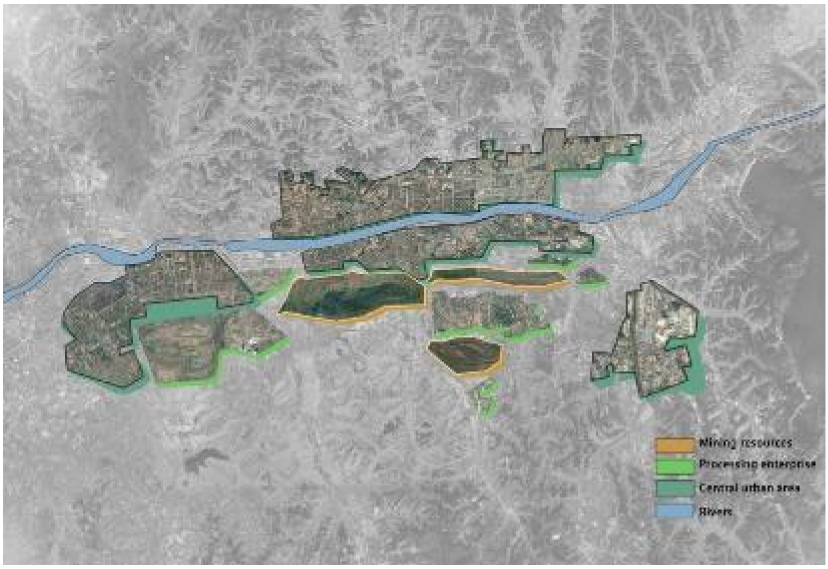

Figure 2.4 Fushun, Concentrated distribution type
Image Source: painting by author.

2.2 Formation and development of mining cities

2.2.1 Formation of mining cities

The formation of mining cities is driven by economic activities with the mineral resources industry as the leading industry, and influenced by national macro-layout of regional productivity and relevant policies. And they are gradually formed through the urbanization of mining areas, based on certain storage and location transportation conditions of mineral resources. In the initial process of urbanization, industrial bases engaged in the development of mineral resources generate radiation effects on the surrounding countryside, prompting rural labor force to leave the primary industry into the resource mining industry. People become familiar with and master the resource mining industry technology and gradually accept the influence of urban culture; subsequently, with the development of resource exploitation and the expansion and spatial concentration of industrial and mining areas, the proportion of mining employees in the social population will increase and the scale of urban social population will gradually expand, thus promoting the expansion of urban land use, improvement of infrastructure, and urban economy in the region. The political and cultural functions of the city will be strengthened and gradually, urbanization is completed.

(1) The history of mining city formation

China has a long history of mining exploitation. According to archaeological findings, there were at least 40 ancient mining cities in China as early as the late Neolithic period (Zang Yicheng, 2003), such as Chengtou Mountain in Hunan province and Sanxingdui in Sichuan Province. After a long time, the traditional mining towns built on handicraft industry gradually took shape in the Middle and Late Agrarian Society. China's ceramic development, for example, began at the end of the primitive society, developed a resource center with the shape of a town in the Tang Dynasty, and not until the mid-Ming Dynasty did the resource center grow into a national porcelain center like Jingdezhen. Modern mining cities in China based on industrial production originated from mining areas in the semi-feudal and semi-colonial period. Most of them were controlled by British and Japanese imperialists, such as Fushun, Kailuan, and Jixi mining area. With resources exploitation, the scale of production, population and land use of these mining areas have been continuously improved. Some mining areas have gradually developed into small towns or counties, and most of them were established as cities after the founding of the People's Republic of China (Table 2.4).

Table 2.4 mining cities developed from mining areas before the founding of the PRC

City name	administrative level	City ages	Mining area name and development age
Jiaozuo	prefecture-level	1953	Jiaozuo mining area （1898）
Tangshan	prefecture-level	1949	Kailuan mining area （1881）
Pingxiang	prefecture-level	1960	Pingxiang mining area （1898）
Lengshuijiang	county-level	1969	Xikuangshan antimony deposit area（1860）
Gejiu	county-level	1951	Gejiu tin mine（1886）
Benxi	prefecture-level	1939	Benxihu Iron Mine （1904）
Zaozhuang	prefecture-level	1960	Zaozhuang mining area （1818）
Huainan	prefecture-level	1951	Huainan mining area （1911）
Yangquan	prefecture-level	1952	Yangquan mining area （1903）
Fushun	prefecture-level	1949	Fushun mining area （1901）
Liaoyuan	prefecture-level	1949	Xi 'an mining area （1912）
Datong	prefecture-level	1949	Datong mining area （1907）
Jincheng	prefecture-level	1983	Jincheng mining area （1915）
Hegang	prefecture-level	1949	Hegang mining area （1917）
Jixi	prefecture-level	1956	Jixi mining area（1925）

Beipiao	county-level	1985	Beipiao mining area（1921）
Hebi	prefecture-level	1957	Hebi mining area（1912）
Hancheng	county-level	1983	Hancheng mining area（1931）
Yumen	county-level	1955	Yumen oilfield（1939）
Ma on shan	prefecture-level	1956	Ma 'anshan Iron Mine（1942）
Fuxin	prefecture-level	1949	Fuxin mining area（1936）

There are three main stages of formation in China's mining cities.

The first stage is in the 1950s and 1960s.

This is the first peak of the formation of mining cities in China. In the early days of the founding of the country, the government built and developed several mining cities on the basis of the mining areas established before liberation, such as Tangshan, Fushun, Fuxin, Liaoyuan, Datong, Hegang, Gejiu, Huainan, Yangquan and so on. Later, during the First Five-Year Plan period (1953-1957), guided by the development strategy of the heavy industry system centered on the steel industry, large-scale economic construction generated a large demand for resources and energy. The state has taken advantage of its original weak industrial base, capital and technical assistance from the former Soviet Union and low-cost labor and other conditions. On the one hand, China continued to develop and build up old mining areas; on the other hand, a number of new mining areas have been built, and gradually formed urban formations. Subsequently, in the three years of the Great Leap Forward period (1958-1960), the state further increased efforts to develop the mining industry, when the spatial distribution of mining cities emphasizes decentralized construction and expansion from central Plains to remote areas.

The second stage is 1961-1980.

From 1964 to 1980, China carried out the "third-line construction" based on national defense considerations, that is, a large number of industrial bases built in 13 provinces and autonomous regions which belonged to the third-line regions. Among them, the main mining bases are: Panzhihua Iron and Steel Base, Jiuquan Iron and Steel Base, Jinchuan Non-ferrous Metal Base, Liupanshui Coal Industry Base, Weibei Coal Base, and other oil and gas fields in Sichuan, Jianghan, Changqing, Zhongyuan. These industrial bases have gradually grown into the pillar of industrial development in central and western China. Industrial bases like Panzhihua, Liupanshui have evolved into mining cities through urbanization.

The third stage is 1981-1990.

After reform and opening up, the state gradually shifted its focus to economic construction. In this stage, China strengthened the exploitation of coal, oil, iron and steel, non-ferrous metals, electricity, building materials and other resources, and thus strengthened the construction of resources and energy bases. There emerged the second peak of the formation of mining cities in China. After the 1990s, China's economy developed rapidly. The demand and intensity of mineral resource exploration were greatly increased. However, the possibility of forming new mining cities gradually decreased due to the mechanism of resource exploitation under the market economy.

(2) Formation pattern and characteristics of mining city

According to the order of mining and city generation, the formation of mining cities in China can be divided into two modes— “mining before city” and “city before mining”.

“Mining before city” mode is developing the mining area before establishing a city. Originally, there was no urban foundation, and the mining area was built on farmland, mountain villa, forest and even wilderness and desert. With the development of the mining area, the scale of land use and population expanded and gradually established the urban formation. The mining area is the starting point of mining city formation and the basis of its development. The urbanization of a mining area mirrors the formation of the mining city. Built on the edge of mining” and “born from mining” are important characteristics of the formation mode of such mining cities. Most mining cities in China, such as Daqing, Ma’anshan, Panzhihua, Bayan Obo, Pingdingshan, Jinchang, Karamay, etc., all belong to this mode.

“City before mining” mode is the mining city formation mode in which cities reemerge due to resource extraction or cities completely change their evolving directions. “Prospered by mining” is the main characteristic of such mining cities. Datong, Tongling, Korla, and Dexing belong to this mode.

Both the mode of “mining before city” and “city before mining” show different formation characteristics of mining cities compared with other types of cities in China. First, mining cities are strongly resource-pointed and resource-dependent. The formation of a mining city relies on mineral resources with rich proven reserves, which is the basic element of the formation of a mining city. Second, it is influenced by national macro strategies and policies. The formation of mining cities in China is controlled by national development strategic objectives, development plans and related policies, and is the product of national macroeconomic regulation. Third, the formation of mining cities begins unexpectedly. In a short period of time, the state mobilized a large amount of capital, manpower, material construction plant, transportation facilities, power facilities, residential areas, and other life service facilities to make sure that mining areas can be put into production as soon as possible to meet the huge number of resources and energy required by national economic development. According to the time of mining formation and city establishment in some mining cities after the founding of the PRC listed (Table 2.5), it can be seen that the process from mining to the formation of city scale and organizational system did not undergo a long evolution process, but happened unexpectedly. This feature is particularly prominent in the formation of mining cities in the early days of the founding of the People's Republic of China.

Table 2.5 Comparison of the time of mining formation and city establishment in some mining cities after the founding of the PRC

City name	**category**	**Mining time （year）**	**City age （year）**
Pingdingshan	Coal type	1953	1957
Tongchuan	Coal type	1955	1958
Ma'anshan	Ferrous metal type	1953	1957
Baiyin	Non-ferrous type	1956	1958
Qitaihe	Coal type	1958	1970
Jiayuguan	Ferrous metal type	1958	1965
Jinchang	Non-ferrous type	1958	1981
Huaibei	Coal type	1958	1960
Wuhai	Coal type	1958	1961
Daqing	Oil type	1960	1980
Liupanshui	Coal type	1965	1978
Panzhihua	Ferrous metal type	1966	1987

2.2.2 Development and evolution of mining cities

(1) The development law of mining city

M. K. Hubbert, an American geologist, points out that the development process of the mining industry and mining cities dominated by the exploitation of exhaustible mineral resources has obvious periodicity, and most of the cities and industries have to go through four development stages: preparation period, growth period, maturity period, recession, or transition period.

Preparation period is the early stage of resource development, including detailed exploration on mineral resources reserves, grade, geological condition, mining plan formulation and selection; preparation and selection of mining scheme; strategic overall planning for urban development; construction of production facilities, auxiliary production facilities, transportation facilities, urban infrastructure, living facilitiesand the construction of public service facilities, etc.

Growth period refers to the stage from the mining area putting into production to the construction of a city. In this stage, with the growth of the mining industry, the scale of production and the number of mining employees kept increasing. Accordingly, the scale of urban population and land use has increased, and the urban infrastructure and service facilities have gradually improved.

Maturity period is a stage in which a city continues to develop after production reaches its design goals. The duration of this phase depends on many factors, such as resource storage conditions, level of production technology, domestic and foreign and regional economic development and national policies. In this stage, the city scale was further expanded and tertiary industries were developed.

Recession or transition period means that with the depletion of resources, the mining industry, which dominates the urban economy, gradually declines, the urban industrial structure needs adjustment and transformation, and urban environmental and social problems become prominent. At this stage, city development is faced with new choices. One of the directions is to make use of the resources, capital, talents, and technological advantages that are already formed. The city needs to transform the old industry with new technology and lengthen the industrial chain. Or the city chooses to introduce and develop emerging industries and make mining cities develop into comprehensive cities through diversified transformation of industrial structure. The second direction is to give up urban development and turn mining cities into “mining sites”.

(2) Development mechanism of mining city

The economic activities of a city are composed of basic and non-basic parts. The part that serves the internal needs of a city is called the non-basic part; The part that serves the needs of other cities and regions outside the city is called the basic part. The urban economic base theory holds that the basic part of urban economic activities is the main driving force of urban development. The increase of the output activities of the basic part can increase income. On the one hand, it leads to an increase in the consumption and service demand of the employees of the basic part, which results in the corresponding increase of the income and employment of the non-basic part of the region. On the other hand, by promoting the expansion of the basic part itself, the urban scale is enlarged and causes the cycle of urban growth with “multiplier effect”[2], which is the internal dynamic

2 Multiplier effect: each increase in the basic activities of a city causes chain effect, leading to an increase in investment, revenue, and the number of workers in the city

mechanism of urban development. In the process of urban growth, the basic and non-basic activities develop dynamically and can be transformed into each other. With the decline of the old basic part in urban economic activities, it is necessary to derive new basic parts in the non-basic part to promote sustainable development of the urban economy. In fact, the development of a city is not only promoted by the expansion of the basic part of economic activities, but also restricted by regional physical geographical conditions, economic conditions, production technology level and other factors. It is an indispensable part of urban development to coordinate dynamic factors and restricted conditions.

For a mining city, the mining industry is the basic part of the city's economic activities. Most of the developed resource products or primary processing products are exported outside and exchanged for revenue to start the cycle and cumulative growth of the city, thus expanding the city scale, and forming an aggregation effect. Due to the high degree of specialization of the basic part of the mining city, and the short history of urban development, the proportion of the basic part in the urban economic activities is relatively high, that is, B/N is relatively high [3], and the city's dependence on the basic part is also relatively high, which is manifested as the single dynamic mechanism of the development of the mining city. The mining

that is several times greater than the output of the basic activities. This amplification effect caused by the basic activity of the city is called the "multiplier effect". "Multiplier" represents a multiplicative relationship, i.e., the ratio of the increase in the total number of city workers to the increase in the number of workers in the basic part for each unit increase in the number of workers in the basic part. The "multiplier" can be used to predict the increase in the total urban population based on the increase in the basic urban population and the amount of increase needed in urban municipal facilities, transportation facilities, and public facilities.

[3] B/N： The proportion between the basic part and the non-basic part of a city is called the basic/non-basic ratio, that is, B/N ratio. Generally, the ratio of the number of employees employed in the basic part and the non-basic part is used to represent the B/N ratio of a city. Cities with small scale, high degree of specialization, short history of urban development (new city) and large B/N are located near big cities.

industry, as a basic part of the city, is affected by various factors such as the non-renewability of resources, limited resource storage and changes in the market demand of products. And it will decline due to the resource depletion, an increase in production cost and a decrease in the market price of products, showing the vulnerability of the development mechanism of mining cities. In addition, most of the main enterprises in mining cities are directly affiliated with the state, and are greatly influenced by the national macro development strategy and plan. The investment, construction, production, marketing, and income of enterprises are uniformly managed by the state departments. The products of enterprises are uniformly allocated by the state, and the price of products is mainly controlled by the state rather than determined by the market supply and demand. Most of the revenues of the enterprises are handed over to the state, and the state compensates some interests of enterprises through subsidies, but the revenue level is far lower than that should be obtained under the market price system. The expanded reproduction of the enterprise itself is also regulated and controlled by the superior department as a whole. The basic urban activities lack independence and flexibility, which is manifested as the passive control of the development dynamic mechanism.

2.3 Causes of industrial land in disuse

The production of industrial land in disuse in mining cities results from three factors. Firstly, the recession of mineral resource exploitation leads to the bankruptcy of mining enterprises and the cessation of industrial production. Secondly, the spatial location transfer of industrial enterprises leads to the land exchange, so the industrial production in original land ceased Thirdly, the use of mineral resources production technology and methods restricted by the production process and technology level has a destructive impact on the surface environment.

2.3.1 Decline of leading industry

The phenomenon of industrial recession, which is an inevitable product of the transformation of industrial structure adjustment in the economic development process, is determined by the basic law of change of the industry life cycle. According to the industrial life cycle theory, the development stage of an industry can be divided into four phases: preparation phase, growth phase, maturity phase and recession or transformation phase. The industry in recession is called declining industry. The study shows that in a mining city, industry declination is mainly manifested by the declination of the leading industry[4] and its related industries in the urban economy. The main reasons are the following.

(1) Irreversible trend of mineral resources depletion

Mineral resources are the product of the long-term evolution of the earth's crust. They are formed by the accumulation of natural minerals under certain geological conditions and geological action for hundreds of millions of years. They are non-renewable and finite in occurrence. After The Industrial Revolution, the rapid development of productivity and science and technology has greatly increased human's ability to exploit and utilize natural resources. With the huge demand and consumption of resources, human beings have consumed more than half of the

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[4] Leading industry refers to the key industry on which the economic development of a country, region or city depends in a certain period. Leading industry has a strong forward driving and backward driving effect on the whole economy and other industries, and occupies a large proportion in the industrial structure.

mineral resources with proven reserves on earth in only two hundred years. As the regeneration rate of mineral resources is far lower than the consumption rate, its ratio tends to be zero, so as long as there is demand, the depletion of mineral resources is inevitable. According to statistics, 21 out of 178 mining cities in China are resource-depleted cities, accounting for 11.8% of all mining cities and involving a population of about 15.641,900 people. Among the 26 mining cities in Heilongjiang Province, Jilin Province, and Liaoning Province, five cities, Fushun, Fuxin, Beipiao, Hegang and Jixi have entered a period of resources depletion.

(2) Resource depletion of many of China's mining cities

Known as the “coal capital”, Fushun's two main mining areas, the “West open pit mine” and “The Tiger Tai mine”, are facing resource depletion, with the west open pit mine expected to operate until 2025 and the Tiger Tai mine expected to operate until 2035. Fuxin has a 100-year history of coal mining. The “Haizhou open-pit mine” and “Fuxin Thermal Power Plant” built in the early years of the founding of The People’s Republic of China were the largest coal mines and thermal power plants in Asia at that time. In the past 20 years, 14 coal mines, including Haizhou open-pit mine, have been shut down. Fuxin was also listed as a national pilot for the transformation of a typical resource-exhausted city in December 2001. Jinchang, “The nickel capital of China”, accounts for 88% of the nickel output in China, ranking the second in the world. However, after more than 40 years of mining, the service life of nickel metal rich ore reserves is only about 20 years (Wang, 2003). Tongling, the “ancient copper capital of China”, had successively established seven copper mines by the state from the late 1950s to the early 1980s. By 2001, 4 copper mines were facing closure and bankruptcy. “World antimony capital” cold Water metal antimony reserves service life is less than 10 years. Pangang

Group, the main enterprise of Panzhihua, a ferrous city in China known as the "capital of vanadium and titanium", has entered the mid to late life of its existing mines, with depleted reserves, reduced grade, and increased cost. It will face a resource crisis in 2030.

(3) Low efficiency of the exploitation and utilization of mineral resources

The overall technical level of China's mining industry is low, and technological update is slow, especially in the old mining areas established in the 1950s and 1960s, the problems of backward production equipment and low technological level are particularly prominent. Taking coal mining as an example, non-mechanized coal mining still takes more than 60%, so the problem of high manpower costs and low efficiency is still obvious. Due to the limitation of technical level, mining is mainly aimed at the high-grade ore, which is easy to be mined, and those ore formations which are difficult to mine and in a low grade are forced to give up. Especially some private mining companies that surround the state-owned big enterprise to mine and taking profit maximization as the goal, they don’t consider the reasonable development and utilization of resources. To reduce cost, those private mining companies use the low-level mining technology, so their mining depth is shallow, and the resource recovery rate is extremely low, resulting in serious waste of coal resources. According to the statistics, the total recovery rate of China's mine resources is about 35%, 10%-20% lower than the world's average level (Bi Xisanwu & Dong Shaohua, 2014). On the premise of insufficient reserves of resources, a lot of mineral resources are wasted, which accelerates the decline of the mining industry.

(4) The impact of the emerging alternative energy industry.

Due to the development of high and new technologies, the development and production of alternative products for traditional resources have made great progress, especially in energy products. The utilization technologies of high-efficiency nuclear energy and renewable solar energy, wind energy, water energy, geothermal energy, tidal energy, and air energy have gradually matured and generated widespread interest. Although new energy cannot pose a threat to the strategic position of coal, oil, natural gas, and other traditional energy products in a long period of time in the future, the increase of the demand for new energy products has formed an impact on the demand for traditional energy.

2.3.2 Location transfer of industrial enterprises

History shows that the optimization and upgrading of urban industrial structure, adjustment of land use layout, reform of the land system and demand for environmental protection driven by economic activities will lead to the change of urban spatial structure, and the location transfer of industrial enterprises is one of the phenomena of this change in a specific development stage.

(1) The effect of industrial structure optimization and upgrading on location transfer of industrial enterprises.

The optimization and upgrading of the industrial structure are mainly reflected in the advanced development of the industrial structure. From the perspective of development direction, the whole industrial structure has a trend of evolution from the primary industry to the secondary and tertiary industries. Within the industrial structure, the dominant proportion of low technology and low added value evolves to that of high technology and high added value. Under the background of industrial structure optimization and upgrading, the historical evolution of urban spatial structure in western countries has gone through three periods.

1) Pre-industrial period

In this period, the economic activities were dominated by the primary industry, the level of productivity was low, the urban spatial form was restricted by geographical conditions, and the structural evolution was slow.

2) Industrial period

The driving force of economic development in the industrialization period comes from the rapid development and aggregation of the secondary industry.

In the early stage of industrialization, labor-intensive industries were the dominant industry. Restricted by the means of transportation at that time, the industrial layout needed to be close to raw material producing areas, energy bases and consumption areas to reduce transportation costs, and at the same time, the proximity to workers' living areas should also be considered. Therefore, industrial land and related storage, external transportation, and municipal public facilities land in the central area of the city staggered in the central area of the city, resulting in traffic congestion, environmental pollution, spatial structure confusion, and restriction of the city’s reasonable expansion.

After entering the mature stage of industrialization, the secondary industry is still dominant, but the industrial structure within the secondary industry has been optimized and upgraded, and the industrial structure has been advanced, which is manifested as capital-and-technology-intensive heavy industry and processing industry have gradually replaced the labor-intensive industry. Another prominent change in this period is that the tertiary industry represented by commerce, finance and service industry gathers in the urban center.

Because the tertiary industry has a high yield rate on land per unit of space, it can pay land rent higher than other economic activities, and has stronger competitiveness in the advantageous location of the urban central area. With the improvement of the urban transportation network and the development of the communication industry, the profitability of the secondary industry has reduced the requirement of urban location, while the high land rent and crowded space in the central area of the city have caused constraints on industrial expansion, so that the location of industrial enterprises began to shift to the suburbs of the city.

In the late stage of industrialization, in the city appeared the trend of suburbanization. With the improvement of mechanization within the industrial structure, the processing industry gradually occupies a dominant position. The negative impact of industrial land on the urban environment has been highly concerned and many industrial cities have intensified adjustment of industrial land. With the large-scale migration of large industrial enterprises to the suburbs, the suburban industrial belt has been formed. The good ecological environment in the suburbs drives the urban population to form an obvious tendency of suburbanization, and brings up the relocation of large businesses. The function of the urban central area gradually began to transition from industrial production and low-level services to information processing and high-level services.

3) Post-industrialization period

After entering the post-industrialization period, the tertiary industry plays a leading role in economic activities. With the development of productive forces and technological progress, the main driving force of urban economic growth comes from the rapid growth of the tertiary industry. The output value of the tertiary industry jumps and surpasses the primary and secondary industries to become the main body of the industrial structure. Within the secondary industry, the economic growth rate of the manufacturing industry of high-tech products such as information and electronics jumped to the leading position, and the proportion of traditional industries in economic activities decreased. The urban spatial structure has developed from the traditional circle structure to the network structure, and there has been a multi-center spatial pattern and the trend of the metropolis.

From the overall trend of China's urban development, the evolution of industrial structure has generally experienced four stages (Chen, 2005). The first stage (1952-1957) is a stage in which the proportion of the primary industry decreases, the secondary industry develops rapidly and the tertiary industry rises slowly. The second stage (1957-1978) is a stage in which the proportion of the primary industry decreases, the secondary industry develops rapidly, and the proportion of the tertiary industry decreases, stagnates and shrinks. The third stage (1979-1995) is a stage in which the proportion of the primary industry decreases, the secondary industry develops stably, the internal structure is rationalized and adjusted, and the tertiary industry develops rapidly. In the fourth stage (after 1996), the proportion of the primary industry further decreased, the proportion of the secondary industry steadily increased, and the proportion of the tertiary industry slowly increased. In the second, third and fourth stages, the proportion of the output value of the secondary industry is the highest. From the perspective of China's average situation, the secondary industry still dominates the urban industrial structure. In fact, at present, except for a few mega cities and coastal open cities in China that have just entered the late stage of industrialization, most cities, including mining cities, are still in the mature stage of industrialization or even the initial stage of industrialization. Promoting the upgrading of industry within the secondary industry will be the main trend of urban development in China. Many cities in China are facing or are undergoing the spatial structure change of the location transfer of industrial enterprises. How to reasonably and efficiently renew and utilize a large number of industrial lands in disuse left in mining cities has become an important issue in front of us.

(2) Urban environmental quality optimization to promote industrial enterprises' transferring the location

The development course of industrialization shows that industrial production has caused huge negative effects on the urban environment.

First of all, resource extraction, metallurgy, chemical, petrochemical, power and other heavy industries lead to the deterioration of urban environmental quality. Industrial production discharged a large number of pollutants caused serious pollution of the urban air quality, water, and soil, and threatened the health of urban residents. Industrial production and transportation produce noise, which disturbs the normal work and life of city residents. In response, China has issued relevant policies on industrial pollution, levied pollutant discharge fees from polluters, formulated technical specifications for cleaner production, and carried out research and practical pilot projects to build ecological industrial parks based on the theory of circular economy and industrial ecology. But to solve the problem of industrial pollution fundamentally needs a long and gradual process.

Secondly, the large volume of industrial transportation brings great pressure to the urban traffic, and heavy transportation equipment damages the urban road. And the process of railway and highway freight discharges a large amount dust, exhaust gas, soot, automobile exhaust and so on aggravating urban environmental pollution.

Thirdly, industrial enterprises occupy too much urban land area, which not only blocks the development of high-yield clean industries such as high-tech industry and tertiary industry, but also restricts the construction of urban parks and urban green spaces, which are conducive to creating a good ecological environment.

In addition, industrial production needs to consume a large number of resources and energy, resulting in a shortage of urban energy supply, which brings inconvenience to the work and life of urban residents.

Therefore, from the perspective of urban environmental quality optimization, transferring the location of industrial enterprises from the central city to the suburbs, and using the original land for the development of high-tech industry and tertiary industry through land replacement are not only beneficial to realizing the potential market value of land and improve the efficiency of land use, but also of great significance to solve the current urban environmental problems.

2.3.3 Use resource production technology

The destructive effects on the surface environment caused by the production technology and methods adopted by the mining and primary processing industries are huge and extensive. The mining subsidence area abandoned open-pit quarry and industrial waste yard are all the products of such production technology and methods.

(1) Mining of ore resources

There are two main mining methods: underground mining and open-pit mining.

1) underground mining

For deep buried and thin seams, underground mining is adopted. The well is drilled from the ground to the underground. After reaching the ore layer, the horizontal roadway is opened to mine the ore, and then the ore is transported to the ground through transportation equipment. After the underground ore is mined, a cavity structure, named the goaf area, is formed in the underground rock strata, resulting in the destruction of the original stress balance of the rock strata, and then resulting in the displacement, deformation, and fracture of the top of the goafand its overlying rock strata successively. With the expansion ofthe goaf area, the movement of rock strata affects the surface and gradually causes surface movement and deformation. Under the influence of mining, the surface sinks downward from the original elevation, forming a much larger subsidence area above the mined-out area, which is generally called mining subsidence area (Figure2.5). The larger the scope and intensity of underground mining, the larger the area of mining subsidence area. The mined ore after primary processing (screening, washing) after the formation of tailing ore, gangue, and other accumulation to form tailings field, gangue hill (yard) abandoned land.

Figure 2.5 Mined-out area.
Image Credits: ©Paul Moore, 2020.

2) Open-pit mining

In accordance with a certain process, open-pit mining strips the topsoil layer and overlying rock of the useful minerals which is thick and not buried so deep, so that the ore buried in the underground is exposed, and then it uses the mining transport equipment to conduct the mining operation in the open space formed (mining) to transfer the rock and ore to the surface.

Open-pit mining technology is developed under the conditions of modern production technology, which is more suitable for the use of large-scale excavating machines and tools than underground mining, and has a short construction period, high efficiency, and low cost. Therefore, it is preferred to be adopted under appropriate conditions. In the process of mining and stripping, the topsoil and overlying strata above the ore bed are directly excavated and damaged, resulting in devastating destruction of soil, surface vegetation and ecosystem. Generally, the open-pit mine whose ore body is above the lowest surface level is called hillside open pit mine, and the one below the lowest surface level is called sag open pit mine. Most open-pit mines are sag open-pit mines, including metal mines and non-metal mines. In order to strip the hard rock strata above the ore body, the rock is blasted to pieces by perforated blasting, and the stripped rock and soil are transported to the dump.

Composition of open-pit mines and surface damage (Figure 2.6)

Figure 2.6 Surface damage caused by open-pit mining.
Image Credits: ©Ming Liu, 2020.

(2) Exploitation of oil and gas resources

Oil and gas resources are generally exploited by hydraulic and pneumatic drives. By artificially injecting energy generated by high-pressure water, gas or other solvents into the mine, minerals are pushed from the mine to the bottom of the oil well (or gas well). High-pressure water injection will aggravate the deformation of the stratum, and lead to geological anomalies such as geological subsidence, ground uplift, cracks and water bubbled, resulting in the destruction of land resources and the formation of abandoned land. Oil leakage in the process of mining, storage and transportation will cause land pollution and seriously damage the surface ecological environment.

2.4 Classification and characteristics of industrial land in disuse

According to the types of mineral resources, industrial land in disuse in mining cities should be divided into coal industrial land in disuse, oil and gas industrial land in disuse, metal, and non-metal land in disuse.

2.4.1 Coal-based industrial land in disuse

(1) Coal underground mining industrial land in disuse

1) Industrial site in abandoned coal mining area

The ground part of coal production is generally referred to as industrial sites, including mine production buildings, coal processing plants, screening plants, raw coal storage systems, transportation facilities, power facilities, and auxiliary enterprises and facilities. Industrial sites in abandoned coal mining areas consist of these facilities and their land use (Figure 2.7\2.8).

Figure 2.7 Coal mine derrick with symbolic significance.
Image Source: sohu.com

Figure 2.8 Characteristic coal mine wellhead house and winch house. Image Source: sohu.com

The characteristics of industrial sites in abandoned coal mining areas are as follows:

Firstly, industrial lands in disuse are built on the safe coal pillars, with stable and safe geological conditions, and their land resources can be utilized for facility construction and installation or industrial production.

Secondly, the original production facilities, transportation facilities, power transmission and distribution facilities, storage facilities and so on in industrial land in disuse have prepared conditions for the introduction and development of new industries.

Thirdly, coal washing is the source of the application of "clean coal technology". Coal washing plants will also play an important role in the adjustment and upgrading of industrial structure in the future, with good development potential.

Therefore, in many coal mine areas that have discontinued production and closed mines, the coal washing plant will continue to play a role, and the original transportation, storage and power facilities in the mining area provide a guarantee for the continuous operation of the coal washing plant.

Fourthly, facilities or sites with iconic or heritage value can be protected and reused as carriers for the continuation of industrial culture in the coal mining area after production suspension and abandonment.

Fifthly, the mining, washing and transportation of coal have caused serious environmental pollution in industrial sites, so the pollution abatement should be done before reusing those sites and facilities.

2) Mining subsidence area

The underground mining of coal mine forms goaf in underground strata and causes surface deformation, which gradually evolves into a coal mining subsidence area. The main characteristics of the mining subsidence area are as follows.

First of all, a lot of land resources have been occupied and destroyed. Researches have shown that the surface will subsidence $2000m^2$. Every time an average of 10,000 tons of coal is mined underground. Thus, it can be estimated that the total area of coal mining subsidence area formed by underground coal mining in China has exceeded $6{,}600km^2$ (Bian, 2015), and with the increase of coal output, the area of coal mining subsidence area is still expanding. According to statistics, the mining subsidence area of Shuangyashan in Heilongjiang province is $62km^2$; the mining subsidence area of Huaibei and Huainan in Anhui province has reached $147km^2$ and $650km^2$ respectively (Wang, 2003). Surface subsidence formed by coal mining in the Kailuan mining area of Tangshan (Figure 3.12b) covers a total area of 208km^2 (Yin et al., 2019). There are more than 150 surface collapses in the Xuzhou mining area, covering an area of about 73.33km^2 (Chen, 2016).

Secondly, coal mining subsidence caused large area of standing water in the eastern Plain of China, some of which evolved into secondary wetlands (Figure 2.9). Coal mining subsidence in hilly and mountainous areas in the west accelerates soil erosion and desertification, and induces natural disasters such as landslides, collapses, and debris flows. Coal mining subsidence has obviously changed the surface ecological environment, and some subsidence areas have caused pollution and damage to soil, surface water system, groundwater, natural vegetation, and cultivated land.

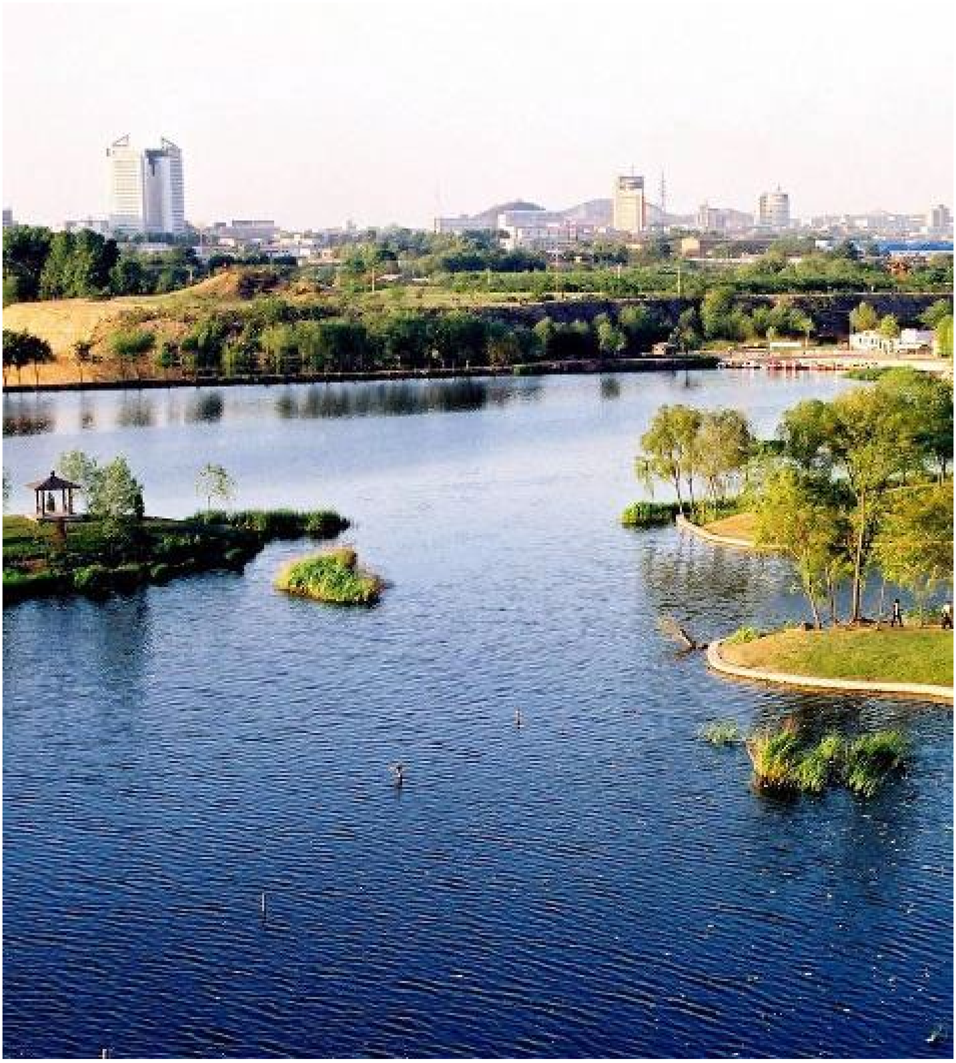

Figure 2.9 The coal mining subsidence area of Nanhu Lake in Tangshan evolved into a secondary wetland. Image Credits: ©Zuo Zhang, 2017.

Thirdly, coal mining subsidence leads to the destruction of ground buildings, transportation facilities (roads, railways, bridges, and culverts, etc.), power transmission and communication lines, municipal public facilities, and water conservancy facilities, resulting in the overall destruction of villages and population migration. Research shows that 2,000 people need to be relocated for every 10 million tons of coal production (Bian, 2015). The local government is faced with the housing construction problem of a large number of people who have lost their homes due to coal mining subsidence

3) Gangue hills

Coal gangue is the solid waste produced in the process of coal mining, cleaning, selection and processing, and the rock mixed with the organic compounds and inorganic minerals co-deposited with the coal during the formation of coal. Coalmining needs to discharge a large amount of coal gangue, whichis about 15%-20% of the raw coal. After a large amount of coalgangue is discarded, it accumulates in the open to form a ganguedump or a gangue hill (Figure 2.10). Gangue hill is formed by stacking gangue, the hill shape is generally conical, and the slopeis the natural angle of repose [5] (36 degrees) of gangue. According to statistics, there are more than 800 gangue hills in China's state-owned coal mines, with a total accumulation of about 1.2 billion tons over the years, covering an area of 60 km^2(Bian, 2015).

[5] Angle of repose is the minimum Angle with the horizontal surface when the inclined plane makes the object on it in the critical state of sliding along the inclined plane (that is, with the increase of the inclined Angle, the object on the inclined plane will slide more easily; When the object reaches the state of beginning to slide, the Angle of the critical state is called Angle of repose.

Figure 2.10 Gangue hills in the Calais Basin of France. Image Credits: ©Huangxin Cheng, 2016.

Gangue hills (stock yards) not only occupy a lot of land resources, but also cause over 20 kinds of environmental problems such as ponding drench water pollution, gangue hills spontaneous combustion, landslide collapse, wind erosion dust lifting and so on.

(2) Coal open-pit mining industrial land in disuse

Coal open-pit mining industrial land in disuse is formed by the abandoned quarry of an open-pit coal mine. Opencast mine stope is composed of an opencast mine (pit), opencast mining industrial site and external dump. The main characteristics of abandoned opencast mine stope are as follows:

Firstly, surface excavation and abandoned rock accumulation occupy a large amount of land. According to the research, $1000m^2$ of land is lost and $1600m^2$ of land is occupied by dump for every ten thousand tons of coal mined by an open-pit coal mine. Accordingly, the total amount of land lost and compressed by open-pit mining in China is about $450km^2$. For example, the "West Open-pit Mine" located in the south of Fushun urban area, which started in 1914, has formed an open-pit coal mine with a length of 6.6km from east to west and a width of 2km from north to south, covering an area of 13.2km^2, with a vertical mining depth of 388m (Figure 2.11). The huge dump and tailings yard cover an area of 24 km^2. "Haizhou open-pit coal mine" in Fuxin is a large open-pit coal mine built in the 1950s in China, located in the Taiping district in the south of Fuxin city. The open-pit mine is 3.9km long from east to west, 1.8km wide from north to south, and the mining depth is 380m. The total area of the mine is 26.82km^2, of which the area of the dump is about 13km^2

Figure 2.11 Fushun west open pit. Image Credits: ©Hongbo Zhang, 2019.

Secondly, the open piles of external discharge sites discharged suspended solid particles, sulfur dioxide and nitrogen oxides into the air, causing atmospheric environmental pollution. Underthe action of rain leaching, the harmful substances and heavy metals in the rock will pollute the soil and groundwater.

Thirdly, the devastating damage to native soil and vegetation on the surface.

Fourthly, there are potential hazards of landslide, soil erosion and debris flow in open-pit mining and external dump.

Figure 2.12 shows the area and proportion of coal industrial lands in disuse such as mining subsidence areas, gangue hills, open quarries, and dump sites in China's coal mining areas.

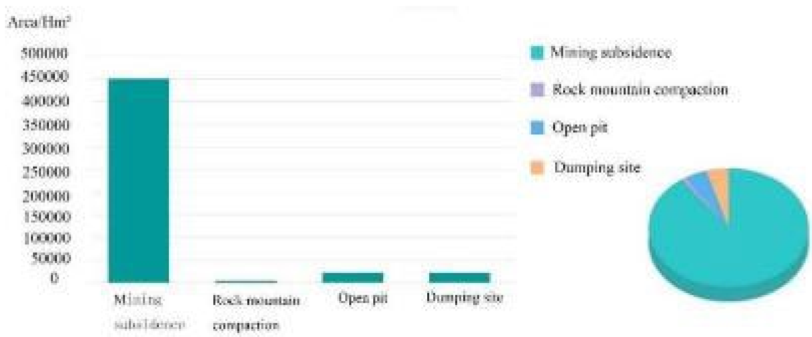

Figure 2.12 Area and proportion of some coal - based industrial lands in disuse in China. Image Source: painting by author.

(3) Coal mining related industrial land in disuse

Enterprises related to coal mining, such as coal power, coal chemical industry, coking, building materials, machinery and tools processing, machinery repair, industrial and mining accessories, steel rolling and other enterprises, due to the recession closed down or location transfer to form coal mining related industrial land in disuse.

2.4.2 Oil and gas industrial land in disuse

(1) Industrial land in disuse in oil and gas field quarry

Oil and gas fields are generally composed of a number of “well sites”, the basic production units. Each of them includes well site devices, metering stations, gathering and transportation pipelines, oil pump stations, oil depots, water injection stations, water distribution rooms, water supply engineering facilities, power transmission and distribution facilities, heating facilities, etc. The depletion of recoverable oil and gas resources is known to result in the termination of oil and gas production activities, then there occurs the abandonment of oil quarries (well sites), the plugging of boreholes below the surface of oil wells, and the abandonment of original industrial production land and surface engineering facilities. Some of the abandoned well site devices with historical and cultural value or landmarks, such as drilling derricks and pumping units, can be preserved as industrial heritage.

Abandoned well sites occupy a large number of land resources. For example, the Shengli oilfield in Dongying, Shandong province, has occupied 5,606.95 hectares of land since its first oil well was drilled in 1961, of which 350 hectares are abandoned by industry and mines.

(2) Land surface deformation industrial land in disuse

In the process of oil and gas exploitation, the use of hydraulic and pneumatic driving mode will cause the intensification of surface deformation, subsidence, cracks, water, and other geological phenomena, then form the surface deformation industrial land in disuse. For example, due to the forced exploitation, more than 4000 square kilometers of water level drop funnel has been formed in the west of Daqing Oilfield, with a drop difference of 47 meters (Wang, 2013).

(3) Oil extraction pollution industrial land in disuse

Solid waste (such as drilling waste mud, etc.) is generated in the process of oilfield exploration, exploitation and transportation being piled up, crude oil spilling on the surface, and wastewater being discharged. All of the above will occupy land and cause soil, vegetation, surface water and groundwater pollution (Figure 2.13)

Figure 2.13 land in disuse of oil stope in Dongying Oilfield.
Image Credits: ©He Liu, 2015.

2.4.3 Metallic and non-metallic industrial land in disuse

The mining of metallic and non-metallic mines in China includes both open-pit mining and underground mining, but open-pit mining is the mainstay (Figure 2.14).

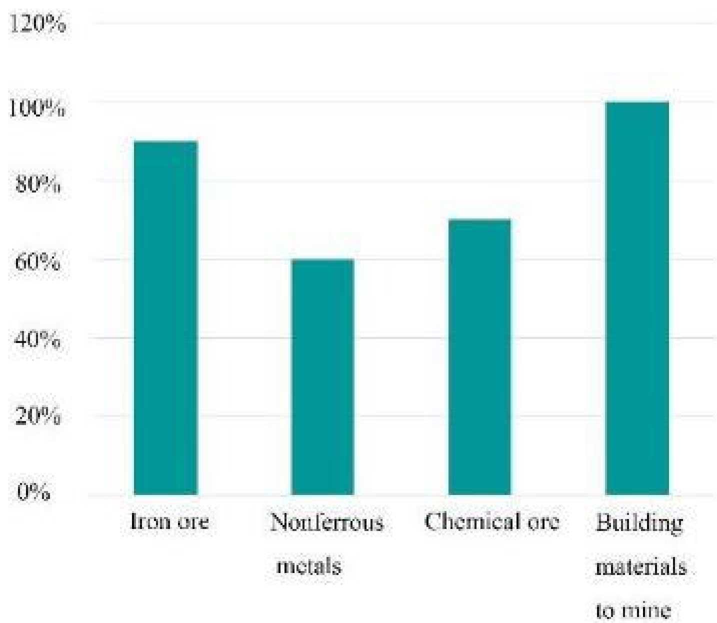

Figure 2.14 China's output of some metal and non-metal open-pit mines accounted for. Image Source: painting by author.

(1) Metallic and non-metallic underground mining industrial land in disuse

1) Industrial land in disuse

Industrial land in disuse formed by underground mining of metallic and non-metallic mines include mining production facilities, mining processing production facilities, power facilities, repair facilities, warehouses, auxiliary production facilities, administrative offices, living facilities, waste rock yards and other facilities (Figure 2.15).

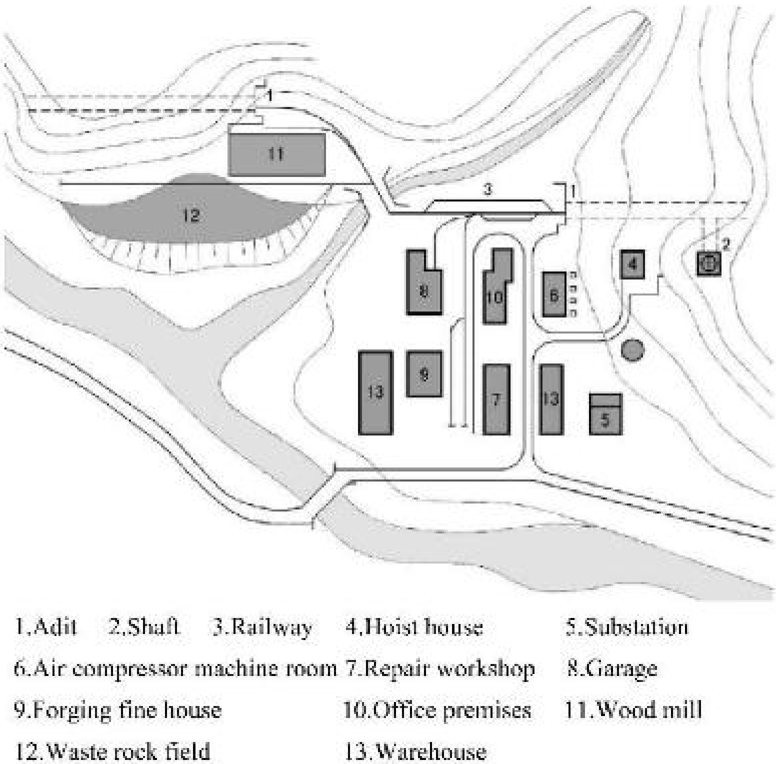

Figure 2.15 Layout of underground metal mining industrial site.
Image Source: Painting by author.

2) Tailings site (pond)

Tailings are the solid waste remaining after the mined ore is separated from the concentrate by the mineral processing plant. Tailings are usually discharged into river ditches or dumped in tailings pond with dams near mines (Figure 2.16). Both underground and open-pit mining produce large amounts of tailings. Except for a small part of the tailings discharged from ore mining in China, most of the tailings are stored, occupying a large number of land resources. According to the statistics, in 2000, China's tailings and waste rock destroyed and occupied about 18,700 to 24,700 square kilometers of land, and the annual increase was 300 to 400 square kilometers (Zhang et al, 2006).

Figure 2.16 Xianrenpo tailings pond. Image Credits: ©Xuefei Liu, 2016.

Tailings storage is prone to induce disasters such as flow, collapse, or landslide. With the increase of tailings volume, the height of the tailings dam increases. This can easily lead to dam failures, resulting in mudslides, and other serious damages to farmland, forest land, and farms, resulting in casualties (Figure 2.17). The tailings dust disperses under the action of wind, which will cause air pollution. And the heavy metals and toxic substances produced by tailings under the action of rainwater leaching will pollute the soil, groundwater, and surface water.

According to the survey, the direct contaminated land area caused by tailings in China reaches one million mu, and the indirect contaminated land area is nearly 10 million acres (Zhang et.al, 2006).

Figure 2.17 The 110-meter high Fundão mine tailings dam in Minas Gerais collapsed. Image Credits: ©Fonseca do Carmo, 2017.

(2) Metallic and non-metallic open-pit mining industrial land in disuse

Metallic and non-metallic open-pit mining industrial lands in disuse are mainly abandoned open-pit mine sites. Its land use structure includes open-pit mining site, mining industry site, support material processing site, ore crushing site, auxiliary facilities site (substation, water purification station, transfer station, warehouse, explosives storehouse, etc.), waste storage site (waste storage site, etc.) quarry, tailings quarry) and some living facilities (Figure 2.18).

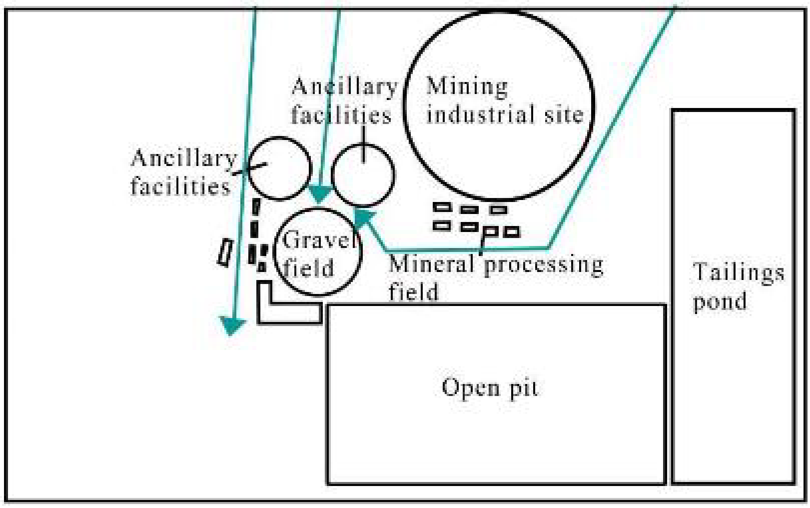

Figure 2.18 Layout diagram of a non-ferrous metal open-pit mine. Image Source: painting by author.

(3) Metal and non-metal mining associated industrial land in disuse

With metallic, non-metallic mining related metallurgy, building materials and other industrial enterprises bankruptcy or migration, the associated industrial land in disuse formed. The formation of this kind of abandoned land comes from two ways: first, due to the resource constraints and changes in market supply and demand structure, industrial enterprises closed down and went bankrupt. Second, after the location transfer of industrial enterprises, the original industrial sites are abandoned and left idle.

1) Resource and market constraint paths

Take the representative steel industry as an example.

From the perspective of resource constraint, most of China's important iron and steel enterprises tend to be the origin of raw materials and rely on the advantages of local iron ore resources. For example, Anshan iron and steel plant is close to Anben iron mine, Ma'anshan iron and steel plant is close to Ma'anshan iron mine, Panzhihua iron and steel plant is close to Panzhihua iron mine, Baotou iron and steel plant uses Baobai iron mine and so on. In the traditional sense, the reduction and depletion of resource reserves will have a significant impact on the iron and steel industry. However, in the context of today's economic globalization, the constraint of resources on the development of the iron and steel industry has gradually weakened. China's iron and steel industry has basically gone through the stage of resource development, and formed an industrial system dominated by steel smelting and rolling processing, greatly reducing the dependence on resource exploitation.

2) Industrial enterprise location transfer path

To control and eliminate the city pollution, strengthen urban functions, and optimize the environment of the city, promote the value of urban land, and upgrade the urban industrial structure, the urban space layout structure needs to be optimized and adjusted. Timely replacement of those super-heavy, high-energy consumptions, high material consumptions, high pollution heavy industries that occupying the dominant position in the city's downtown area including iron and steel industry, chemical industry, building materials and so on should be done. After these heavy industry enterprises' location transfer, the original industrial sites change into industrial land in disuse.

The overall relocation of heavy industry enterprises has become one of the important trends in the spatial structure optimization of China's comprehensive cities. Representative projects that have been started include the relocation of Beijing Shougang to Caofeidian Port in Tangshan, the relocation of Wuhan Iron and Steel to Yangluo, the relocation of Chongqing Chonggang

Group to Changshou, and the relocation of Jiangxi Hongdu Iron and Steel plant from Nanchang to Changbei Economic and Technological Development Zone.

In the adjustment of spatial layout structure of mining cities, relocation of heavy industry enterprises is also inevitable. Tangshan, Anshan, Ma'anshan, Benxi, Panzhihua, Baotou and other important metal mining cities in China have taken relocation of polluting heavy industry enterprises as animportant trend of urban space development in the future.

Chapter 3

Theoretical framework of landscape character

Chapter 3 Theoretical framework of landscape character

3.1 The epistemological basis of landscape character theory

3.1.1 The third typology

As the basic consciousness of human reason, classification is a typical way for people to know things. In natural sciences, this method is called taxonomy. In social sciences, this method is called taxonomy (Wang, 2010). Typology has a long history in architecture and urbanism and is still one of the most widely and frequently adopted theoretical foundations. The earliest use of typology in the study of architecture and urbanization was in *The Ten Books of Architecture* by Pollio Vitruvius in ancient Rome. And one of the most classic examples of typology is the discussion in ancient Greece of three types of pillars and their corresponding temples. Subsequently, through the development of recent philosophy and architecture, the theoretical construction of architectural typology has become increasingly improved. The theoretical construction of architectural typology has gone through stages such as archetypal typology, paradigmatic typology and a third typology.

The third typology emerged in the 1960s. The first two typologies rationalize architecture by making analogies with products other than nature or architecture. The third typology is different from the first two typologies in that it focuses more on the city and architecture itself. Italian scholar Giulio Carlo Argan (1966) proposed that typology is not only a historical process of architecture, but also a thinking and working process of architects. Typology is structuralist after modernism. Similar to the concept of “deep structure” in structuralist linguistics, architecture and urbanists consider the type as essence. (Shen, 2006). As modernism faced a crisis, typology began to connect with history, emphasizing a broader quest for “meaning”, as types are always inferred or deduced from historical experience. In addition, typology does not stop at categorical analysis or post-evaluation, and it also places great emphasis on creative steps. As a method of operation, the initial design of typology is always conceptualized and its output is always diversified. Just as Argan said, once accepting the idea of transcendental reduction of types, artists can be liberated from the influence of existing historical forms and neutralize them (Giulio, 1966). In the subsequent development, typology was again noticed and developed by many architects and urbanists. Some emphasize its attributes as a category, others as a means.

Sigmund Freud has an analogy between the juxtaposition of architectural spaces in different historical periods and the human mind. He assumed that Rome was not an urban space, but a spiritual being with an equally long and rich history. Nothing that ever existed in Rome will disappear again, and all the early stages of development will continue together with the latter. In this case, since the same space cannot carry two different contents, and at the same time, if you want to express the time sequence by space domain, you can only express it by space juxtaposition. Sigmund Freud believed that this revealed the great distance between the representational world and the properties of the mental world (Shen, 2006).

However, this operation of juxtaposing contents from different historical periods is the process of transforming transience into synchrony. It is the idea of structuralism and the ideological basis of typology to study the process of urban time accumulation with corresponding parallel space. We cannot closely trace the long history of a city, but we have a large number of spatially juxtaposed historic cities in their current state. Therefore, this research views the present historical land in disuse as a kind of synchronic expression or achievement. Then it analyzes and constructs the historical land in disuse in mining cities to understand it with the framework of structure and type.

In short, the third typology and the structuralist logic behind it are one of the important foundations on which this study is based.

3.1.2 Interpretative anthropology

The study of cultural anthropology originated from classical anthropology at the end of the 19th century and belonged to the research category of anthropology. From the beginning, anthropology promised to accomplish the discipline's unique cultural insights, which is to explain the culture from the point of view of its natives. The development of cultural anthropology has experienced from the early mono-linear evolution, nonlinear evolution, to the emergence of functionalism, structure-functionalism, and structuralism. Since the post-modern period, new research paradigms such as symbolic anthropology and interpretative anthropology have emerged. Architecture and the city, as the most important material components and typical ideological expression of human culture, naturally present the research progress of anthropology. Among those theories, interpretative anthropology, founded by American scholar Clifford Geertz (2008), emphasizes understanding through continuous explanation. This is the second important epistemological basis on which this study is based. Gertz adopted a hermeneutics view in defining the scope of his research. First of all, he believes that the basic characteristics of human culture are symbolic and explanatory. Secondly, anthropology, as a discipline that studies culture, is self-interpretive. (Wang, 2018) Therefore, Gertz tends to base himself on indigenous thought and stay away from the grand narrative. In other words, he hopes to express meaning by exploring human behavior, that is, to fully seek more local knowledge, so he emphasizes explication. Clifford Geertz (2008) draws on Gilbert Ryle's concept of "thick description". Thick description not only describes and explains the behavior itselfbut also focuses on the context or background of the behavior. In this way, meaning can be generated for non-native outsiders. Therefore, in the framework of interpretative anthropology, good cultural analysis is not to construct an absolute formal level of description, but to seek to explain the essential depths of what happened. Thus, Geertz proposed that cultural analysis should be a prediction of meaning and evaluation of numerous predictions, thus discovering the best explanatory conclusion. Such an explanatory conclusion is the aim, and there is no need to draw a physical scene that does not exist. And when it comes to the application of theory, he goes out of his way to point out that "recognizing where an explanation comes from does not determine where it is forced to go" (Clifford, 2008).

In general, under the concept of interpretative anthropology, the fundamental task of theoretical construction is no longer to sort out some abstract laws, but to try to make thick description possible. The author thinks that this way of thinking is not to cross the individual, but to generalize and explore methods in individual cases. It should be advocated by urban historical landscape as a new research method and concept of urban and cultural heritage. Each of the city cases we analyze through thick description may have a different history and may have a variety of structures or types. But what is unified is the deep meaning of the method, that is, the way in which the theory is applied. The cognitive models and paradigms behind them are the same. It is an epistemology that is analytically oriented rather than therapeutic or corrective. Its starting point may be small and straightforward, but through a compact set of case facts, coupled with logical and brief reasoning, the conclusions to be drawn may be enormous and profound. Therefore, when solving the problems related to urban historical landscape, the author always emphasizes the importance of having a relatively well-developed cognitive system. The first is a deep understanding of the past and the present, and then it is possible to try to make future-oriented guidance when applied to the conservation and design of cities and buildings.

To sum up, interpretative anthropology is the second important epistemological theory on which this study is based.

3.2 The methodological basis of landscape character theory

3.2.1 Design language and semiotics

(1) semiology

The use of symbols has a long history, and the study of semiotics came into being in the late 19th century and the early 20th century. People get their knowledge of the world from symbols. Symbols are a medium for conveying information. Semiotics is the study of the rules for the transmission of symbolic systems. Semiotics and linguistics are two closely related subjects. Vocabulary and grammar in linguistics actually belong to symbol system, and they can be regarded as a language symbol. The scope of semiotics includes linguistic signs and non-linguistic signs.

The Swiss linguist Ferdinand de Saussure (1984) and the American logician William Pierce Charles Sanders Peirce (1998) are considered to be the founder of modern semiotics. They put forward the concept and theory of semiotics from the end of the century to the beginning of the century. Later, a variety of new theories such as literary semiotics and architectural semiotics emerged.

On the basis of Saussure and Pearce's theories, American behaviorist Morris (1938) divided semiotics into three branches: syntactics, semantics and pragmatics. He explained the three branches as follows: syntactics deals with the combination and formation of elements in symbols, regardless of their specific ideographic meanings; semantics is concerned with the signification of symbols and signifiers, that is, the way in which they actually carry meaning; pragmatics involves the origin of symbols, application, and the effect when symbols are used in actions. Morris's symbol theory is more scientific and systematic, which promotes the establishment of the theoretical system of modern semiotics.

(2) Research on the construction of design language

In the study of the construction or arrangement of architectural language, there are three representative works: *The Classical Language of Architecture* (1964) by John Samson; *Modern Architectural Language* (1978) by Bruno Zevi, Professor of Architectural History in Rome, Italy; *The Language of Postmodern Architecture* by British architectural critic Charles Jencks (1977). These three books correspond to the collation and categorization of architectural language in classical, modern, and postmodern periods respectively.

The Classical Language of Architecture is a formal study of architectural language to explain classical architecture from the perspective of linguistics (Bu, 2000). Based on the summing up of *Ten Books of Architecture* (2001) complied by Vitruvius, Samson formed a set of formal language with exemplary meaning. Therefore, classical architectural language is also called paradigm language. Bruno's original intention of *Writing Modern Architectural Language* (2005) was also inspired by The Classical Language of Architecture, hoping to "clarify the precise meaning of modern language through modern architectural language, so as to talk about architecture in an anti-classical tone". Based on summarizing the modern architectural language created by the modern architects, the author puts forward a new language system to replace the classical architectural language formulated by the academic school. Bu Zhengwei classifies "modern architectural language" of

Professor Sai Wei as "regular language". In *Postmodern Architectural Language*, he puts forward the "popularization" of architectural expression and makes it clear that modern architectural art should be "clearly used as a means of communication". Jenks believes that the analysis and study of architectural language by borrowing the concepts of "vocabulary", "phrase", "syntax", "semantic" and "metaphorical" rhetorical devices is necessary means to realize the "appealing to all" and popular communication of architecture.

From 2000 to 2001, Mr. Bu Zhengwei successively published 7 papers on architectural language in New Architecture magazine. Drawing on the system of linguistic theory, he composed the core part of architectural language structure frame by vocabulary, statements, and syntagm (Figure 3.1). He connected the core part with its extended content and features—shape, style, semantics, and rhetoric, forming the structural framework of architectural language. This frame restores architectural language to linguistic language connotation and builds the structural frame of architectural language by imitating its structure. Based on his description of architectural space entity and indoor and outdoor environment, Bu Zhengwei (2000) constructs architectural language into two composite systems: morphological language system and picturesque language system. Form language is the description of architectural space entity, which is composed of four "language form elements": form, light, color, and texture. Situational language is about the environment.

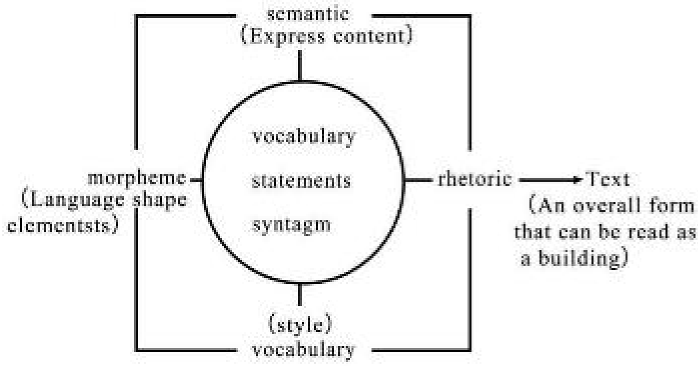

Figure 3.1 The structural framework of architectural language.
Image Source: painting by author.

In the process of systematically tracing the origin and analysis of architectural forms, Buthayna Hasan Eilouti (2018) divided previous studies on formal languages into three categories. Given the current research on the generation of architectural form, there is no clear and systematic discussion. This paper aims to build a theoretical and computational framework for the form processing program, which can clearly and systematically trace and analyze the source of form. Professor Anne Weston Spen constructs the system of landscape language from four aspects: landscape elements, grammatical rules, pragmatics, and rhetoric. Among them, landscape language elements include process (patterns of actions and events); material (sensual and dynamic; form (shape and structure) performance space (places needed and in use); These are non-material objective elements, but they take people and places as the starting point and pay attention to the elements of the landscape process. Anne Weston Spen's landscape language system emphasizes structural order. From the grid and order principles of grammar principles to "creating a framework for stable development and unexpected things" in the shaping of landscape expression, it reflects that the creation of frame is the orderly evolution of landscape things in the change of time. The frame creation is for the landscape to evolve in its order over time, as she evaluated S.I. Andersson's Mama Garden. S.I. Andersson gave the garden an evolving structure of its own, the poetry of the landscape played out in the free growth and change of plants (Spen, 1994).

Different from Mr. Bu Zhengwei's construction of architectural language, Anne Weston Spen directly attributes rhetoric to the creation of landscape poetry. In addition to the difference between architecture and landscape in terms of sensory experience, it also has to do with the fact that in the 1980s people's technical and artistic, practical, and poetic pursuits of landscape were mutually severed. In order to further demonstrate the unity of "poetry" and "utility", this research takes "dialectic" as the main theme in the last part to discuss the dialectical relationship between the technology and art of landscape and the pursuit of the unity of "utility" and "poetry".

3.2.2 Space syntax

The theory and methodology of spatial syntax was founded by Bill Hillier at Cambridge University in the 1970s. It continues the tradition of mathematical research in Cambridge, and explains the spatial forms of buildings, communities, towns and other scales and their social and economic activities from the perspective of spatial construction activities. (Hillier, Leaman, Stansall & Bedford, 1976). The technique of spatial syntax, from the perspective of system theory, holism, and development theory, attempts to reveal the ineffable social logic and spatial rules under the spatial phenomena by analyzing the complex connections between different spaces at different scales and their interrelationship with people's activity patterns, and proposes a self-organized model of spatial structure and its evolution. (Hillier & Hanson, 1984; Hillier, 1996).

Spatial syntax theory has three cornerstones. The first stone: space is regarded as a way for people to achieve social, economic, and cultural goals, and is reflected in the specific process of space construction and use. The second stone: spatial structure needs to be seen and experienced not only from a bird's eye view but also from a human view to experience and understand. The third stone: the location of local space (such as a street) depends on the connection between the space and all other spaces, not on the local characteristics of the space itself.

These three theoretical cornerstones are interdependent, based on the need for a dynamic and holistic correlation of form and function within space. In this sense, space syntax uses holistic principles and methods to quantitatively calculate the location value of each street at different scales, such as neighborhood, community, district, city, region, and country. Then it analyzes the city's spatial structure, development direction, composition pattern, etc. Therefore, space syntax further analyzes the relationship between spatial structure, traffic, and land use function, to explore the interaction law of urban spatial form and function, which can be used to predict the evolution of urban spatial structure.

Space syntax explores various mathematical ways to reproduce space, four of which are used: convex, axial line or segment, isovist, and cell (Figure 3.2).

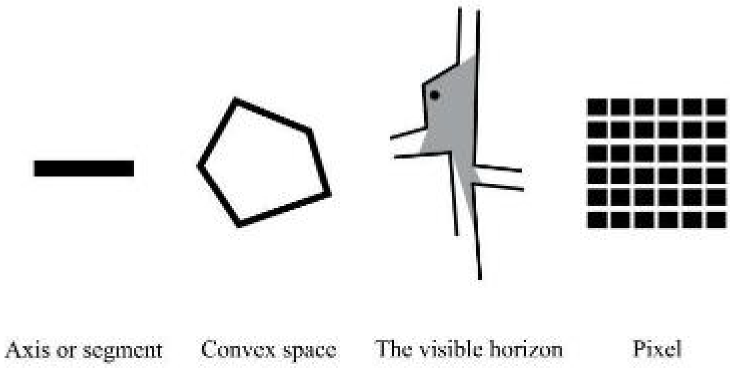

Figure 3.2 A simplified representation of space image. Source: painting by author.

Architecture or urban space can be simplified into basic elements such as lines, planes, and points, which are connected and together constitute the system of physical space form. Then the relationship between each spatial element and all otherspatial elements can be calculated to measure the structure of theentire spatial system. We can calculate the distance between each element and all the other elements, called the generalized distance, including topological distance, metric distance, angular distance, and the complex distance based on these three kinds of distances. For each element, we calculate some kind of distance and then attribute the distance to the element itself, that is, using "generalized distance" to describe the space attribute of each element, and sort elements according to the size of "generalized distance". And then different colors are expressed according to the color sequence. For example, red represents the maximum "generalized distance" value, while dark blue represents the minimum value. Thus, the color gradation diagram approximates the fabric structure of a spatial system.

The theory of space syntax itself is facing a paradigm shift. The spatial structure of cities and towns under different cultures shows explicit heterogeneity. How these featured spaces are formed under the role of spatial cultures at different scales, and how they are related to each other are also the direction of further study of this theory. This is analogous to string theory's exploration of diverse mechanisms in physics. Therefore, studying multi-scale interaction and changes in spatial syntax will help in promoting the development of spatial syntax theories and methods.

3.3 The overall framework construction of landscape character theory

Landscape character and biological genes have commonalities: both can be considered as information carriers, and they can store information that guides the survival and development of the organism, as well as issue instructions which present as traits.But there are also differences between them: on the one hand, biological genes are objective beings whose basic units are nucleotide sequences; landscape character is an abstract pattern whose basic units are spatial elements and their configuration relationship. On the other hand, biological genes extracted from any level of an organism (such as cells, tissues, organs, etc.) are identical and have all the genetic information of that organism; while landscape character extracted from different levels of the landscape are different due to their different components and relationships. For example, industrial land in disuse focuses on the sequential structure of spatial elements such as buildings, structures and environment linked by production and living streamline. Industrial land in disuse cluster consists of different types of industrial lands in disuse linked by tangible and intangible linear elements.

Given the existing researches on spatial morphology and recognition, there are some problems, such as concept generalization, unsystematic recognition elements, unclear scale division, and the deficiency of "emphasis on features and neglect dynamics", "emphasis on elements and neglect relations" in the extraction process. These problems lead to incomplete extraction of character information and weak interpretation of extracted content. Therefore, based on principles of "base pairing" and "DNA sequence assembly" in genetic information storage and transmission, this research uses a multidisciplinary approach to establish a landscape character structure system at multi-scale levels, draw a landscape character atlas, and propose protective and creative strategies.

The whole process of landscape character extraction and application is summarized as follows: 1) to use landscape character structure system, from a multi-level perspective, landscape character was sorted out, and construct the unit-piece-chain-domain structure system; 2) identify and extract landscape character from deconstructed multi-level units; 3) coordinate the results of character extraction, encode landscape character, and draw landscape character atlas based on the data; 4) propose overall control measures and creative design strategies based on landscape character atlas (Figure 3.3).

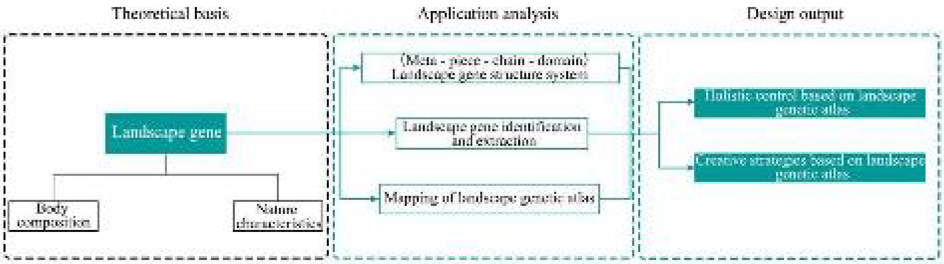

Figure 3.3 The overall framework of landscape character atlas

Image Source: painting by author.

3.3.1 "Unit-piece-chain-domain" model

This study proposed "unit-piece-chain-domain" model (Figure 3.4). The multi-level organization of chain is used to correspond to spatial hierarchical and correlation changes, and to strengthen the diversity of domain and its quality as a system through tangible and intangible links of chain.

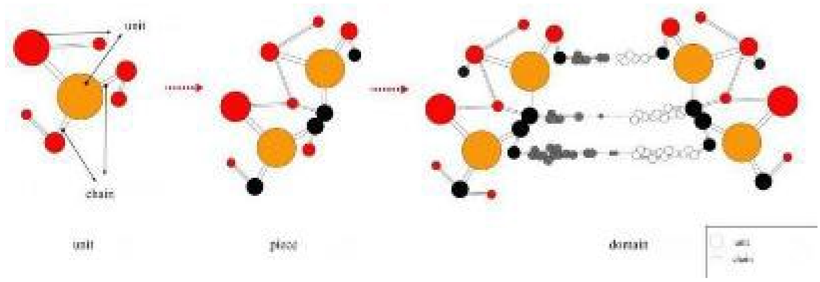

Figure 3.4 "Unit-piece-chain-domain" mode.
Image Source: painting by author.

(1) Unit

Unit is the individual unit carrier of landscape character, which can be used to explore and discover its character. It is the smallest unit that people can intuitively perceive.

(2) Piece

Piece is the result of connection, nesting, and compound of units through the epistasis and basic organization rules under the action of time and space, that is, the combination, arrangement and extension of units in a specific region, which can be analogous to the gene fragment reflected a certain character of the organism.

(3) Chain

"Chain" is expressed as an association mechanism and a clue. Character chain originates from the pathway, but is not limited to it. A chain can be the combination of nits or non-materials such as industrial narrative. According to the hierarchical laws, it is manifested in multi-levels and multi-dimension, and it links and compounds the continuous units into the domain.

(4) Domain

Domain can be regarded as a map. There are crosses, fusions, and overlaps between piece, chain and domain, and the domain acts as the map base of the other two.

3.3.2 Identification and extraction of landscape character

Similar to the diversity of biological genes, landscape characters also have multiple types, according to the differences of recognition dimensions. There are different landscape character classifications, thus forming varied landscape character cognitive systems (Table 3.1). There are mainly two types of recognition systems. One is based on the objective and static features of landscape character in expression form and existence form, and can be divided into different types, such as the explicit and implicit type, material and immaterial type, cluster and independent type. The other is based on the dynamic behavior and its importance in the process of expressing landscape character, which tends to recognize complex landscape character with multiple types interwoven.

Table 3.1 Landscape character cognitive system based on two types of recognition system.

Landscape character recognition system	Landscape character identification dimension	Landscape character identification results
character recognition based on objective static features	Expression form	Dominant
		Recessive
	Existence form	Material
		Immaterial
	Carrier	Population
		Independent
character identification based on dynamic expression behavior	Degree of importance	Main
		Attached
		Hybrid
		Mutant
	Expressive behavior	Structural
		Regulate
		Operation

Landscape character extraction can be mainly summarized as the following processes: 1)screening character units, and eliminating invalid information contents that destroy the landscape or have obvious differences in causes, forms and cultural bases from the research scope; 2)extracting the character information, combining with the four principles of landscape character recognition, that is, overall superiority, local prominence, individual uniqueness and character uniqueness; 3) to complete the extraction of landscape genes. According to the situation of character categories and research needs, this research adopts the element extraction method based on tangible entities, the pattern extraction method using logo patterns as a medium, and the feature extraction method using spatial features as elements.

3.3.3 Landscape character atlas construction

Landscape characters can be sensed simultaneously in a certain spatial range in different times and spaces, and attached to the units through inheritance, replication and mutation. Therefore, based on the result of landscape character extraction and character encoding, and combined with the information base, a character atlas can be drawn with a featured information index and spatial distribution display function.

(1) Landscape character encoding

The significance of character encoding lies in narrative features and digital expressions of pictorial information content after typological division. Based on the landscape character structure system of industrial land in disuse and the classification and deconstruction method of landscape character, combined with the existing information coding theories and character encoding examples, the landscape character encoding model was proposed. Firstly, the domain segment and type of landscape character are determined according to the landscape character structure of industrial lands in disuse, i.e., to set the topological relationship and hierarchical positioning of characters in urban space. Secondly, the classification and extraction methods of landscape characters were used to judge the categories of landscape characters and to complete the large and small subcategories of characters and the information content encoding.

(2) Landscape character atlas mapping

The character coding model of industrial land in disuse already has the attribute of information base. In this study, ArcGIS spatial analysis function is used to record all locations of every character into geographical space in the form of coordinate points according to their types. According to the character and spatial information aggregation, the landscape character atlas associated with data is drawn.

3.3.4 Controlling measures and creative design methods

On the basis of landscape character extraction and landscape character atlas mapping, industrial land in disuse are conserved and utilized through such as original authentic cultivation, graded protection, isolation archiving, benign recombinationand functional grafting.

(1) Authentic cultivation and hierarchical protection of landscape characters

The landscape character atlas visualizes the valuable characters in the study object and is the basis for ensuring the authenticity and integrity of the landscape character. Landscape characters are often subject to mutations, breaks and disturbances due to external forces, forming many types of variants. For this reason, it is necessary to eliminate the mutated characters that have been irreversible and repair the reversible damaged fragments to ensure that the characters can maintain the original state and avoid the value decay that continues toward malignant mutations.

(2) Benign recombination and functional grafting of landscape characters

The free recombination and functional grafting of landscape characters can promote the landscape characters to reach the ideal state of the most adaptable to external environmental changes. Relying on the law of landscape character recombination, in the process of daily production life, spatial environment construction and technical and artistic expression, the landscape characters are benignly recombined and functionally grafted to form new landscape character types.There are three creative strategies for benign reorganization and functional grafting of landscape characters, namely landscape character juxtaposition, landscape character translation and landscape character symbiosis (Figure3.5). Landscape character juxtaposition emphasizes the coexistence of original genes and new elements within the object; landscape character translation emphasizes the transformation of the original characters within the site to form new characters, and this process is not the elimination of the original characters, but rather the original characters have a profound influence on the generation of a new structural language, and the characters take on new forms of expression; landscape character symbiosis emphasizes the new symbiosis of multiple cultures inside and outside the site through creative design. Regardless of landscape character juxtaposition, translation and symbiosis, their only purpose is to generate a new, symbiotic and holistic design logic order based on the landscape character atlas.

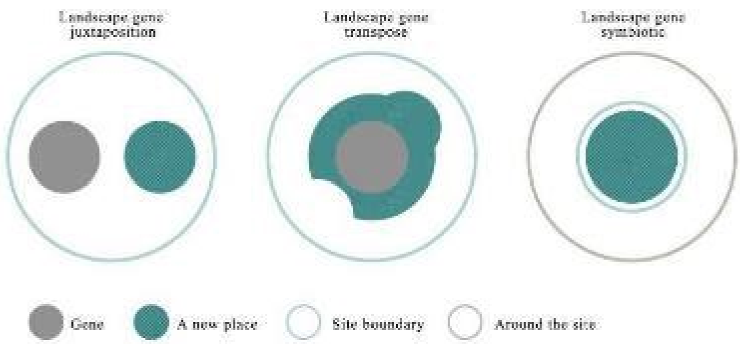

Figure 3.5 Landscape character juxtaposition, landscape character transpose and landscape character symbiotic.
Image Source: painting by author.

3.3.5 Feasibility of applying landscape character theory to industrial land in disuse

(1) Landscape characters of industrial land in disuse

Although most industrial lands in disuse have not experienced hundreds or thousands of years of history, their birth and development have recorded, participated in and even guided drastic transitions and changes in China in a certain spatial and temporal context since the rise of modern industry. Therefore, they have indelible and undeniable spatial and cultural values. Although the industrial lands in disuse are mainly engaged in production, they indicate the architectural characteristics and the technology of the times, and based on the material buildings, generate related activities as well as the culture and spirit of the time and space. In addition, the inherent richness of industrial lands in disuse from production to living, industrial beauty, ruin beauty and other factors make the lands in disuse also have landscape contents that deserves exploration and excavation.

(2) Potential for landscape extraction from industrial land in disuse

Industrial lands in disuse are generally short-lived, with clearer historical traces and landscape memories, so they have a better possibility of tracing the origin, and excavating and refining elements and sequences. Secondly, industrial production has rational characteristics and a clear logical structure. In addition, industrial lands in disuse have some effects on the matrix of the near environment and later reconstruction. For example, the residential communities around the Daye iron ore mine in Huangshi, Hubei Province, are influenced by the Tieshan community and have similar appearances within a certain range.

(3) Significance of landscape characters for industrial land in disuse

The study of industrial land in disuse at present lacks holistic thinking, systematic exploration and combined application, and landscape character theory provides an effective method for its further study. The purpose of landscape character identification and atlas mapping is not to control the industrial lands in disuse in a non-interference way, nor to impose hard management to the landscape sequence. It is to provide a screening basis and approach for heritage retention, conservation and organic regeneration in urban renewal. The landscape genetic atlas can provide advice to conserve urban patterns and landscapes.

Chapter 4

Research on landscape character structure system of industrial land in disuse cluster

Chapter 4 Research on landscape character structure system of industrial land in disuse cluster

4.1 Value evaluation of industrial land in disuse

Value evaluation is an important method to identify the landscape character of industrial land in disuse formation. Through value evaluation, valuable landscape genes can be identified, which lays a foundation for the establishment of subsequent landscape gene structure system. Value evaluation is a comprehensive cognitive activity with a multi-dimensional subjective and objective combination. Industrial land in disuse has multiple value connotations. With the aim of protective utilization, this paper discusses levels and reasonable ways of the evaluation, development and utilization through the consideration of its comprehensive value system. According to the elements and evolutionary process of natural and human activities in industrial land in disuse, two evaluation systems, one of protection value and one of development value, are established based on the goal and significance of protective utilization. Protection value includes four aspects: noumenon, culture, ecology and social value; development value mainly refers to economic value. The comprehensive value evaluation system is established by horizontally distributing conservation indicators and development value indicators for the components of natural and human activities, and vertically intersecting them for comprehensive value evaluation. This will facilitate the quantitative cognition of the value connotation from different aspects and the understanding of the relationship between the elements, so as to interpret the connotation and structure of industrial land in disuse. This chapter takes the industrial lands in Huangshi as a case to study the method of value evaluation of industrial land in disuse.

4.1.1 Value analysis of industrial lands in disuse in Huangshi

Huangshi is a city in China with well-developed industries and a clear lineage of urban development. Huangshi has been engaged in mining and metallurgy since the Shang Dynasty, which occupies an important position in the history of this field in ancient China. In the long history of mining and metallurgy of Huangshi, the Shang Dynasty (1600-1046 BC) and Zhou Dynasty (1046-256 BC), the Spring and Autumn (770-476 BC) and the Warring States (475-221 BC) periods and the late Qing Dynasty (1840-1912) are the most prosperous, which promote the process of Chinese mining and metallurgy culture and even social civilization. However, industrial production began during the “Westernization Movement” in modern China.

Before the Qing Dynasty (1636-1912), the mining, metallurgy and agricultural products processing in Huangshi began to take shape, showing the initial form of the traditional handicraft industry. However, as a complete modern industry, it began with the "Westernization Movement" in 1859. The rebirth of industry and the construction of factories and mines have directly promoted the rapid expansion of urban space, which has also become the main reason of the different development of Huangshi City from that of ordinary cities. Huangshi urban space can be summarized as a top-down development mode.

Firstly, factories and stations were built from industrial and mining enterprises, and then the urban space was gradually formed. Due to the relationship of the industrial chain, Huangshi factories and mining enterprises were formed in various types of resources, processing, energy and fuel at the beginning, such as the Daye Iron Mine, the Daye Iron Plant, the Huangshi Power Plant, the Hubei Cement Plant and the Coal Plant. These factories and enterprises are the beginning of Huangshi urban space, and also define the basis of Huangshi urban spatial development in terms of spatial scope.

Huangshi as the thriving place and heritage city of mining and metallurgy culture in China

Rich copper resources laid the material foundation of Chinese civilization. Before the Western Zhou Dynasty (1046-771 BC), Huangshi belonged to the Jiangnan region. The crude copper produced within the region became an important raw material for the casting of weapons and ritual vessels in the Shang and Western Zhou Dynasties, and thus was continuously exported to the Central Plains. From the Spring and Autumn Period (770-476 BC) to the Warring States Period (475-221 BC), the rich copper resources in the Huangshi area laid a solid material foundation for the development and prosperity of Chu culture.

Advanced mining and metallurgy technology is an important symbol of the scientific and technological achievements of the civilization in China. Advanced copper and iron ore smelting technology is an important part of the brilliant scientific and technological achievements of Chinese civilization, which greatly promoted the rapid development of productivity at ancient times and affect every aspects of Chinese civilization. As one of the three major copper mining bases in China in the pre-Qin period, Huangshi mining and metallurgy technology, which took the Tonglushan ancient mining area in Daye as its center, held an incomparable leadership position at that time, which was an important symbol of the level of social and economic development and the comprehensive strength of the country.

The mining and metallurgy culture has lasted for 3000 years and is unique in China. The pre-Qin mining and metallurgy culture in the Huangshi area centered on Tonglushan began in the Western Zhou Dynasty, flourished in the Spring and Autumn and Warring States periods, and continued to the development of modern and contemporary industry and mining. Three thousand years of continuous life of the mining and metallurgy culture has played an irreplaceable and special role in all periods of history. Compared with other mining and industrial cities in China, Huangshi started in an earlier period and has stronger continuity, which give rise to its uniqueness of mining and metallurgy culture in China.

Huangshi as the cradle of China's modern smelting industry

Huangshi is the birthplace of the iron and steel industry in China. It was one of the first industrial bases in China during the Westernization Movement, and the Daye Iron Mine in Huangshi was the first large-scale open-pit iron mine using machines in China. Compared with other industrial cities such as Tianjin, Nanjing and Tangshan of the same period, Huangshi's modern industries in their start-up period had the characteristics of large investment, large numbers of factories and mines, prominent heavy industry and important positions. During the Westernization Movement, Huangshi became an advanced area of modern industry. A number of representative enterprises such as the Daye Iron Mine (Table 4.1) have emerged, successfully transforming China's iron and steel industry from machinery mining to industrial smelting, leaving many “orphaned” pieces of China's modern heavy industry heritage.

Table 4.1 Representative industrial enterprises in Huangshi

Name of Factory or Mine	Year of Establishment	Character
The Daye Iron Mine	1893	The first large-scale open-pit iron mine using machines
The Wang Sanshi Coal Mine	1891	The first coal mine in Hubei using machines
The Daye Hubei Cement Factory	1907	The second cement factory in modern China

A relatively complete modern raw material industry system was formed early in Huangshi. With the iron and steel industry as the starting point, it led to the mechanized mining and smelting of a wide range of mineral resources in the Huangshi area. Different from other heavy industrial cities, such as Tangshan, which was formed on the basis of the mining-based Kaiping Mining Bureau, and Wuhan, which was formed on the basis of the smelting-based the Hanyang Iron Works, and Huangshi combined mining and smelting. Before the outbreak of the War of Resistance against Japan (1937-1945), the Huangshi area gradually formed a complete system of raw material industries involving coal, cement and electricity.

Huangshi as an exceptional case of an industrial and mining landscape city

Mining and metallurgical activities from the pre-Qin to the Han Dynasties: the selection of the site for the city was inextricably linked to the landscape conditions. Three ancient cities, Wulijie, Ewangcheng and Caowangzui, in the Huangshi area were built during the Spring and Autumn period, the Warring States period and the Western Han Dynasties respectively. The three ancient cities were built with the shift of mining and smelting centers, and were closely related to mining and smelting, making them unique examples of ancient Chinese mining-based cities. All the three ancient cities were built close to the Daye Lake, with unobstructed and convenient waterways. They are surrounded by rich copper resources and dense ancient copper mining and smelting relic sites, forming a sites group centered on the city site.

Expansion of modern cities: build a factory according to the mine, and build a city according to the factory. The urban pattern is highly compatible with the layout of the mining and metallurgical industry system. From modern times to the early days of the founding of New China, the urban area in Huangshi formed an urban structure with industrial logistics lines as the framework and large factories and mines as the groupings, and formed a spatial layout of the Huangshi mining and metallurgical industrial system. The six major factories and mines in the Huangshi urban area are the main body of the Huangshi heavy industry system. The locations of the six major factories and mines are the most concentrated and representative area of Huangshi's existing industrial heritage, as well as the important basis for the delimitation of Huangshi's historic districts (Figure 4.1).

Figure 4.1 The Huaxin Cement Plant.

Image Credits: ©Peng Ruan, 2016

Huangshi is a place where modern Chinese urban planning concepts are put into practice. Modern urban planning has had an important influence on the development of the spatial pattern of the Tieshan district and the Binjiang urban area. The Binjiang urban area was developed from the new workers' village in 1954, and its overall pattern has continued since the planning was established at beginning of liberation. The overall layout of Tieshan reflects the functions and spatial layout of the integration of “mine, factory and the city”. This spatial structure was conducive to the production-oriented and life-friendly concept at the time. The city, the squares and the streets form a distinctive axial radial layout (Figure 4.2).

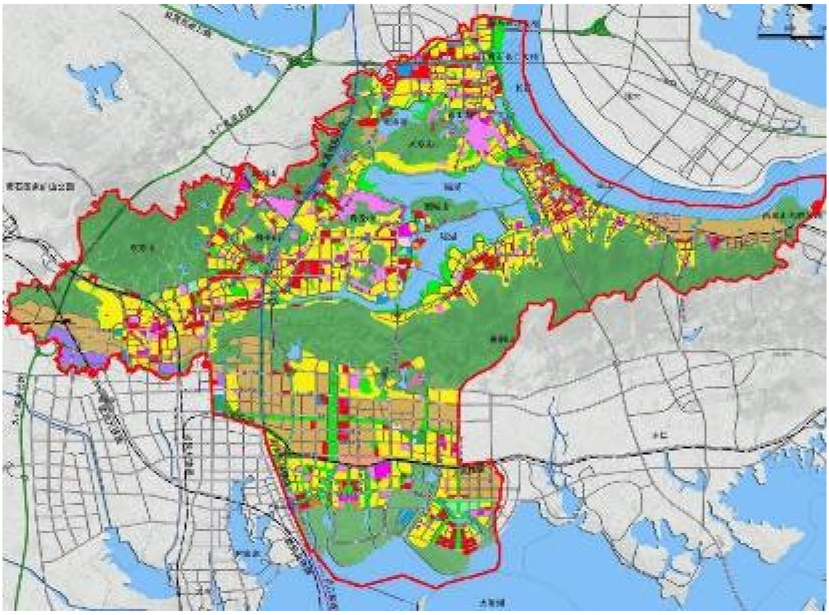

Figure 4.2 Urban planning map of Huangshi City.

Image source: Huangshi natural resources and planning bureau, 2020.

A large number of large factories and mines are the support for the modern urban pattern of Huangshi. The large factories and mines built in modern times such as the Daye Iron Mine, the Daye Steel Works and the Huaxin Cement laid out production, offices and residential quarters for industrial workers in close proximity to each other, forming a number of relatively independent urban clusters. This planning model became the basis of Huangshi's modern urban pattern. Up to this day, the historical and cultural districts such as the Daye Iron Mine Dormitory, the Dizhi Village and the Yegang Soviet-style workers' dormitory (Figure 4.3) are still well preserved and serve as strong evidence of the construction of workers' living quarters around large mines and factories.

Figure 4.3 Workers' village of the Xinye iron and steel plant.

Image Credits: ©Qipeng Liao, 2020.

(1) Aesthetic Value of Huangshi Industrial lands in disuse

The artistic and aesthetic value of Huangshi's industrial lands in disuse is mainly reflected in two aspects: the typical "technical aesthetic" characteristics and the "non-daily nature" of the heritage landscape. The unique industrial landscape not only has distinctive aesthetic characteristics itself, but also is an indispensable part of Huangshi urban landscape system. It is because of the unique charm of the industrial lands in disuse landscape that makes Huangshi urban landscape appear more abundant and more three-dimensional.

1） Typical technical aesthetic characteristics

Technical aesthetics is also called machine aesthetics, industrial aesthetics or engineering aesthetics, whose core concern is the beauty of technology, machinery and equipment or the construction and production process. Relatively speaking, the technical aesthetics of Huangshi's industrial lands in disuse is mainly reflected in the productive factors, such as production workshop buildings and structures. Because they directly serve the production, the form of these facilities is based on the production process and production technology. As productivity and efficiency being the fundamental goal of their form design, there is very little superfluous decoration, which shows a strong “form follows function” characteristic. For Huangshi industrial lands in disuse, the rational overall layout, the rough visual texture, the flexible flowing space, and the exposed structure and construction perfectly illustrate its unique technical aesthetic characteristics.

① Rational overall layout

Due to the logical nature of the production process, the overall layout of Huangshi's industrial lands in disuse shows clear characteristics of “rationalism”. This rationalist layout is based on geometric and logical design principles, with the key production chain and the positioning of large workshops as the core, following the principle of putting production efficiency at the first place, and focusing on simplicity, straightness, and a sense of logic. Compared with the surrounding natural and cultural environment, the geometric regularity reflects a strong feature of artificial planning, and is arranged orderly visually (Figure 4.4).

Figure 4.4 The abandoned Daye cement plant

Image Credits: ©Qipeng Liao, 2020.

② Rough visual texture

For the buildings and structures in Huangshi industrial lands in disuse, the construction materials are often locally sourced, and are mostly reinforced concrete, cement and metal materials, and rarely masonry and mortar. In addition, the original texture of the materials is mostly maintained, so most of them look rough and direct, and the external image reflects a unique rough texture (Figure 4.5). This way of keeping the natural texture of materials is consistent with the modernist view that "decoration is sin", and has the beauty of simplicity and nature, reflecting a special artistic value.

Figure 4.5 A corner of the production plant of the Huaxin Cement Factory

Image Credits: ©Huangxin Cheng, 2022.

③ Flexible flowing space

As the saying goes, “architecture is the machine of life”. For workshops, buildings are the container to accommodate industrial raw materials and products as well as machinery and equipment. Due to the industrial nature and the heavy industrial properties of machines and products, and the requirements of technological process, the appearance of the buildings in Huangshi industrial lands in disuse is mostly presented as a huge volume and magnificent scale. Inside the factory, it fully adopts the structural form of bent frame, truss and space grid with a large span, and the internal space has no or few columns, which is quite wide to accommodate the giant production equipment, and can also facilitates the secondary division of internal functions and the flexible use of space. This feature is in line with the theory of “flowing space” (footnote) advocated in modernist architecture. It is because of this magnificent spatial scale and the fluidity of space that allows considerable flexibility in function replacement and reuse in the future (Figure 4.6).

Figure 4.6 Interior space of Huaxin Cement Plant

Image Credits: ©Huangxin Cheng, 2022.

④ Exposed structure and construction

Structure and construction exposing is one of the characteristics of the buildings in Huangshi's industrial lands in disuse. Most of the structural types, material properties, and methods of node construction of the buildings are directly exposed, thus conveying the beauty of the spatial structure and mechanical characteristics, different from the civil buildings that are often hidden by suspended ceilings and additional decorative layers (Figure 4.7).

Figure 4.7 Internal structure of Huaxin Cement Plant

Image Credits: ©Huangxin Cheng, 2022.

The exposed structure and construction practices eliminate unnecessary decorations and bring the building back to the authenticity of construction, which can enlighten the viewers and make them fully appreciate the authentic beauty of the construction process and the high technical level at that time. In the subsequent reuse of industrial heritage, it also has great potential to inspire people to explore the industrial production process, develop the laws of construction science, and stimulate creative thinking.

2) The “non-daily” nature of industrial lands in disuse

For ordinary people, the strange and novel industrial productions are far away from their daily lives. What they show to people are large steel and concrete structures, complex and complicated pipes, towering chimneys, and a regular and almost rigid architectural layout. Many people think that there is no aesthetic value in these landscapes. But it is because of their “non-daily” nature that a kind of beauty is formed due to distance, which makes these workshops and factories have unique aesthetic values. In the current context of the consumer era, this novel aesthetics is having growing potential.

① Strong machine style

The machine aesthetic forms the aesthetic basis of Huangshi's industrial land in disuse, and it is also an irreplaceable and important element of the modern Huangshi urban landscape system. Industrial elements such as blast furnaces, chimneys, locomotives, machines, pipes, rails, trestles, conveyor belts and tower cranes are constructed into a network at the horizontal and vertical levels, forming a unique industrial landscape. For the city, this heterogeneous style greatly enriches the urban skyline and enhances the charm of the city. For example, the Daye Steel Factory which is located along the Yangtze River was built initially for the convenience of transportation and land acquisition. With the continuous expansion of the industrial and living areas, the industrial landscape of the Daye Steel Factory gradually emerges, with grand industrial plants, towering chimneys and intertwined railway lines which present a strong industrial aesthetic. Not far from the Daye Steel Plant, the Xisai Mountain is near the Yangtze River, and Sanhuazhou faces the Daye Steel Plant across the river. The natural landscape of precipitous and beautiful scenery and industrial heritage landscape complement each other, presenting a unique aesthetic interest.

② The sublime beauty shaped by transcendental attributes

When experiencers approach the viewing platform and see the Tieshan open-pit quarry in Huangshi that extends 2 kilometers with a drop of 400 meters, their uncontrollable reaction is similar to that of seeing the Great Wall. There is always a transcendental attribute in the real high-quality things that allows the audience to sense beyond gender, faith, nationality, and culture.

The sublime nature of post-industrial heritage comes from industrial civilization, firstly from the fact that the spatial scale of the industrial construction system far exceeds the conventional size of the civilian use. Under the tension of the huge scale of blast furnaces, cooling towers, chimneys, dust towers, pipe corridors, etc., people will feel their own smallness and powerlessness when they face industrial facilities or buildings, which is similar to what they feel when facing the grant mountains and rivers in nature. In the interior space of these industrial buildings or facilities, it is easy to obtain a sense of sublimity and sacredness similar to that of religious space. Both inside and outside, the sublime has not disappeared in the post-industrial decadence, but has been strengthened to a considerable extent, which can be called the sense of sacredness in the industrial land in disuse. However, different from the connotation of nature worship, these are all created by human beings. The sublime nature of industrial and post-industrial landscapes also implies the worship of the great power brought about by the capabilities of science and technology.

③ The unique beauty of ruins

Most of the industrial lands in disuse left in the Huangshi area have a long history. Thus, many ruins appear to be mottled, seemingly lacking in beauty. However, just like the contribution made by ruined remains of ancient Greece and Rome to modern Greek and Italian cities, the beauty of such ruins contains historical memory and cultural precipitation, and is a unique cultural resource of the city.

The former site of the Hanyeping Coal and Iron Mine is the earliest preserving iron and steel industry site in China, and its smelting furnace is the earliest existing iron and steel smelting site in modern industry in China. Although having the appearance of a set of steel and concrete ruins, it has very high heritage value and fills the gap in the protection of iron and steel industry heritage in early modern China, being typical, unique and irreplaceable.

In the Tonglushan copper mine relic site, there are hundreds of shafts, inclined shafts, blind shafts of different structures and support methods, and more than one hundred flat alleys existed from the Western Zhou Dynasty (1046-771 BC) to the Han Dynasty (202 BC-220 AD) for more than a thousand years, as well as a number of copper furnaces from the early Spring and Autumn Period (770-476 BC). Along with them, a large amount of copper, iron, bamboo, wood and stone production tools used for mining, beneficiation and smelting were also unearthed. Both the mining relics in the Tonglushan Ruins Park and the archaeological ruins displayed in the Ruins Museum are rich in historical and cultural value. Through these ruins, people can perceive the ancestors' wisdom in production. Although the beauty of this kind of ruins has no traditional aesthetic features or the function of daily life elements, it has unique historical and cultural value and a rare beauty of traveling through time.

(2) The historical recognition value of Huangshi industrial lands in disuse

The historical recognition value of Huangshi industrial lands in disuse refers to the understanding of social, political, economic and cultural development in the time dimension, including the group consciousness of local people's concepts, psychology and emotion, etc., combined with the study of its historical formation, development process and evolution law. It is the material and spiritual wealth accumulated in production and life activities, and is the comprehensive embodiment of the historical layers of local civilization. The Huangshi area has a long history of mining and metallurgy culture since the Shang and Zhou Dynasties (1600-771 BC), thus having a very high historical status. In modern times, the national bourgeoisie guided by the policy emerged, promoting the mechanized mass production scale of heavy industry sectors like copper and iron ore mining, iron and steel smelting, cement processing, coal mining and processing and power production in the Huangshi area, and make it become an important base for national heavy industry in modern China. The historical recognition function of Huangshi's industrial lands in disuse, which combined with the method of historical coordinates and locates its development lineage and characteristics, can provide scientific reference for its material and immaterial cultural protection and utilization.

1) Recording the footprints of historical figures

The important industrial lands in disuse heritage in the Huangshi area is associated with some important historical figures and historical events, reflecting the chronology and importance of historical events. In particular, some important historical figures or historical events often determine the process of the establishment, development and growth of industrial enterprises. For example, three historical figures played great roles in promoting the development of the Huaxin Cement Factory during its most difficult period. They are Zhang Zhidong, the founder of the Hubei Cement Factory, Cheng Zufu, the founder of the Hubei Cement Factory, and Wang Tao, the founder and pioneer of China's cement industry. The founding of the Daye Iron Mine was also due to Zhang Zhidong’s earlier founding of the Hanyang Iron Works, which required raw materials and fuels such as iron sand, coal and jade to make iron. Then Zhang Zhidong sent German technicians to survey the area around

Daye and found that there were abundant iron ore deposits, which led to the construction of the Daye Iron Mine. These historical figures and historical events reflect the historical value of Huangshi's industrial land in disuse heritage.

2) Marking the beginning of certain industrial categories in China or Hubei

In the process of industrialization, many industrial categories in China or Hubei begins in Huangshi, which is pioneering in industries. The main categories are as follows:

In iron ore mining and steel smelting. Zhang Zhidong founded the Daye Iron Mine in Huangshi, which ushered in China's modern iron and steel industry, and Huangshi thus became the birthplace of China's iron and steel industry in modern times.

The main component of the Daye iron ore Hanyeping company, is the only enterprise that is preserved and still in normal operation founded by Zhang Zhidong. The Daye Iron Mine has many firsts in history: it was the first large open-pit iron mine in China using machinery; it was the first large copper and iron deposit discovered in China by employing foreign experts in geological science exploration; and it is the largest hard rock greening reforestation and reclamation base in Asia with an area of 247 square meters on the 370 million tons of waste rock yard.

The first railroad built in the central and southern regions was the ore transporting railroad from Tieshan to the Shihuiyao River built by Zhang Zhidong in 1890 when he set up the Daye Iron Mine. It was the first railroad in Hubei Province and the first railroad in the south of the Yellow River in mainland China. The Xialu railway station is the oldest existing railway station in the central and southern China.

3) Witnessing the urban history of Huangshi

As a resource-based city famous for its mining and metallurgical resources and an important city that led the trend of China's modern industrial civilization, Huangshi has a large number of industrial heritages. As relics or testimonies of the history, these industrial heritages of outstanding value constitute an important part of this city, telling the history of the city through their own changes and the existence of materials. Huangshi is a typical city established due to mining. Industrialization directly contributed to the emergence of Huangshi as a city of immigrants.

In terms of the history of the city, Huangshi cannot compare with the ancient capitals like Xi'an, Nanjing or Luoyang, and in terms of archaeological value, it cannot compare with those major provinces of cultural heritage like Shaanxi or Henan. The characteristics of Huangshi's historical and cultural heritages lie in the ancient mining and metallurgical remains and the heritage of modern industrial lands in disuse formed since the late Qing Dynasty.

(3) Social and cultural value of Huangshi's industrial lands in disuse

1) Preserving the heritage of industrial lands in disuse is to preserve the industrial memory of an era

Being the copper capital during the Xia, Shang and Zhou Dynasties (2070-256 BC), and the important iron town during the Tang, Song and Yuan Dynasties (618-1368 BC), Huangshi presented a brilliant mining and metallurgical civilization in terms of scale, quantity and technology; during the Westernization Movement, it became the first industrial base and the birthplace of the iron and steel industry in China; the War of Resistance Against Japanese changed the national heavy industry pattern and witnessed the Japanese plundering of China's mineral resources; it was also the first special industrial and mining zone in New China, and was the gathering place and cradle of heavy industry celebrities. These together shape the social and cultural value of Huangshi mining and metallurgical cultural landscape, reflecting the progress of human's knowledge as well as thought, and witnessing the change of natural environment and the development of human civilization.

2）Industrial lands in disuse have strong scientific and cultural education value

Industrial lands in disuse have high heritage value and educational significance. Each industrial land in disuse can reflect the social history of the time. Factories, machines and production lines are vivid teaching materials, which have educational functions beyond textbooks. For example, the Huangshi National Mine Park has preserved a large number of mining relics and cultural landscapes related to mining activities in the process of development and utilization, and has become a large open-air museum and educational base.

(4) The value of economic development of Huangshi industrial lands in disuse

Economic development value is an important value form of Huangshi industrial lands in disuse under the conditions of market economy and consumer society, and is the value system embodiment of comprehensive characteristics of Huangshi industrial land in disuse. The development of Huangshi enters a new era of industrial adjustment and transformation and innovative development. As a special resource, Huangshi industrial lands in disuse should be further explored and developed for its historical and cultural value, and this advantage should be integrated into all levels of urban transformation and modernization development to enhance the optimization of both hard environment and soft environment, highlight the regional cultural characteristics, enhance the attractiveness and comprehensive competitiveness of the city, transform cultural resources into productivity, and promote economic development.

1) Reuse of industrial buildings and other facilities

Due to specific functions and space requirements of industrial buildings, the more advanced building technology at that time is often adopted in the construction, which makes the old industrial buildings have good infrastructure, solid main structure, clear structural forces, and the commonality of large span, large space and high headroom. Some large space buildings such as production plants and comprehensive warehouses have great flexibility in the transformation, and can often go through multiple changes in its function within the life span of the building, which provides the possibility of multiple uses.

2) Developing urban economy and promoting the transformation of resource-exhausted cities

With the completion of the development of mineral resources, the mining industry will no longer exist, and the city will continue to survive on other industries, or decline and gradually die out. The heritage of industrial lands in disuse plays an important role in developing the urban economy and promoting urban transformation. Turning the lands in disuse of the Daye Iron Mine into a national mine park and building scenic spots for people to experience mining relic experience, ecological reclamation and self-service mineral processing can turn the lands in disuse into a tourist area of the city. The lands in disuse located in the center of the city can be combined with urban functions to develop cultural and creative industries.

4.1.2 Comprehensive evaluation model of industrial lands in disuse in Huangshi city

(1) Principles for the establishment of the comprehensive value evaluation system

The evaluation of Huangshi industrial lands in disuse has rich content, complex object and grand time and space. Its evaluation index system should be designed based on natural geographic environment, material and immaterial culture and subject activity elements, combined with its development history, characteristics and internal structure, and focus on the scientificity, systematization, reference, dominance, feasibility and guidance. In the scientific principle, the selection of indicators and the design of the system are carried out around their connotation and degree of goal achievement, neither overlapping nor omitting information; in the comprehensive principle, it emphasizes the overall and hierarchical evaluation of them and constructs a systematic indicator system; in the reference principle, it combines the research results of other related evaluation fields such as cultural geography, urban and rural planning and tourism for a more adaptable evaluation method; in the dominant principle, considering the huge and complex characteristics of Huangshi industrial lands in disuse which involve political, economic and cultural fields, the indicators are selected with emphasis on typicality and representativeness, highlighting the key points and reasonably designing the weights; in the guiding principle, combined with the evaluation purpose, an in-depth understanding of the association between the establishment of indicators in the system and cultural landscape is conducive to master its theory and guide its practice.

(2) Hierarchical design of comprehensive value evaluation system

The process of establishing the comprehensive value evaluation system of Huangshi industrial lands in disuse is as follows (Figure 4.8): firstly, data collection and statistics based on field investigation and expert questionnaires; secondly, research on relevant evaluation theories and methods, combined with data collection and extraction of constituent elements of industrial lands in disuse to design the method of comprehensive value evaluation; thirdly, based on the evaluation method, the influence weights of the elements are counted through the further questionnaire; fourthly, the quantitative demonstration was carried out through sample cases, combined with qualitative analysis for comparison and correction, and from this feedback the index system is further improved and the comprehensive value evaluation of Huangshi industrial lands in disuse is conducted.

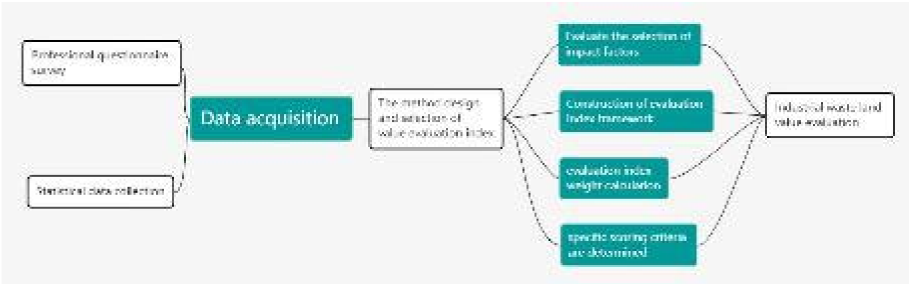

Figure 4.8 Evaluation Process

Image Source: painting by author.

The design process focuses on the characteristics of evaluation objects, evaluation objectives, and evaluation processes, and establishes three levels of indicator systems as follows: target level, criterion level, and factor level (Figure 4.9). On this basis, combined with the comprehensive value evaluation content system of Huangshi industrial lands in disuse, the construction of target level A, criterion level B, factor level C, sub-factor level D and indicator level E is carried out in conjunction.

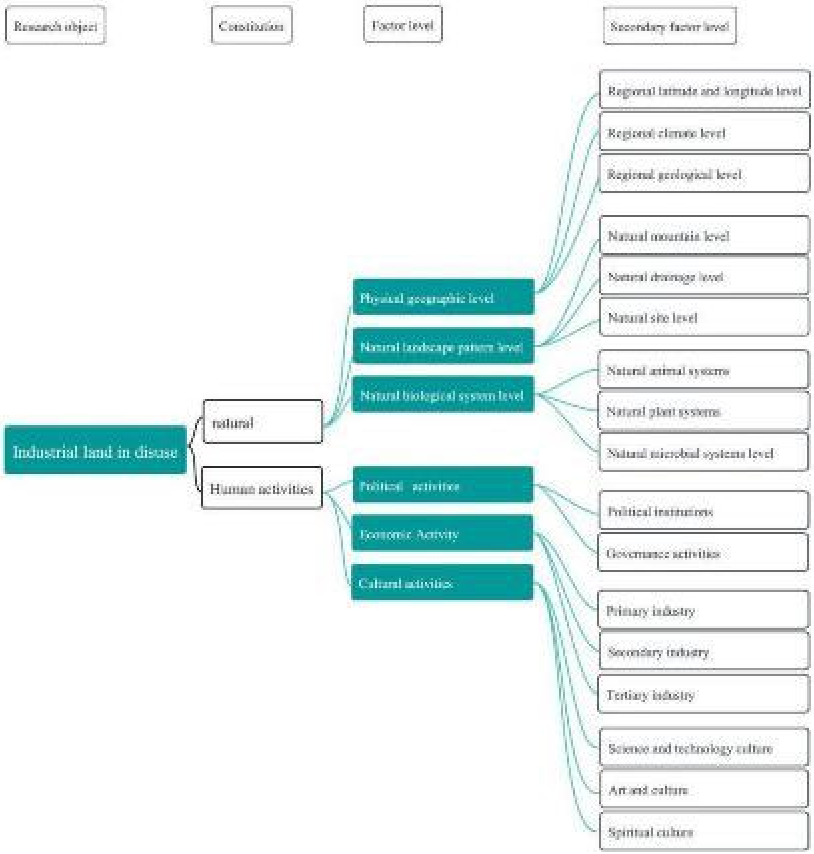

Figure 4.9 Evaluation index system of Huangshi industrial lands in disuse

Image Source: painting by author.

1) Target layer A

This system takes the comprehensive value of Huangshi industrial lands in disuse as the target level, which is represented by A. Five criterion levels of indicators are set up: noumenon value, cultural value, social value, ecological value and economic value, which are represented by B1, B2, B3, B4 and B5 respectively.

The formula is expressed as.

A= {B1, B2, B3, B4, B5}

2) Criterion level B and factor level C

The target level A is composed of several criterion levels B, under which factor levels are expressed by the letter C. The factor levels are the division of the object types of the evaluation system.

① Noumenon value B1. It is the embodiment of the objective value of Huangshi industrial lands in disuse itself and its own characteristics. It is composed of spatial value C1 and material value C2 factors.

The formula is expressed as:

B1= {C1, C2}

② Cultural value B2. It is the embodiment of the cultural characteristics of the Huangshi industrial lands in disuse. C3, C4 and C5 represent the historical cultural value, aesthetic cultural value and spiritual cultural value factors respectively.

The formula is expressed as:

B2= {C3, C4, C5}

③ Ecological value B. It is the embodiment of the ecological characteristics of Huangshi industrial lands in disuse. It is composed of environmental ecological value C6, plant ecological value C7 and animal ecological value C8 factors.

The formula is expressed as:

B3= {C6, C7, C8}

④ Social value B4. It is the embodiment of the social characteristics of Huangshi industrial lands in disuse. It consists of social impact value C9 and social importance value C10.

The formula is expressed as:

B4= {C9, C10}

⑤ Economic value B5. It is the embodiment of the economic characteristics of Huangshi industrial lands in disuse. It consists of the factors of direct value of production C11 and indirect value of transformation C12.

The formula is expressed as:

B5= {C11, C12}

3) Sub-factor level D and indicator level E

The sub-factor level D is the level of the specific evaluation object, and is the subordinate level of the factor level C. It can be divided into external space value D1, site space value D2, unit space value D3, structure value D4, building value D5, equipment value D6, facility value D7, time dimension D8, important person D9, important event D10, historical status D11, morphology D12, texture D13, moral orientation D14, motivational effect D15, identity function D16, adaptation to the times D17, inherited development D18, geology D19, mountain D20, water system D21, site D22, terrestrial community D23, aquatic community D24, vertebrate D25, invertebrate D26, popularity D27, emotional degree D28, attention level D29, support degree D30, production function D31, labor D32, means of production D33, location transformation D34, spatial transformation D35, functional transformation D36, and material transformation D37

(3) Calculation of evaluation index weights

1) Determination of index weight

The index weight is the quantization value of the proportion of index of the measured object in the set value. This study is mainly based on the statistical analysis of the questionnaire on the subject of evaluation to preliminarily set the indicator weight value. During the process, repeated consultations will be made with relevant experts, scholars and government agencies for adjustment.

In this study, the questionnaire is designed based on the content of the comprehensive value evaluation of Huangshi industrial land in disuse, and 100 out of 130 questionnaires are selected as valid data. The evaluation subjects are as follows.

The process of determining the weight is as follows: constructing the judgment matrix by comparing the relative importance of the factors of the previous level with the factors of this level, calculating the two relative data of each index, using the AHP (Analytic Hierarchy Process) to compare their importance, and using the sum-product method to obtain the index weights, then evaluating index weight value.

4.1.3 Analysis on evaluation results of industrial lands in disuse in Huangshi city

(1) Method of data collection

The distribution of Huangshi industrial lands in disuse is not only point-like, but the points are interrelated to present a network relationship and develop into a surface. In this process, the overall landscape is formed by constantly keeping the output of resources and entry of immigrants into the outside world. As for the selection of the evaluation in this study, it is necessary to classify the evaluation of Huangshi industrial lands in disuse for it is in different types. Discussion is carried out by selecting various types of representative samples.

The field survey and the literature study are conducted simultaneously. The overall research on industrial lands in disuse in Huangshi can be divided into three stages: in the first stage, important industrial lands in disuse were selected for research, and the current status of “national conservation units, provincial conservation units, and municipal conservation units” is the main focus; in the second stage, due to the existence of industrial connection, the spatial connection, cultural connection,industrial connection and other intrinsic aspects of the connection are investigated, and more historical information that is now weakened or disappeared can be deduced through the investigation; in the third stage, the research scope is expanded, and the external connection of Huangshi industries is collected and investigated according to the industrial connection line.

(2) Evaluation results of the comprehensive value

In this study, 29 samples of five types are scored for comprehensive value evaluation (Table 4.4). A total of 11 A-grade samples are found, accounting for about 37.9% of the total samples, and 18 B-grade samples are found, accounting for about 62.1% of the total samples, reflecting the high value of Huangshi industrial lands in disuse samples, among which mining and smelting samples are of outstanding value.

(3) Analysis of evaluation results

Nearly 30 samples of Huangshi industrial land in disuse are selected through the model of this evaluation system, which completely covers 5 major categories and 15 subcategories of mining, smelting, transportation, derivation and settlement. The analysis of the results of the comprehensive value evaluation is as follows:

1) Analysis of the results at the overall level

At the overall level, noumenon value, the spatial value and material value are generally high, and the types are complete, with long time distribution and no break in generations. In the cultural value, the historical value is generally high, the aesthetic value is mainly concentrated in the beauty of landscape and nature, magnificent factory and mine, and the spiritual value highlights the inspire the spirit of the times. In the social value, the social impact value is high, and the social importance value is slightly lower. In ecological values, mining, smelting and derivative classes have a rather great impact on natural ecology, but the room for restoration is also large, and the ecological scores of transport and settlement are higher. In the economic value, the direct economic value is generally low, and the location value affects the direct economic value, but the transformation economic value is rather high.

2) Analysis of the results on the different types

On the one hand, the evaluation of different types presents a relatively high, medium and low distribution. Among them, mining category and smelting category are of high rating; derivative category is of medium rating; transportation category and colony category are of low rating. The mining category and smelting category have a generally long historical span, concentrated distribution, profound cultural connotation, high economic creation value and transformation value; the derivative category is concentrated in modern times, with high historical status, high influence, good location conditions, and high economic creation and transformation value; the transportation category is influenced by industrial development, and the transportation category is directly influenced by the development of transportation technology, and the ancient inland water transportation declined in modern times, and less remains; the settlement category is also formed around industrial development, and with the development of derived industries, a large number of people gathered and formed cities. On the otherhand, each category has typical representatives with high ratings, such as Tonglushan and Tieshan in the mining category, the Daye Steel Factory in the smelting category, the Huaxin Cement Factory in the derivative category, modern railroads, tunnels and ropeways in the transportation category, and the ancient mining and metallurgical city in the settlement category, which reflects the imbalance in different types.

3) Analysis the results on unit level

Although there are high, medium and low ratings in the evaluation of the unit level, the comparison in the unit level is unscientific to a certain degree due to the differences of the types. Especially in the middle and low ratings of the unit level, there is a certain aspect with a high value evaluation, and each of its rating values has a compound value characteristic. For example, although the transportation function of the Daye Lake no longer exists, resulting in a low composite score, its ecological value and economic value are high, and it has a good protective utilization value; the historical value and cultural value of Huangshi Donggang are at an average level, but its noumenon value and economic value are high, and it also has a good development value; the overall rating of the railroad is average, but its development potential is high; the overall rating of the ancient city of mining and metallurgy is low, but its historical value and cultural value is very high. This type of unit needs to be categorized in the process of conservation and utilization, and not to be treated in a broad-brush manner, so as to better utilize its value in higher ratings.

4.2 Composition of landscape character structure system of industrial land in disuse cluster

Based on the landscape character theory and the value evaluation of industrial land in disuse, this study establishes a structural system of “unit-piece-chain-domain”. The multi-level organization of chains is used to respond to the hierarchical and correlative changes of industrial lands in disuse, and the tangible and intangible relationship of chains is used to strengthen the continuity and systematization of landscape character and realize the diversity of character carrier (Figure 4.10).

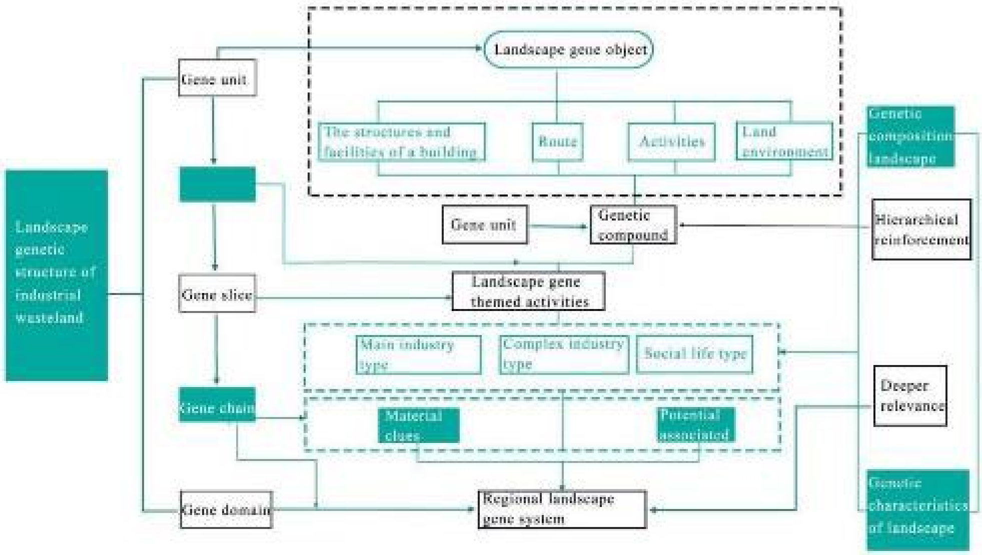

Figure 4.10 Landscape character structure system of industrial land in disuse cluster.

Image Source: painting by author.

This study compares the landscape character structure of Huangshi industrial lands in disuse from macroscopic level to microscopic level, and from whole level to local level, and establishes the “unit-piece-chain-domain” landscape character structure system of Huangshi modern industrial land in disuse cluster. This structure system can effectively solve the problem of fragmentation of Huangshi industrial lands in disuse and lay the foundation for the extraction and mapping of landscape characters atlas. The landscape character structure system of Huangshi industrial land in disuse cluster has the following characteristics. First of all, Huangshi has superior natural resources and location, and has formed large scale industries with complete types and structures during the century of development and change. Due to the rich spatial and temporal remains and complete character structure, the landscape character richness of Huangshi’s industrial lands in disuse cluster is very high. Secondly, as a prominent representative industrial city in China, the landscape characters of Huangshi's industrial land in disuse cluster promote the formation of urban space under the linkage of tangible and intangible chains. Finally, the landscape characters of Huangshi industrial land in disuse cluster have the continuity of time and the integrity of space, which have irreplaceable value and significance in the world and need to be developed scientifically.

4.2.1 Unit in industrial land in disuse

Unit is the smallest part of landscape character. The units in land in disuse cluster mainly consist of single facilities, including industrial production complexes, dedicated storage facilities, dedicated transport facilities, dedicated municipal utilities and public facilities serving industrial production, residential facilities and other constituent elements such as buildings, structures and equipment. The buildings are the workshops used for various types of industrial production, including the main workshop and the auxiliary workshop, which are subdivided into different sections according to the requirements of the production process. Structures include functional structures that are used in industrial production or have a supporting role. Equipment includes a variety of industrial production and storage equipment, transport equipment, etc. The constituent elements of this level can be subdivided into major, medium and minor categories.

At the level of units of lands in disuse cluster, the landmark had significant morphological uniqueness and can associate with specific industrial types. Therefore, it is possible to determine the type of industry to which it belongs on the basis of its appearance, such as giant cooling towers, generating sets and boiler rooms in power plants, refining process units in oil refineries, steel blast furnaces in steel mills, coal mine derricks and wellhead houses and winch houses, oil wells and oil extraction machines in oil fields, shipyards and ship cranes in shipyards and so on.

The scale of landscape character of industrial land in disuse cluster corresponds to the scale of individual facilities from the detail to the whole, and the corresponding scale of information collection, protection and reuse design varies according to different elements. As the various elements vary greatly in scale values, from a few centimeters for fine details to thousands of meters for large buildings, this study uses a proportional scale to measure. Among them, the common scale for the design of buildings and structures is 1/20 to 1/300, and the scale for industrial production machinery and equipment is 1/5 to 1/300.

(1) Spatial characteristics of units of industrial land in disuse cluster in Huangshi

The industries in Huangshi are early in process, complete in industrial categories, rich and diverse in types, and have many valuable landscape gene units of industrial land in disuse. A large number of landscape gene unit of industrial lands in disuse have witnessed Huangshi in various historical periods. Landscape gene unit of industrial lands in disuse in Huangshi city is mainly located in the landscape gene piece of the Tonglushan Area, the Daye Iron and the Steel Plant Area, the Huaxin Cement Plant Area, the Tieshan Mining and Metallurgy Area, the Yuancang Coal Mine Area, the Yuanhua Coal Mine Area, the Xialu Iron and Steel Plant Area, the Daye Nonferrous Metal Smelting Area, and the Huangshi Power Plant Area. （Table 4.2）

Table.4.2 Spatial distribution of unit of industrial lands in disuse in Huangshi city

`	**Building structures and facilities**				**activity**		**Workplace environment**	
classification	industry basis	industry auxiliary	Life Supporting facilities	culture content	enterprise activity	culture activity	production place	industry transport
Patina Hill area	Production buildings, structures and facilities, etc	Copperhead Office building and storage facilities	Schools, hospitals, markets	Ancestral temple, earth temple, museum	Festival, group construction	Sacrificial rites, weddings and funerals, legend of characters	Ancient pit, modern pit	Ring road network; Dasha Line railway
Daye Steel Plant area	Han Yeping coal and iron factory site	Watchtower, West Main Gate	Soviet-style buildings, workers' clubs	Landmarks, statues of famous people	History education and cultural publicity	Outdoor movies, ballroom dancing	Production and supporting sites	Han Yeping Railway, Yangtze River waterway wharf
Huaxin Cement Factory area	Calcining kiln, four mouth packing machine	Stone factory, asbestos factory, machine shop	Staff club, staff canteen, bathhouse	Celebrity sculpture, site museum	Enterprise culture exhibition, huaxin spirit universal education	Family dinners, outdoor movies, ballroom dancing	Cement warehouse, rotary kiln, rough grinding workshop	Loading rails, packing platforms, old docks

Tieshan Mining and metallurgy area	Large mining truck, mining equipment	Production workshop of briquettes factory	Soviet-style and Japanese-style buildings	Iron Ore Museum	Selection of advanced figures of The Times	Staff exhibition	A quarry, tailings yard, mine, etc	Ore railroad
Yuanhua coal mine area	Coal mine wellhead, workshop	Japanese office building	Japanese brick and wood structure dormitory building	Celebrity sculpture			A mine or pit	Yangtze River coal terminal
Xialu Iron and Steel Factory area	Crushing workshop, coal blending workshop, desulfurization equipment	Cement factory, lower land railway station, etc	Sino-soviet mixed style buildings	Industrial museum		Industrial system, workshop poetry	Steel-making area, sintering area	Lower land Railway Station
Daye nonferrous metal smelting area	Sulfuric acid workshop, furnace workshop	Design and Research Institute	Soviet-style buildings	Era slogan	The enterprise culture	Mining and metallurgy culture	Mining sites	The railway
Huangshi Power Plant area	Repair shop, thermoelectric chimney, pump room	Unloading machine, derrick	Pitched roof construction	Power plant Club, etc	The enterprise culture	The worker party building		River coal terminal

(2) Temporal characteristics of units of industrial land in disuse cluster in Huangshi

The formation time of units of the industrial lands in disuse cluster in Huangshi can be divided into five historical stages. Buildings are the core components of the units, corresponding to five major period styles respectively: (1) the late Qing Dynasty (1891-1938). The industrial land in disuse present the European non-conformist style dominated by English and German. The shape, volume and decoration of buildings vary according to their functions, displayed in production nestedbuildings, office buildings management staff accommodation and so on, and most of the equipment are produced in Germany,and there are still lots of material remains, distributed along bothsides of the railway; (2) the Turbulent period (1938-1949), modern Japanese style is presented. The Japanese architecture in this period was assimilated by European elements, mainly displayed in dormitory buildings and villas inhabited by high- ranking managers, few of which still exist; (3) the Soviet-aided period (the 1950s and 1960s). The Soviet-style modular architecture is presented, with similar features of the same type of functional buildings in different locations of the city; (4) the middle of the founding of the country (1970s and 1980s). In this stage, industrial construction was still influenced by Soviet styleand gradually “mutated” to form Chinese unitary architecture;
(5) in the period of rapid development (1990s to present), the architectural forms in industrial land in disuse tended to be simplified, with some remaining Soviet-style architectural decorations and localized morphological translations (Figure 4.11). These “testimonies” of historical periods and important events are embedded in the domain and piece, forming the spatial and temporal network of the units of Huangshi industrial land in disuse cluster.

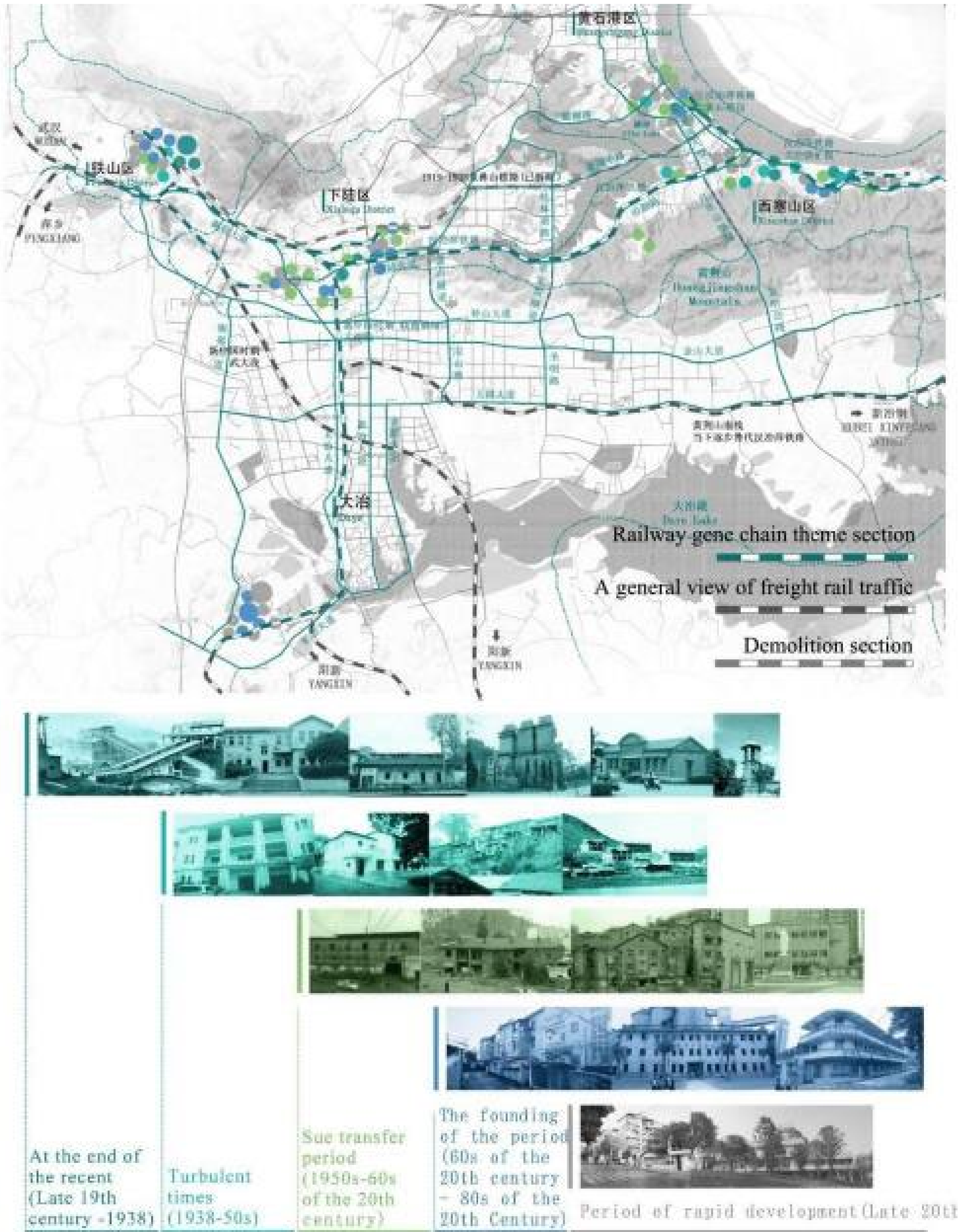

Figure.4.11 Temporal distribution of units in industrial lands in disuse cluster in Huangshi
Image Source: painting by author.

4.2.2 Piece in industrial land in disuse cluster

On the one hand, the piece is a composite group with a certain industry as the main body in urban space, on the other hand, the piece is the result of units connected, nested and compounded under the function of space and time through the landscape character association path and basic organization law, which can be analogized to the character fragment reflected behind certain biological characteristics. According to different types of industries, pieces can be divided into mineral, smelting, derivative ones, etc. And there is not a single industry within each types of pieces.

Piece is composed of individual facilities and site environment. At this level, the single facilities are manifested as the combined form of facility groups which basically constructed the framework. The site environment is composed of natural environment, artificial environment and biological communities in the environment. Among them, the natural environment includes the geology, topography, geomorphology, hydrology, hydrogeology and soil of the area; the artificial environment covers various productive artificial environments, landscape artificial environments and derivative artificial environments formed by industrial production and related activities; the biological community consists of ecological populations.

The overall structure of the piece includes functional zoning structure, spatial structure, transportation structure, landscape structure, etc. The texture of the overall structure can be extracted through the analysis of the piece's structure, which can be used as the basis for the planning and design of the area.

The functional zoning structure is the zoning structure of the industrial production system that reflects the industrial production process and environmental characteristics. The functional zoning with common characteristics in the piece generally includes the main production area, auxiliary production area, storage and warehousing area, power facility area, management and living area, etc. The specific functional content and structure of different industrial types vary greatly due to differences in production processes, equipment, product characteristics and so on.

Spatial structure refers to the spatial distribution and combined morphological structure of the gene piece area, and the orderly spatial environment consists of visually identifiable nodal space, path linear space, regional faceted space, spatial interface and spatial signs and other elements and the correlation between them. The spatial structure of the genetic area internalizes the process flow, functional zoning and transportation structure. The refining of spatial structure elements and the analysis of their combined relationships are important aspects of the structural analysis of gene piece.

The locational characteristics of the piece are derived from the principles of site selection of modern and contemporary industrial enterprises: firstly, the industrial layout should be as close as possible to raw material and fuel producing areas and product consumption areas; secondly, with convenient traffic conditions, the factory should be set up in districts with convenient waterways, railways and highway transportation,and conditions for building port terminals, freight yards and other facilities; thirdly, the factory should meet the requirements of environmental protection. For example, chemical, metallurgical, petroleum, mining and other heavy polluters should be located at the edge of the urban areas; machinery, textile and other polluting enterprises should be located in independent industrial zones or independent sections within urban areas; and handicrafts, sewing factories and other general enterprises should be arranged independent area in the urban living and residential area.

The scale of land use piece spans from small factories covering hundreds of square meters to large integrated enterprises covering dozens or even hundreds of hectares. This study proposes to use the proportional scale from the general design of the piece to the constructive detailed planning to measure the scale characteristics of this level. The corresponding scale of information collection, protection and reuse research and design is 1/500 ~ 1/2000.

(1) Spatial characteristics of pieces of industrial land in disuse cluster in Huangshi

There are 8 major pieces in Huangshi. They are the Tieshan mining and metallurgy piece, the Tonglushan mining and metallurgy piece, the Hanyeping coal and Iron Works piece, the Xialu Steel and Iron Works piece, the Daye nonferrous metal smelting site piece, the Yuanhua coal mine piece, the Huaxin cement plant piece and the Huangshi power plant piece. Except for the Tonglushan ancient copper mine site area, all other areas and blocks are located in the urban area of Huangshi.

According to the spatio-temporal category of the research object, the main pieces are sorted out, classified and deconstructed, with their spatial positions marked (Figure 4.12), and then the classification, domain segment and type are sorted out, coded and then mapped (Table 4.3).

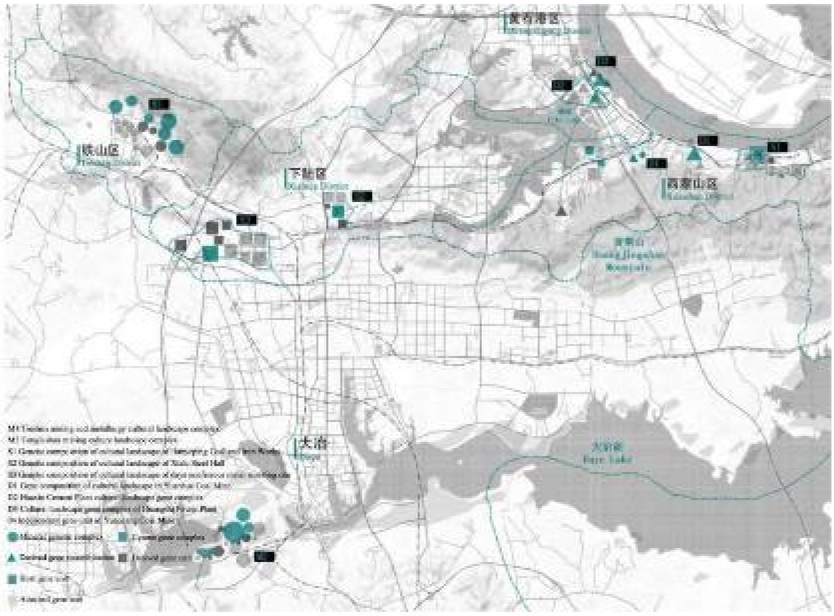

Figure.4.12 The distribution of pieces of industrial land in disuse cluster in Huangshi

Image Source: painting by author.

Table 4.3 pieces of industrial lands in disuse cluster in Huangshi

Pieces	**codin g**	**Types of units**	**Example of units**	**coding**
The Tieshan mining and metallurgy Since 1890	M01	Host unit （C）	East open-pit mine of the Daye Iron Mine	M01cO 1
			The Daye iron mine tailings yard	M01cO 2
			Gene units from Shizishan Mine of the Daye Iron Mine	M01cO 3
			......	M01c...
		Derived unit （D）	The Daye Iron Concentrator	M01d0 1
			The Daye iron ore pellets	M01d0 2
			The Daye Iron Ore Museum	M01a01

		Attached unit（A）	The Jiulongyuan Community	M01a02
			The Kuangshan Road Community	M01a03
			The Shengli Road Community	M01a04
			......	M01a...
The Tonglushan Mine Since 1971	M02	Host unit（C）	Ancient pit group in the north of Tonglushan mountain	M02c01
			Modern open pit in Tonglushan	M02c02
			The Tonglushan Tailing Plant	M02c03
			The Daye colored stope	M02c04
			......	M02c...
		Derived unit（D）	The Daye Non-ferrous Metal Powder Factory	M02c02
			The Tonglushan Ore Processing plant	M02c03
			......	M02c...
		Attached unit（A）	The Patina Hill Community	M02a01
			The Prospecting community	M02a02
			......	M02a...
The Hanyeping Coal and Iron Works Since 1916	S01	Host unit（C）	The Hanyeping coal and iron Plant site	S01c01
			The Daye Iron Works (Xinye Steel)	S01c02
		Attached unit（A）	Living area (culture Street) of the Hanyeping Coal and Iron Works	S01a01
			Soviet style building complex of the Daye Iron Works	S01a02
			Living area of the Daye Iron Works	S01a03
			......	S01a...
	S02	Host unit（C）	The Xialu Iron and Steel Plant	S02c01

The Xialu Steel and Iron Works Since 1958		Derived unit（D）	The China 15th Metallurgical Metal Structure Factory	S02d01
			......	S02d...
		Attached unit（A）	The Xialu Steel Iron Mine	S02a01
			Living area of the China 15th Metallurgical Plant	S02a02
			......	S02a...
The Daye nonferrous metal smelting site Since 1953	S03	Host unit（C）	Daye nonferrous metal smelting and production area	S03c01
		Derived unit（D）	The Daye Non-ferrous Chemical Plant	S03d01
			Daye nonferrous mining area	S03d02
			......	S03d...
		Attached unit（A）	Wanjianao in Daye Colored Living area	S03a01
			......	S03a...
The Yuanhua Coal mine Since 1935	D01	Host unit（C）	Production office area of the Yuanhua Coal Mine	D01c01
		Attached unit（A）	Living area of workers in the Yuanhua Coal Mine	D01a01
The Huaxin Cement Plant Since 1907	D02	Host unit（C）	Production area of the Huaxin Cement Factory	D02c01
		Derived unit（D）	Lime kiln limestone mining area	D02d01
			The Huaxin Cement Factory old wharf	D02d02
			The Huaji Cement Factory site	D02d03
		Attached unit（A）	Huaxin Village (Hongqiqiao Community)	D02a01
			Huaxin Er Village (Nanyuewan Community)	D02a02
			Huaxin Sancun	D02a03
			......	D02a...

The Huangshi Power Plant Since 1945	D03	Host unit（C）	The Huangshi Power Plant produces generating region	D03c01
		Derived unit（D）	Old coal terminal of the Huangshi Power Plant	D03d01
			Storage yard of the Huangshi Power Plant	D03d02
		Attached unit（A）	The second dormitory of employees of the Huangshi Power Plant	DO3a0 1

(2) Structural characteristics of landscape gene piece

Piece is composed of multiple units, which can be divided into host units, derived units and attached units. The relationship between units is usually determined by productive relations and social relations. Units are linked by chain. The chain between the host units and the derived units is mainly manifested as the transfer of production relations and production materials, and there is continuity between the upper and lower parts of the industry. However, the chain among the host units, the derived units and the attached units are more manifested in the social relationship.

The spatial characteristics of Huangshi industrial land in disuse cluster have the following features: the main units as the core form three kinds of combination patterns—banded ones, polymeric ones and dotted ones. There are also three combination patterns of host units, derived units and attached units—annular ones, lamellar ones and multinucleate ones (Figure 4.13).

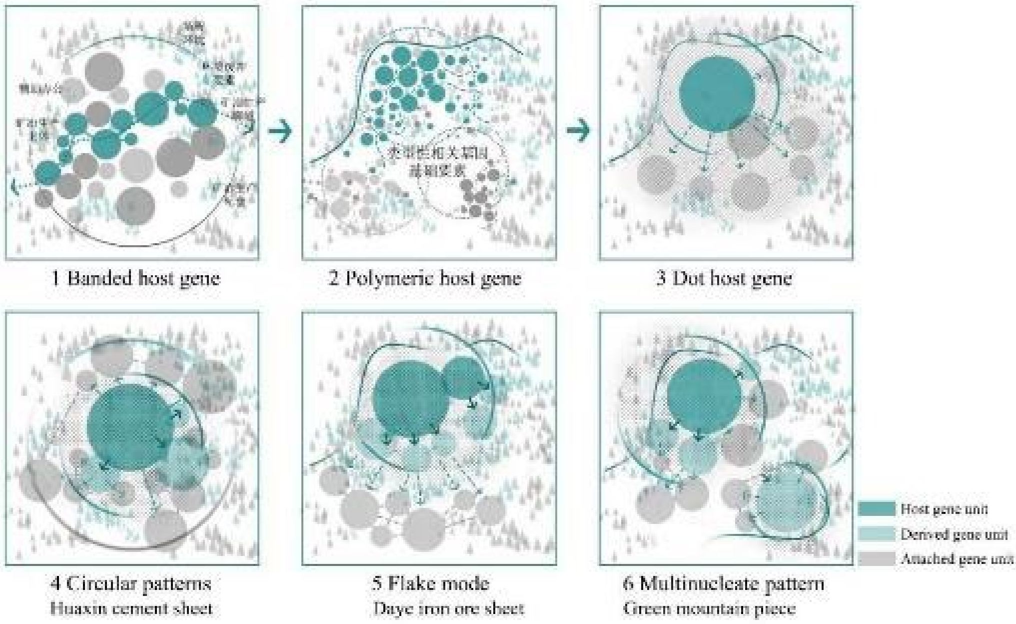

Figure.4.13 Structural characteristics of pieces of industrial lands in disuse in Huangshi

Image Source: painting by author.

4.2.3 Chains in industrial land in disuse cluster

"Chain" means a kind of association mechanism and clue. In the industrial lands in disuse cluster, the chain source can be either the combination of material elements such as units or the non-material links such as industrial narration. Chain plays an important role in the integrity and systematicness of piece and domain. At the level of piece, it links the units to combine into the pieces. At the level of domain, it links the pieces to form the domain. The multi-level organization of chains should be used to cope with the hierarchical and relational changes of space, and the chains should be expanded into tangible and intangible links to strengthen the continuity and systematicness and realize the diversity and characteristics of domain.

The material form of the chain of industrial land in disuse cluster is mainly transportation lines, such as road, railway, canal and so on. Transportation lines link the flow of material, energy and people. Material flow mainly includes the traffic flow in the industrial production process. Energy flow refers to the transmission lines of electric energy, water energy and steam energy needed for industrial production. Stream of people is to point to personnel inside each functional area or the traffic streamline between different functional areas.

The immaterial form of the chain of the industrial land in disuse cluster is dominated by the industrial narrative. The industrial narrative theme is extracted from the transmission process of technology transplantation, adaptation and exportation, and reflects the characteristics of industrial development. Industrial narratives integrate industrial land in disuse from an immaterial perspective and are an important clue to a comprehensive understanding of industrial land in disuse. UNESCO requires a series of industrial cluster bids to integrate industrial resources around unique narrative themes. For example, the mining basin of Calais in northern France was selected for 109 components around the quest to create model cities of labor in European industrial cities from the mid-1800s to the 1860s; the heritage of the Meiji Industrial Revolution in Japan was based on 'the first example of successful introduction of industrialization in a non-Western country' from the industrial resources of three industries across Japan: steel, shipbuilding and coal mining. The heritage of Japan's Meiji Industrial Revolution is based on 'examples of the first successful introduction of industrialization in a non-Western country', with 23 components selected from industrial resources in three industries: steel, shipbuilding and coal mining across Japan. The World Heritage experience shows that unique industrial narrative themes guide the integration of resources, and that the key to integration is the value that each component contributes to the series, which requires a comparative selection of resources around narrative themes.

Chains of industrial land in disuse cluster can be divided into chains in domain and pieces according to different levels, and the chains in domain and the pieces in chain will be partially overlapped. As intradomain chain layer in piece has been discussed in the part of piece, this section mainly focuses on the study of the intradomain chain layer in domain. Combined with the actual situation of the industrial lands in disuse in Huangshi, this research discusses the chains of the industrial lands in disuse in Huangshi from the two aspects of tangible expression and hidden invisible content.

(1) Tangible manifestations of the chains in Huangshi

Tangible chain is the material representation that can be truly felt, which is constructed by the combination of units. The Huangshi tangible chain is mainly manifested as the coupling of land and water transportation, that is, the combined transportation of the "railway-Yangtze River-road network".

1) Railway and its branch transportation

Railway was an important mode of transportation in modern industrial transportation in China. The main body of railway lines in the region is composed of the Han Yeping railway. The railway line includes the Dasha section leading from Xialu to Daye and Yangxin, and Huangjing Mountain southern line leading from the southern foot of Huangjing Mountain to the Xinye Steel (Figure 4.9). Constructed in 1890, the Hanyeping Railway is the earliest surviving urban railway of the modern period in China, with the longest operating period and outstanding representation. At the beginning of its construction, the Hanye Ping Railway and the Xiangbingshan Railway of the same period transported the ore raw materials from the Daye Iron Mine to the Daye Iron Works and the Yangtze River Channel respectively. Huangshi's railway genetic chain has always existed as an industrial mining transport and general production line for the region. In addition to its industrial function, it also has social life attributes (Table 4.4).

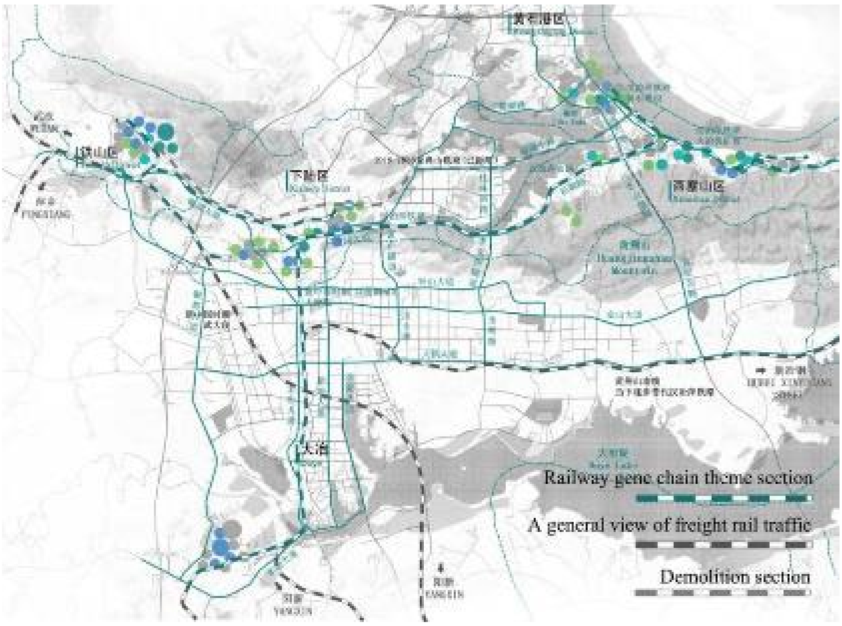

Figure. 4.14 Schematic diagram of railway and its branches

Image Source: painting by author.

Table 4.4 Characteristics of the Huangshi Railway chain in different periods

Name	Construction time	Initial function	Current situation of buildings and structures
The Tieshan railway station	1894	A two-story "cross" shaped building	The main body is changed to railway office, and a flat building is built in the East, which is now abandoned;
The Xialu railway station	1892	The main body of the building is the waiting hall, which is equipped with weighing objects;	Existing buildings, station signs, railways, etc., have been protected and renovated into the ping coal and iron factory and mine site;
The Xialu railway station New waiting hall	1958	The main part of the building was originally a waiting space, with two wings for ticket sales and office.	The main body and the west wing are now rebuilt outsourcing Internet cafes, east wing side office;
The Xiangyang Bridge	1940s	Lime kiln branch bridge to the Huangshi Port and Xisai Mountain direction;	Now the road is built on its side, and the railway on the bridge is abandoned for residents to pass;

2) The Yangtze River Channel

Influenced by resource-based cities, the transportation of production materials and industrial products along the River has always been a major feature of the industrial industry in Huangshi, which was initially constructed at the same time as the Hanyeping railway. The Han Mine wharf, the Ri Mine wharf and the Xinhan Mine wharf were successively built in the Limestone kiln area, and the Huaxin wharf, power plant wharf and Coal enterprise wharf in the Xisaishan District were built in Shenjiaying with the development of industry (Figure 4.15). A large river transport system of wharves, shipping and port services formed gradually and became the end of Huangshi's industrial system and transport. While the Yangtze waterway connects the industrial landscape along the river vertically from Shenjiaying at the Huangshi Port to Xisaishan, the landscape genes attached to it have become an important part of the industrial landscape of Huangshi.

Figure 4.15 Landscape of the Yangtze River Waterway

Up: Landscape of Huangshi section of the Yangtze River in 1930s

Down: Landscape status of Huangshi section of the Yangtze River

Image Source: Huangshi Industrial Heritage Protection Center.

3) The main urban road network

Early in the Anti-Japanese War, the Elephant Trunk Railway was dismantled and a road was set up along it, which was later the main part of the Magnetic Lake Road. After the founding of the People’s Republic of China, Huangshi's urban development and early planning saw the construction of an urban road network dominated by production transport. Influenced by the resource-based city, the longitudinal Huangshi Avenue along the riverside section of Hanyeping was built earlier to link the Huangshi Port, Lime Kiln and Xisai Mountain. Based on this, the Magnetic Lake Road was improved, and the east-west "Tonggu Avenue-Xialu Avenue-Yanhu Road" was built along the main Hanyeping railway line, linking Tieshan, Xialu and Lime Kiln. To strengthen the spatial connection between Huangshi's central city and Daye city, several major roads were extended horizontally and vertically, and tunnels were dug to solve the problem of Huangjing Mountain obstruction and severance (Figure 4.16).

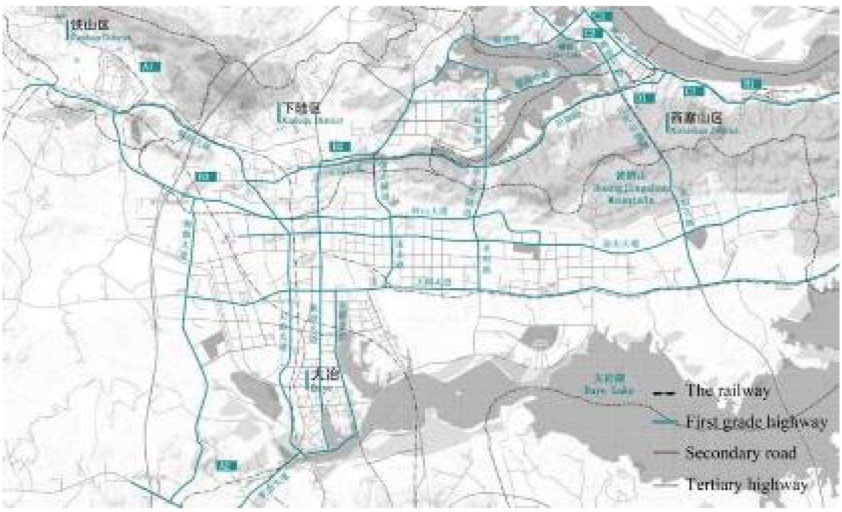

Figure 4.16 Huangshi main urban road network,

Image Source: painting by author.

(2) Intangible association of the chains in Huangshi

Behind the representations there is often a need to uncover deeper derivations and metaphors. The linking of chains also provides a narrative relationship between pieces. The “railway-Yangtze River-road network” chain is therefore not only a spatial and formal landscape corridor, but also defines the main framework of the spatial layout of the leading industries and the spatial form of the city.

1) Composition of industrial chain system

From a chain system perspective, the role of the chain is no longer simply the transport of materials, but also the link between industries. For example, the mining, smelting and transport industry chain and the mining, derivative and transport industry chain. The industrial links between the pieces are particularly well represented. For example, the Daye iron ore mine and the Hanyeping coal and iron plant, the Yuanhua coal mine and the Huangshi power plant. The railway and road networks are the main parts of the chain of production lines and relationships between mining, smelting and derivation within the region; the Yangtze River waterway, as the end of the overall regional industry chain, assumes the role of a resource and production export port (Figure 4.17).

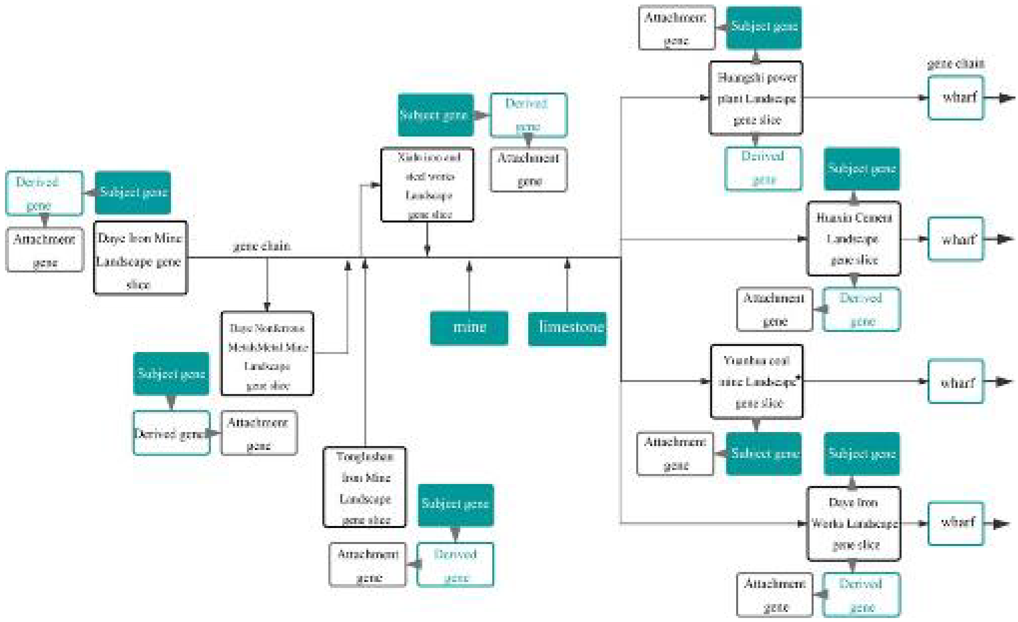

Figure 4.17 Composition of the whole industrial chain system of Huangshi mining and metallurgy

Image Source: painting by author.

2) The relationship between chains and urban pattern evolution

Huangshi's modern urban spatial development shows a top-down pattern, that is, railway transport established the foundation of Huangshi's urban skeleton, and the construction of industrial and mining enterprises contributed to the formation of the urban pattern (Table 4.5). In terms of urban spatial evolution, the railway as the core of the landscape gene chain has played an important role in the development of Huangshi towns at different times and stages since modern times. The subsequent urban transport network was also woven within a framework of rail and the Yangtze multi-modal transport (Figure 4.18).

From the perspective of industrial industries, Huangshi's leading industries are resource extraction, smelting and processing. The railway and the Yangtze River multi-modal transport has been part of the industrial chain, and has become the driving force behind the construction and development of new and old industrial enterprises, influencing the choice of regions for various types of enterprises and the supporting radiation of regional functions, eventually forming a railway urban spatial belt and a riverside urban spatial belt interlaced from the inland to the Yangtze River, from resource development to processing and output. The three cores of the city are the T-pattern. Overall, the initial framework of the Huangshi's modern urban space was formed by the railway.

Table 4.5 historical evolution of the modern Huangshi urban pattern

Period	Pattern	Characteristic
1891-1938	Multi-point layout guided by industrial and transportation stations	Han Yeping, Elephant Trunk Mountain railway as the axis; Tieshan and Xialu stations are the core industrial concentrated areas; Liyao, Huangshi Port station as the core of the riverside business district; Supporting living space in railway station area.
1938-1949	Industrial plunder leads to "bipolar" development	Han Yeping railway as the link; Restore and rebuild iron Mountain and iron works, expand the scale of the region, and improve the supporting facilities, such as houses and schools; Lime-kiln, iron hill, iron factory supporting commercial, entertainment and medical space.
1950s and 1960s	Industrial resources guide spatial layout and expansion	The Yangtze River railway combined transport as the condition; Build Huangshi Port light industry zone, Tieshan, Xialu, lime-kiln, iron works and other heavy industrial areas; Large industrial enterprises supporting living, commercial, social service space.
1970s and 1980s	Industrial association leads to belt extension	The Hanyeping Railway and the Yangtze River combined transport is the framework of urban transportation system; Industrial enterprises radiate expansion, horizontal connection to form urban space.
Since 1990s	T-shaped urban pattern	The Hanyeping Railway and the Yangtze River combined transport oriented; Huangshi Port and Liyao old city as the main city, large scale, diverse functions; Xialu district and Tieshan District are two auxiliary cities, small in scale and single in function.

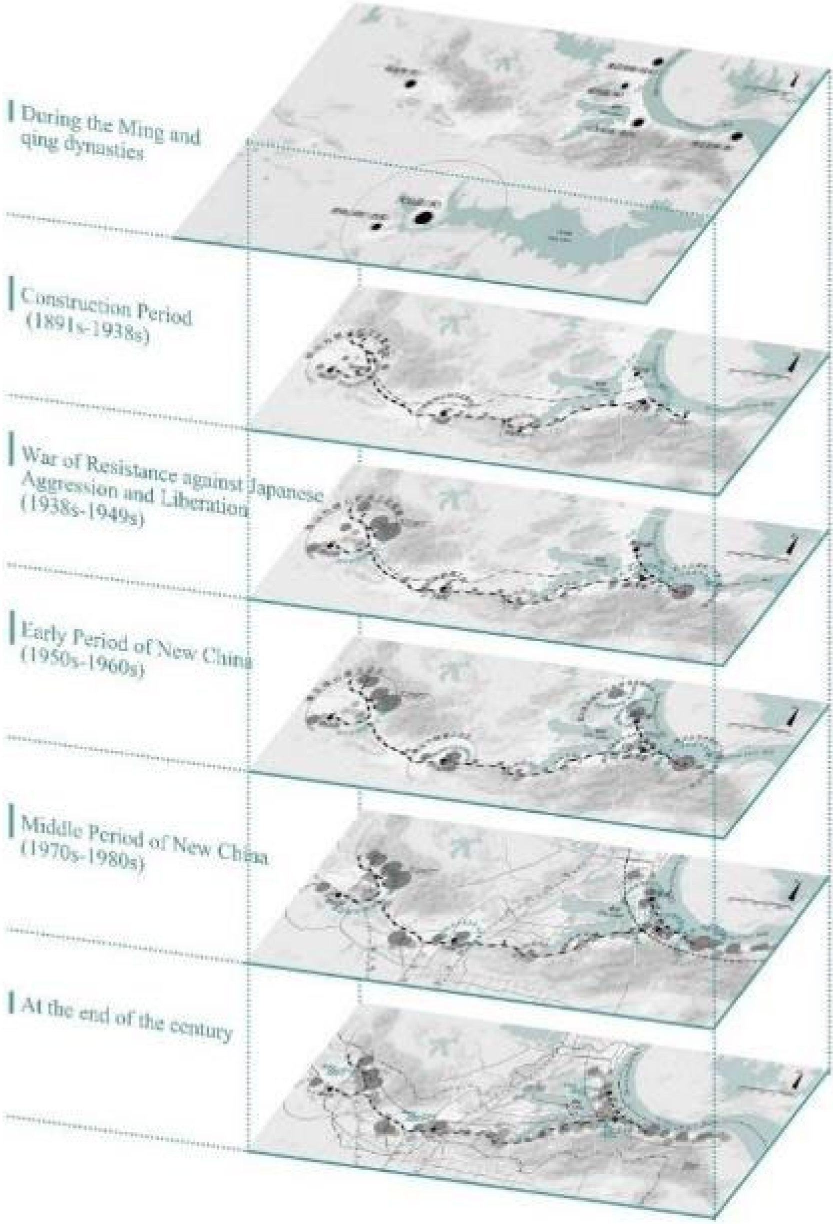

Figure 4.18 relationship between chain and urban pattern evolution of Huangshi Image Source: painting by author.

（4） Domain of industrial land in disuse

Domain can be considered as a substrate. The domain of industrial land in disuse is usually based on an industrial town or even a larger industrial zone, and consists of a number of industrial lands in disuse clusters and surrounding environment. The industrial towns are affected by the discontinuous and uneven distribution of mineral resources, and the spatial layout is scattered; each part of the town is built independently around the scattered mining areas, which are spaced far apart, forming enclaves. The design scale of industrial land in disuse domain covers from a few hectares to a few dozen square kilometers, with a scale of 1/1000 to 1/25000, and if the industrial zone is expanded to cover an area of 100,000 square kilometers or more, the scale for planning and design is 1/10000 to 1/500000.

From units, pieces to a domain, as the scale increases, the degree of association of the constituent elements within the hierarchical system shows a decreasing trend from large to small, that is, the larger the scale of the system, the looser the relationship between its constituent elements. In this study, the smallest level includes buildings, structures and equipment, which are closely related to each other; the genetic elements in the domain hierarchy are closely related to each other in terms of production processes or direct support, and the landscape has a certain degree of integrity and continuity; the relationship between the constituent elements in the landscape genetic domain hierarchy decreases, and the visual tension of the landscape is weakened. The landscape genetic domain expresses a certain integrity and continuity in landscape form.

Domain is the definition of the spatial and temporal scope of the object of study and the integration of the landscape pattern with the urban environment. A large number of industrial-related material and immaterial remains in recent times have created the uniqueness of Huangshi's industrial land in disuse landscape. A T-shaped structure has been formed with the Hanyeping railway as the axis of the horizontal space, the vertical space of the main city of Huangshi along the Yangtze River and the vertical space of the transport corridor from Xiaolu to Tonglv Mountain. The spatial structure of Huangshi city is defined by the flow of industrial production and the excellent landscape environment. Thus, a domain with a close integration of industry and nature is formed (Figure 4.19).

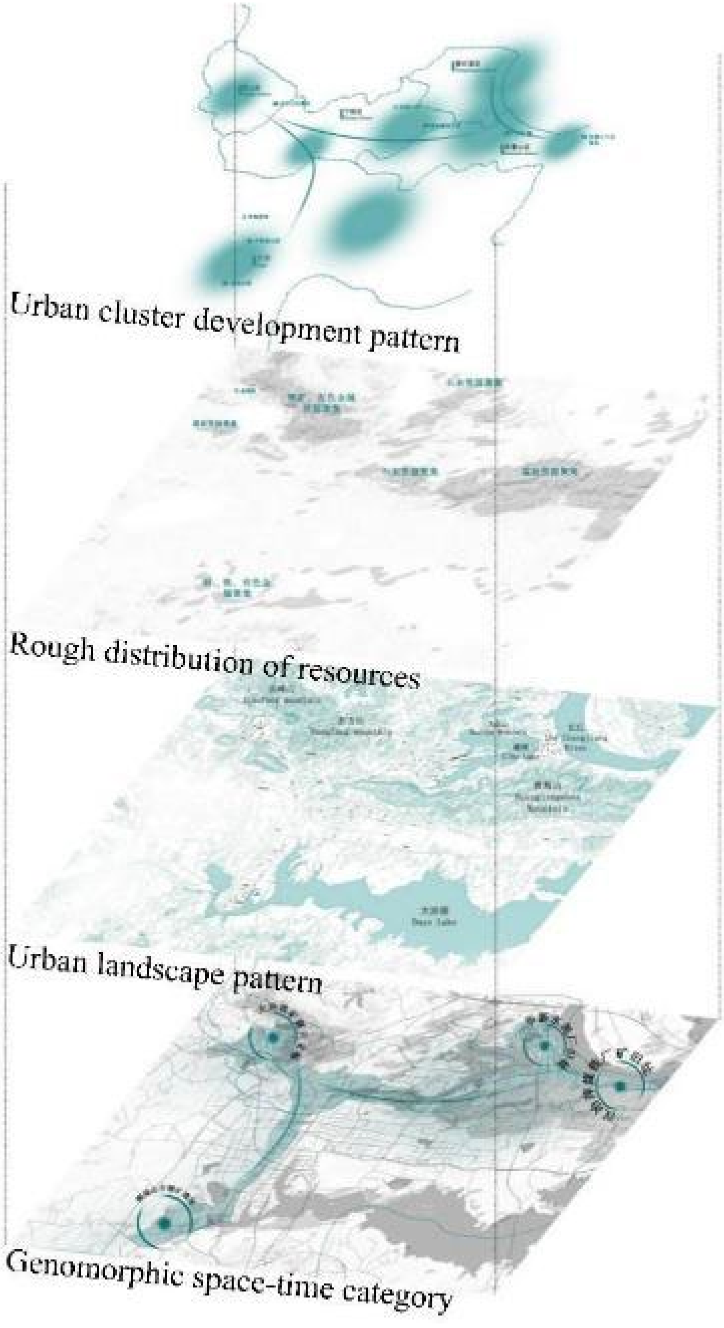

Figure 4.19 relationship between chain and urban pattern evolution of Huangshi
Image Source: painting by author.

4.3 Coupling analysis of "city—industrial land in disuse cluster—green space"

For mining-based cities, urban areas, industrial lands in disuse and green spaces are taking the non-stop transformation. In the pre-industrial period, green space in the broad sense gradually differentiate into settlements and narrowly defined green spaces. In the early process of industrialization, settlements gradually expand into urban form and industrial production begins, with excavation in some mineral-rich areas. In the middle process of industrialization, cities expand further, industry and extractive industries develop, and green space is progressively fragmented. In the post-industrialization period, parts of the industrial and mining sectors were shut down, a large number of industrial lands in disuse emerged, and cities emerged stagnation or contraction. The question of which industrial lands in disuse should continue to host urban production and living activities and which should be returned to nature is an important issue to be discussed in the construction of ecological civilization.

In urban transformation and development, mining cities should give priority to ecological strategies to cope with environmental pollution and ecosystem degradation, and the transformation of industrial lands in disuse into urban green spaces is one of the important ways to provide new ideas and methods for the construction of urban and rural landscapes and sustainable urban development. In the context of ecological civilization, particular attention should be paid to industrial lands in disuse that threaten the integrity of important ecological patches and the connectivity of green spaces, and their integration into the green space system will facilitate the construction and optimization of urban green space networks. The following is still an example of the relationship between cities, industrial lands in disuse and green spaces in Huangshi, China.

4.3.1 City-industrial land in disuse cluster

An analysis of the landscape character structure of the Huangshi industrial lands in disuse reveals that there are a large number of industrial lands in disuse in Huangshi, which vary in size and are basically distributed along the mountains, the Yangtze River, railways and roads in a “one horizontal and four verticals” pattern (Figure 4.20).

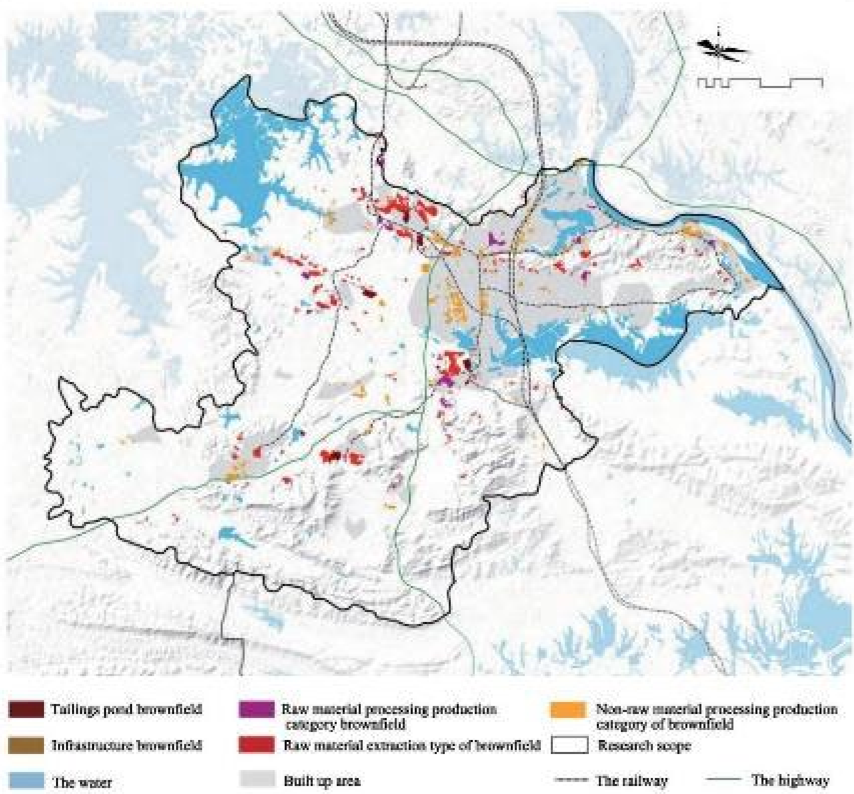

Figure 4.20 distribution map of Huangshi industrial lands in disuse
Image Source: painting by author.

All in all, the distribution of industrial lands in disuse is closely related to the elements of the natural and built environment of the city, showing a coupled character. As mineral resources are mostly distributed in mountainous areas, while the Yangtze River as the important channel for industrial transportation, the distribution of industrial lands in disuse in Huangshi is significantly related to the landscape pattern in terms of natural environment. Due to the high dependence of raw material extraction industrial lands in disuse on mineral resources, these industrial lands in disuse are relatively concentrated in the larger mining areas of the city, such as Tieshan, Tonglushan, Jinjinshan and Lingshan, while raw material processing and manufacturing industrial lands in disuse are mostly adjacent to rivers and raw material extraction industrial lands in disuse. In terms of the built environment, the distribution of each type of industrial landin disuse is most closely related to the transportation element. Some of the large raw material extraction sites have separate railway stations directly connected to the freight railway, such as the Tieshan station in the Daye iron ore mine and the Jinshandian station in the Jinshandian iron ore mine. The industrial lands in disuse of raw material processing and manufacturing are mostly located near the railway lines; the industrial lands in disuse of non-raw material processing and manufacturing are more influenced by the policy elements and distributed along the road rules, such as the Lingcheng Industrial Park and the Huigui Industrial Park. The development process of Huangshi city is a typical urbanization process driven by industrialization, and its spatial pattern of coupled "urban-industrial land in disuse clusters" is formed during the four stages of urban and industrial development (Figure 4.21).

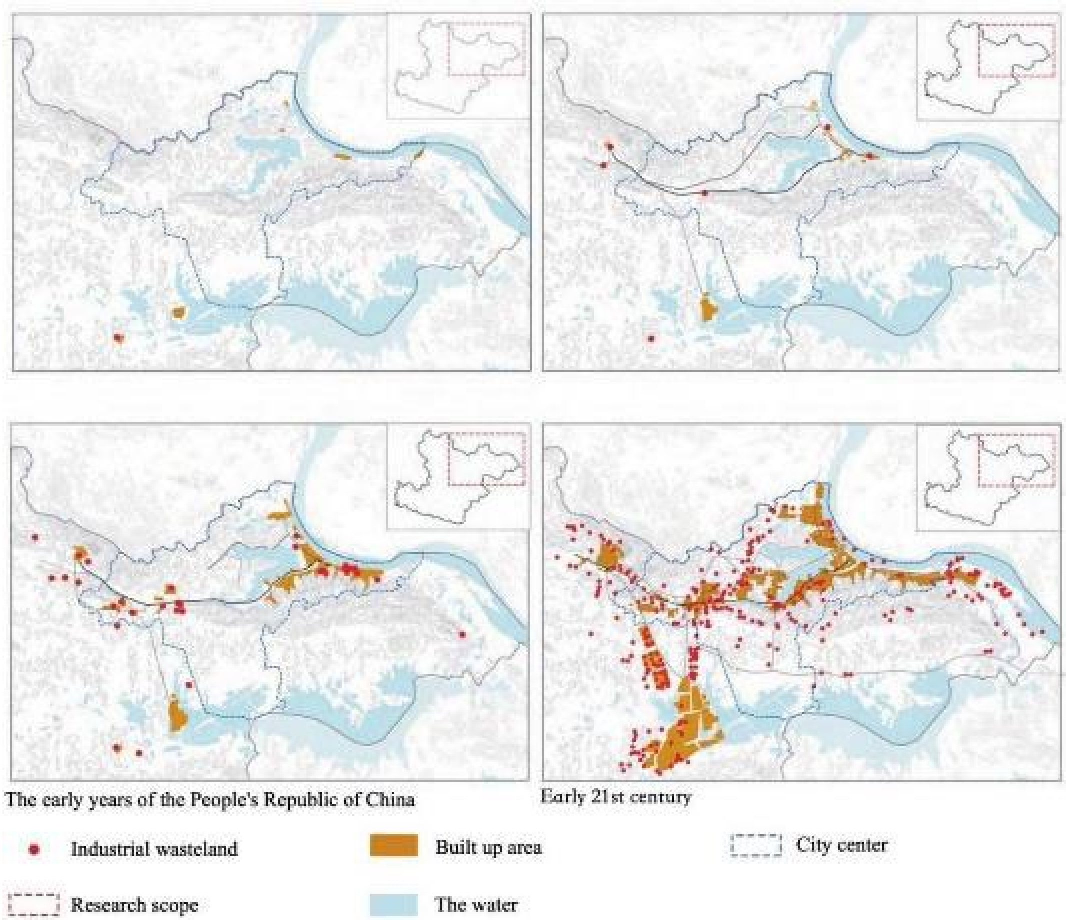

Figure4.21 The relationship between Huangshi's industrial lands in disuse and urban development
Image Source: painting by author.

(1) Copper mining or smelting began as early as the late Western Zhou Dynasty in the Tonglushan Mine. During the Spring and Autumn period, the mining and smelting center of ore and the distribution center of processed products and the economic life of the ancient inhabitants was formed at the ruins of the ancient city of Wulijie and the city of Caowangzui (Zhu &Li, 2005). After the Song Dynasty, the city of Daye was gradually built up,

with the main built-up area now located to the north of this area. The Daoshifu town in the Eastern Han Dynasty, the town of Lime Kiln in the late Yuan Dynasty and the town of Huangshi Port in the Ming Dynasty all relied on the Yangtze River to facilitate water transportation and became a gathering and distribution point for materials from the north and south of the river, and also initially built the foundation for the development of Huangshi along the river.

(2) At the end of the Qing Dynasty, the development of the foreign affairs movement kicked off the modern industrialization process in Huangshi. With the completion and opening of the Daye Iron Mine Railway in 1892, the western part of Huangshi was connected to the eastern part of the city by railway, and a skeleton of the city was initially built. Driven by a series of large heavy industrial enterprises such as the Daye Iron Works, the Fuhua and Yuanhua Coal Factory, the Huangshi Power Plant and the Huaxin Cement Plant, residential areas, schools, railway roads and other service-oriented supporting facilities were built around large-scale industrial and mining enterprises. The urban space was mainly developed around the large industrial and mining enterprises in a dotted pattern.

(3) From 1949 to 1989, Huangshi City was clearly positioned as a “heavy industrial city with mining, smelting and construction materials as the mainstay”, and with the gradual expansion of the typical industrial clusters in the Gongjiaxiang Metallurgical Machinery Industrial Zone and the Xiaolu Industrial Zone, the major factories and mines became one, and the city expanded rapidly along the Yangtze River and the railway. The T-shaped urban structure of Huangshi was basically established.

(4) At the beginning of the 21st century, the city crossed the Huangjing Mountains and shifted to develop along the Daye Lake, with the Wujiu Line, the National Highway 106 and four

tunnels allowing the city to break through the constraints of Huangjing Mountains and removing industrial and mining lands rom the key development areas of the city.

4.3.2 Industrial land in disuse custer-Green Space

An analysis of the relationship between the distribution of industrial lands in disuse and the current green space in Huangshi reveals that industrial lands in disuse threaten the integrity of important ecological patches and the connectivity of green space to a certain extent (Figure 4.22). On the one hand, there are 129 industrial lands in disuse intersecting with important ecological patches, accounting for 22.91% of the current number of industrial lands in disuse and an area of 18.75 square kilometers, or 34.53% of the current industrial lands in disuse area. Among them, extractive industrial lands in disuse are the most numerous and the largest in area, which is inextricably linked to the dependence of extractive industrial lands in disuse on mineral resources and the spatial distribution of mineral resources. It can be seen that there are overlapping areas between some industrial lands in disuse and important ecological patches, threatening the integrity of important ecological patches.

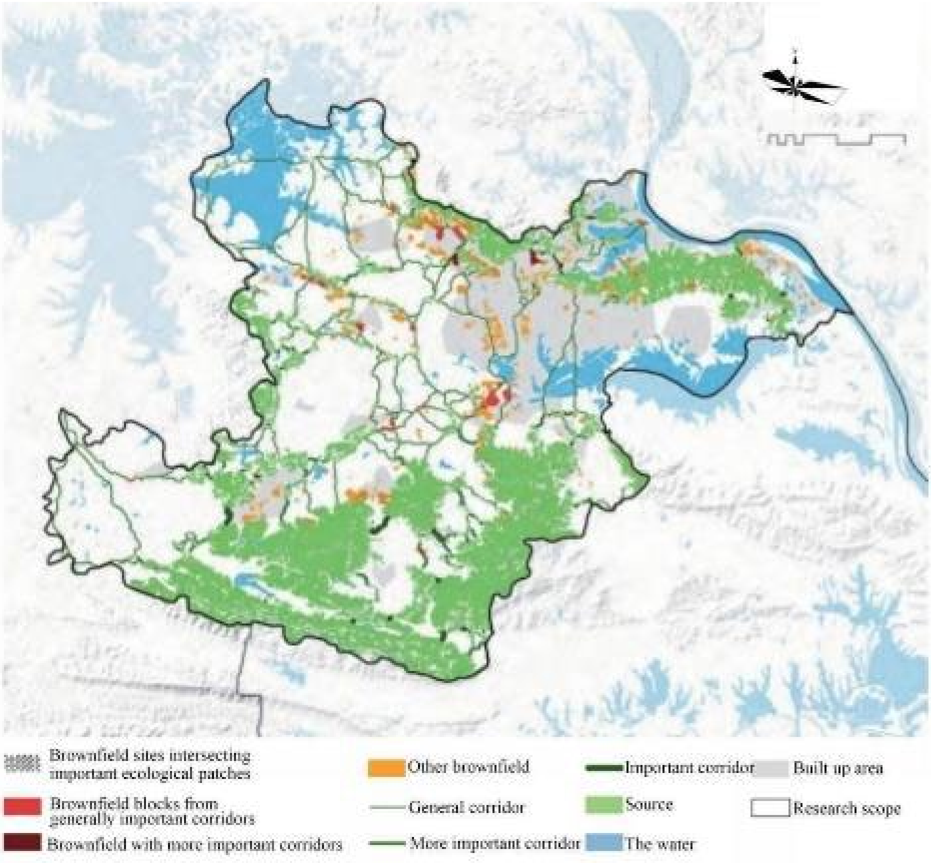

Figure 4.22 Relationship between the Huangshi industrial land in disuse group and green space

Image Source: painting by author.

On the other hand, no industrial lands in disuse blocked important potential ecological corridors, but there are still 15 industrial lands in disuse blocking important potential ecological corridors and 45 industrial lands in disuse blocking general potential ecological corridors. Among the industrial lands in disuse blocking potential ecological corridors, the largest number of sites were in the non-material processing and manufacturing category, while the area of industrial lands in disuse in the material extraction and tailing storage was larger. The spatial conflicts between industrial lands in disuse and potential ecological corridors are mainly concentrated in the Xialu Area, the Jianlinshan Area, the Longjiao Mountain Area and the Penjia Mountain Area. Among them, the Xiaolu Area, which is dominated by Donggang Iron and Steel Works, is a typical urban raw material processing and manufacturing industrial land in disuse, blocking the potential ecological corridor through Huangjing Mountain, Lion Mountain and Dongfang Mountain; the Jianlinshan Area, Longjiaoshan Area and Penjia Mountain Area are the raw material extraction bases of Daye Iron Mine, Tonglushan Mountain Copper and Iron Mine and Limestone Mine respectively, blocking the potential ecological corridor between the main body of Jianlinshan, Longjiaoshan and Penjia Mountain and the surrounding areas respectively. It can be seen that some of industrial lands in disuse are blocking potential ecological corridors and threatening the connectivity of green space. From a regional perspective, these industrial lands in disuse occupy key ecological nodes in Huangshi, especially the 12 industrial lands in that threaten both integrity and connectivity, and have important ecological potential, which should be considered for inclusion in the urban green space system in order to optimize the green space system of Huangshi.

An analysis of the relationship between the distribution of industrial lands in disuse and the green space system planning in Huangshi shows that some industrial lands in disuse have been included in the scope of the planned green space, but there are still some industrial lands in disuse with important ecological potential that are not included in its scope and there is room for further optimization in the future. On the one hand, the central urban area of Huangshi covers 94.70 square kilometers of built-up land, of which area is 25.40 square kilometers and theplanned green space area is 81.60 square kilometers. The 157 industrial lands in disuse located in the central urban area have a total area of 9.82 square kilometers, of which 104 industrial lands in disuse intersect with the planned green areas, with an overlapping area of 4.33 square kilometers, accounting for 44.10% of the total area of the current industrial lands in disuse and 5.31% of the planned green areas. The industrial lands in disuse intersecting the planned green areas are mainly raw material extraction industrial lands in disuse, including a series of mine pits of a certain scale and important historical industrial and mining sites such as the Donggang Steel Plant, the Huaxin Cement Plant and the Huangshi Port Authority Group Wharf. These sites are generally located along Dongfang Mountain, Huangjing Mountain and the railway line, within the boundaries of other green spaces and parkland in the plan. It is evident that green spaces have become an important means of reusing industrial lands in disuse. However, according to the field investigation, the series of mining pits at the southern foot of Huangjing Mountain are still bare land in disuse and need further restoration work. On the other hand, within the central urban area, there are 55 industrial lands in disuse with significant ecological potential, covering an area of up to 5.81 square kilometers, of which about 2.67 square kilometers have been planned as green space, leaving more than half of the area disintegrated into the urban green space system. Although there are 42 abandoned industrial lands in disuse that have been incorporated into the planned green space, some of the industrial lands in disuse have been transformed into part of the urban green space system with only a small amount of space within the site, leaving room for further optimization in terms of the integrity and connectivity of the urban green space. From a regional perspective, industrial lands in disuse are potential spaces for green space, and integrated reuse of industrial lands in disuse and urban green space system planning will facilitate the rationalization and development of urban space under the pressure of land scarcity and industrial lands in disuse rehabilitation.

4.3.3 spatial pattern of "city-industrial land in disuse cluster-green space"

This study analyses the landscape genetic structure system of the industrial land in disuse cluster in Huangshi, and finds that different types of industrial lands in disuse show significant differences in spatial morphology and spatial location. The spatial characteristics of industrial lands in disuse affect the choice of regeneration pathways and the determination of regeneration timings. If the spatial characteristics of industrial lands in disuse can be taken into account in the construction of urban green space systems, it will be beneficial to the practical maneuverability of green space system construction in the future.

At the overall cognitive level, the industrial lands in disuse in Huangshi are basically distributed along the mountains, the Yangtze River, the railway and the highway in a "one horizontal and four vertical" pattern, and are highly coupled with urban spatial elements, showing a coupled "urban-industrial lands in disuse cluster" spatial pattern. The analysis of the "industrial land in disuse cluster-green space" pattern shows that a significant proportion of industrial land in disuse occupies key ecological nodes in Huangshi, especially raw material extraction industrial lands in disuse, with more than 1/2 of the land threatening the integrity and connectivity of green space, which is an important potential space for green space construction and optimization. This is an important potential space for green space construction and optimization. The ecological value that industrial lands in disuse can provide to the city should be taken into account when making decisions about their regeneration, which will facilitate the overall construction of urban green space.

Chapter 5

Landscape Character Atlas
Mapping of Industrial land in disuse

Chapter 5 Landscape Character Atlas Mapping of Industrial land in disuse

5.1 landscape character extraction and atlas mapping of industrial land in disuse

5.1.1 Types of landscape characters in industrial land in disuse and their identification

A deeper understanding of the original logic and history of industrial land in disuse can help improve the accuracy of landscape character prediction. Different predicting dimensions lead to different landscape character classifications, thus resulting in distinguished cognitive systems on landscape characters. There are two main types of prediction systems that have been studied. The first prediction system based on objective static features such as expression patterns, presence patterns, and vectors of landscape characters. It can be divided into different types such as explicit and implicit, material and immaterial, group and independent. The other takes the dynamic behavior in landscape character expression and its importance as a clue, such as tetrad theory, which favors complex landscape character prediction with multi-type interweaving.

There are many similarities between the characters exhibited by the industrial land in disuse and features of the object-oriented analysis approach. Based on the logical classification of landscape characters, this research establishes an object-oriented classification pattern for landscape characters (OOCPLC)(Figure 5.1). Taking industrial land in disuse as an object, OOCPLC firstly analyzes the attributes of industrial land in disuse such as environmental characters, layout characters, building and structure characters, cultural characters, etc., then establishes category criteria according to the differences between each attribute, and on this basis refines them into a specific index system. Environmental characters include pattern, topography, geomorphology, vegetation, climate, and hydrology; layout characters include form, structure, texture, skyline, traffic, and view corridor; architectural characters include structure, form, material, color, and decoration, style; cultural characters include technical system, institutional culture, social structure, and representative figures. OOCPLC has the characters of operability and clear thinking, and it is easy to combine with GIS to realize process identification.

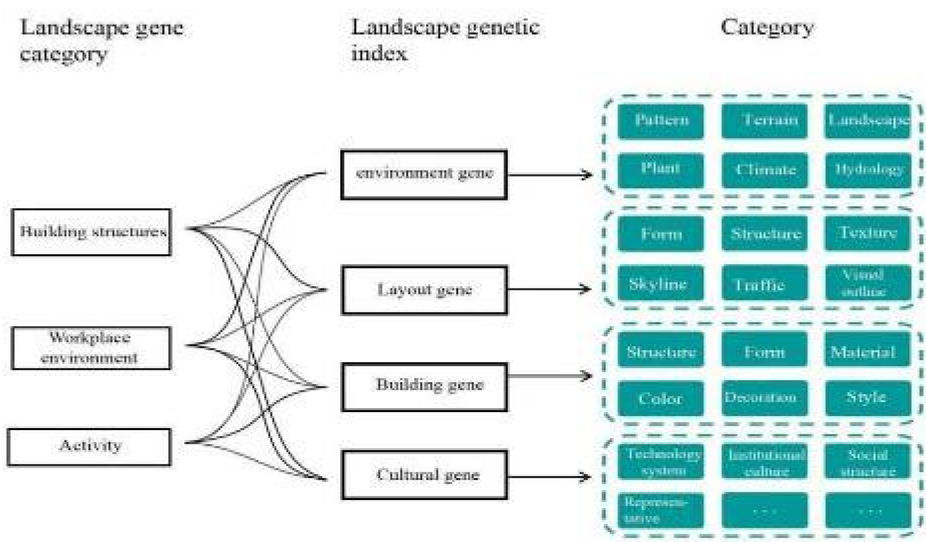

Figure 5.1 summary of criteria for landscape character classification of industrial land in disuse
Image Source: painting by author.

5.1.2 Method of extracting landscape characters from industrial land in disuse

The process of landscape character extraction in the industrial land in disuse is as follows. 1) screening units and eliminating ineffective units that destroy the landscape style; 2) combining four principles of landscape character prediction, namely overall dominance, local prominence, individual uniqueness, and uniqueness, to extract the characters; 3) according to the situation of character categories and research needs, the landscape character extraction should adopt approaches such as element extraction method based on tangible entities, pattern extraction method with sign patterns as the medium, and feature extraction method using the spatial feature as elements.

5.1.3 Mapping of landscape character atlas of industrial land in disuse

Landscape character can be perceived simultaneously under different spatial and temporal scales in a certain spatial range, and is attached to units in the form of replication and mutation. Therefore, based on the results of industrial land in disuse landscape character extraction, the information is encoded, and the character atlas of character information index and spatial distribution and information content can be constructed by combining the information database and spatial information entry software.

(1) Encoding landscape character

The significance of character encoding lies in the narrative characterization after typological delineation and digital representation of pictorial content. Based on the structure system of landscape characters in the industrial land in disuse and the method of decomposition of landscape character classification in industrial land in disuse, and combined with the existing information encoding theory and encoding examples, this study proposes the encoding model of landscape character in industrial land in disuse. Firstly, to determine the domain segment and type of landscape characters, i.e., character topological relationship and hierarchical positioning in the urban space; then, to use classification extraction of industrial land in disuse to determine the category of landscape characters, and to complete the large and small sub-categories of characters and information content encoding. Overall, the code divides the domain segments by uppercase letters: M (mining), S (smelting), D (derivatives), T (transportation); lowercase letters distinguish types: c (subject unit); d (derived units); a (attached unit); h (hybrid unit); double-digit characters indicate specific content: 01 (Building and facility character), 02 (environmental character), 03 (layout character), 04 (cultural character); The major and minor classes are labeled with unit numbers, and the extracted content of characters in each minor class is encoded with two digits, therefore a "location-information" system on character encoding can be constructed (Figure 5.2).

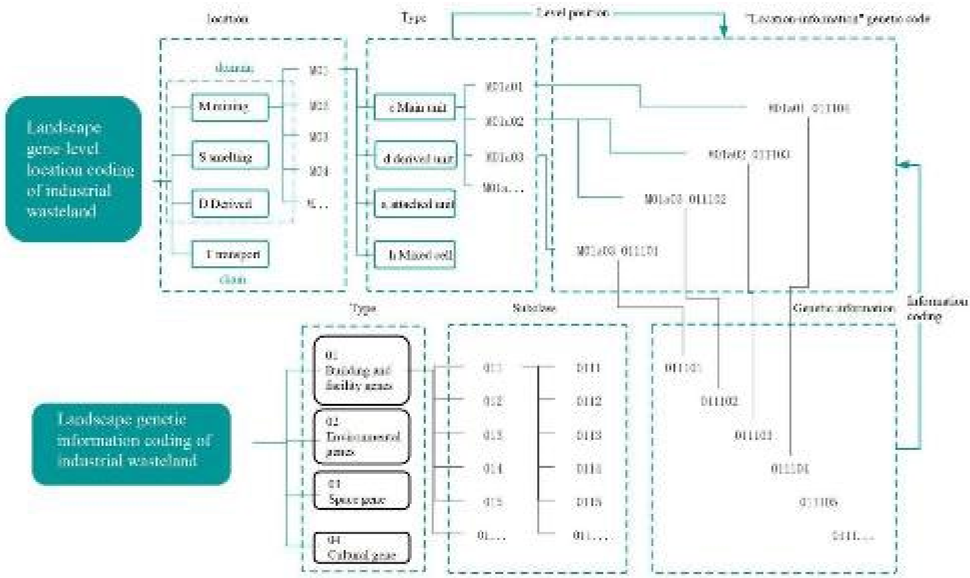

Figure 5.2 the "location-information" system on character encoding of industrial land in disuse
Image Source: painting by author.

(2) Construction of information base of landscape characters

The information aggregated by the encoding model of landscape characters in industrial land in disuse already has character base properties (Song & Zhang, 2020). On this basis, using ArcGIS spatial information collection and analysis functions, the location of each unit can be recorded in geospatial space in the form of coordinate points according to different types; the landscape genetic atlas can be mapped according to the characters and spatial information.

The significance of constructing a landscape character atlas of industrial land in disuse lies in the following aspects: 1) to determine the spatial distribution of characters to facilitate analysis of the way landscape character is combined, arranged, and cascaded; 2) to visualize the actual performance, characteristics and content of industrial land in disuse, and to facilitate the overall control and management of the urban landscaping process from the perspective of character integrity; 3) to facilitate relevant departments to index and locate landscape character through a platform-based approach, and to provide a quick way to record and monitor industrial lands in disuse; 4) to further analyze the aggregation and richness of regional landscape characters, and to provide evidence for the functional transformation and creative design of different types of industrial lands in disuse from the whole to the parts.

5.2 Landscape characters extraction and atlas mapping of Tonglushan land in disuse

5.2.1 Overview of Tonglushan land in disuse

The Tonglushan land in disuse is located in the southeast of Hubei Province, China, adjacent to the central city of Huangshi. The ancient copper mines of Tonglushan are surrounded by mountains in the shape of a valley, and the undulating and variable valley divides the area into more diversified mountainous terrain. Since ancient times this area has flourished from copper mining, including Tonglushan, Dayanyin Mountain and Xiaoyanyin Mountain, etc., forming the Eight Views of Daye. Today, after dozens of years of mining, Tonglushan has been transformed from a mountain to a pit, and the natural pattern of the area is enriched by the water system running from east to west and the Sanchili Lake in the north (Figure 5.3).

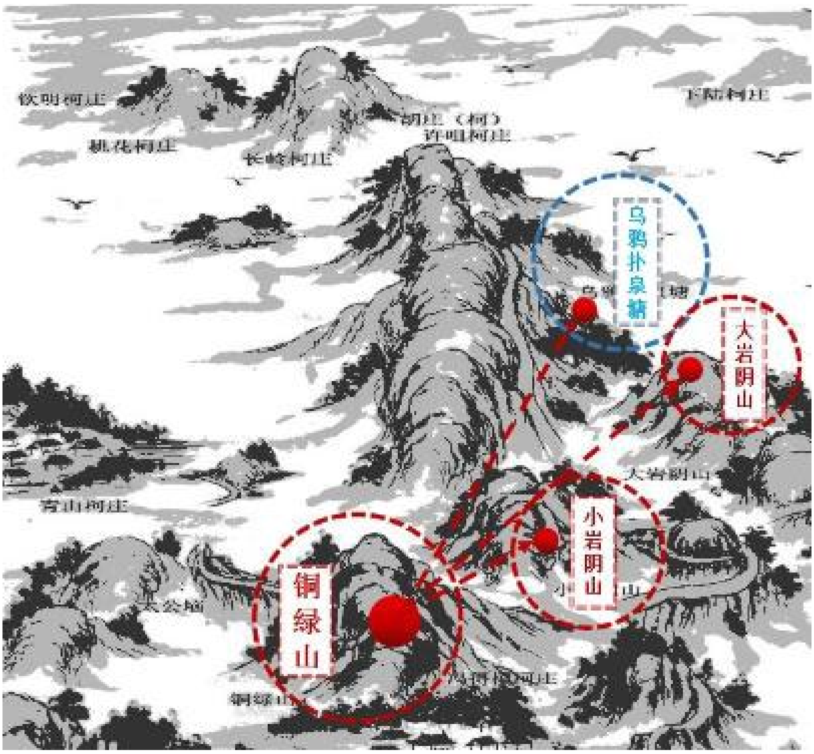

Figure 5.3 Natural Pattern of Tonglushan
Image Source: Huangshi Industrial Heritage Protection Center.

The research area is centered on the Tonglushan pit and the ancient Tonglushan copper mine site, covering more than 10 abandoned factories and five industrial and mining settlements (Figure 5.4). The units, chains, and domain of the Tonglushan land in disuse are coupled with each other, with more typical complex features of multidimensional landscape characters. With technological progress, the mining method has been optimized, from small-scale above ground and shallow underground mining in ancient times, to large-scale surface mining in the 1970s and 1980s, and then to centralized multifunctional underground mining in the past 20 years. Diverse mining methods and continuous mining have created rich landforms.

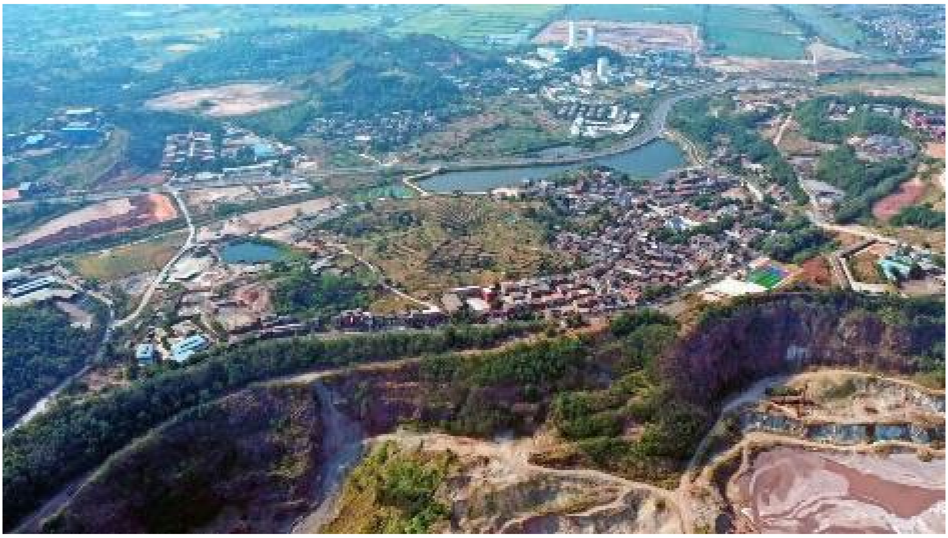

Figure 5.4 the Tonglushan pit
Image Credits: ©Qipeng Liao, 2019.

5.2.2 Classification of landscape characters in Tonglushan land in disuse

The piece of Tonglushan land in disuse are divided into four categories according to their types: environmental character, architectural character, layout character and cultural characters

（1） Environmental character

Environmental characters include ancient mining relics, modern mining relics, water systems, etc.

For ancient mining relics of Tonglushan, the morphology and layout of them are somewhat similar to those of recent pits, however, the scale is relatively small due to the main approach of manual mining. Those artificially cut ore rocks are scattered irregularly on the hills, which have become weathered rock walls after thousands of years (Figure 5.5). Malachite, ancient bronze furnaces and bronze tools are also important historical witnesses of this relic.

Figure 5.5 Entrance to the ancient copper mine site
Image Credits: ©Huangxin Cheng, 2020.

The vertical shaft of the ancient mine at Tonglushan is nearly 100 meters deep, and the technology wooden shaft support ensured the long-lasting stability of the mine structure, which makes the whole mine a typical representative of ancient Chinese shaft-digging mining technology. The innovative construction of ventilation, lighting, and drainage facilities in its shafts also highlights the splendid fruits of ancient Chinese engineering technology.

The whole mine consists of “vertical shaft”, “inclined shaft” and “flat shaft”, and the shaft support is neatly constructed using wooden mortise and tenon joints. The long-lasting stability of the support frame ensures the safety and longevity of the mine, and it is designed and built in almost the same way as the modern mine (Figure 5.6).

Figure 5.6 Ancient mine site at Tonglushan
Image Credits: ©Qipeng Liao, 2020.

For modern open-pit mining of Tonglushan, its exploitation was concentrated in the 1960s and 1970s. A railroad line was built to connect the mine to the lower section of the Hanyeping Railway, linking the Tonglushan mine to the Huangshi mining network. The evolution of the mining process can be shown in the image map, that is the evolution of hills to deep underground pits and the development of single aggregated ore bodies to multiple continuous composite ore bodies(Figure 5.7).

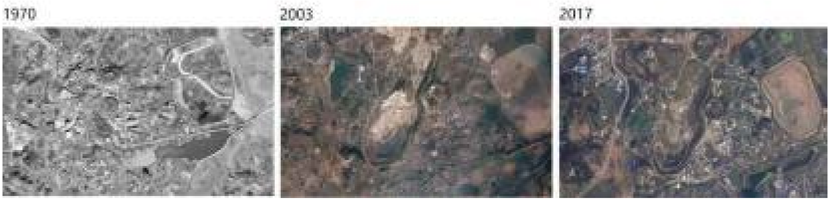

Figure 5.7 Evolution of mining in Tonglushan
Image Source: Google Image.

Inner lake water transportation is the main way of ancientmining and metallurgy transportation in Huangshi. Tonglushan ore and copper materials mostly transported from Daye Lake to the Yangtze River, then to Shangcheng, Zhoudu and Chuying inthe north, or to Wu country and Yue country in the south; Yangxinshan Mountain, Gangxia, and Fengshan copper ore transported from the Wang Lake and the Zhupo Lake; iron ore in Tieshan transported through the Ci Lake out of the Yangtze River (Figure 5.8). At present, there are still many longitudinal and horizontal water lanes in Daye and Yangxin, while the ancient wharves are scarce, and all of these are reflected in the name of some places, such as Zhutang Port, Daquangang Bey, Xiangkou Village, Xiaxiangkou Village, Zhougang, Zhujia Bey, Lijia Bey, Oujiagang Bey, etc. A large number of water lanes and place names reflect the prosperous history of the water carriage of the Daye Lake. A large amount of cultural heritage and human activity records have been kept by factors like the river itself, the water source engineering, water engineering facilities, navigation engineering facilities, and river management system.

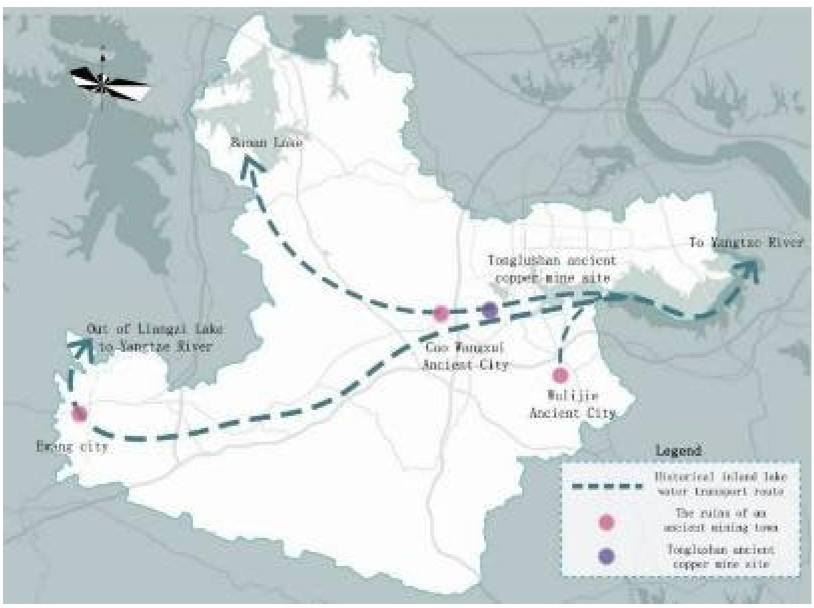

Figure 5.8 Water transportation system of Tonglushan
Image Source: painting by author.

（2）Layout characteristic

The process of mining and metallurgical production determines the spatial layout of the landscape character. The modern production line in Tonglushan is well preserved. The overall layout is compact, with the smelting area adjacent to the mining area, the railway line passing between the two areas, and important production facilities laid out along both sides of the railway line (Figure 5.9). Due to the long production cycle, the site retains buildings, structures and facilities of different ages and styles, which have certain scientific, technological and cultural values.

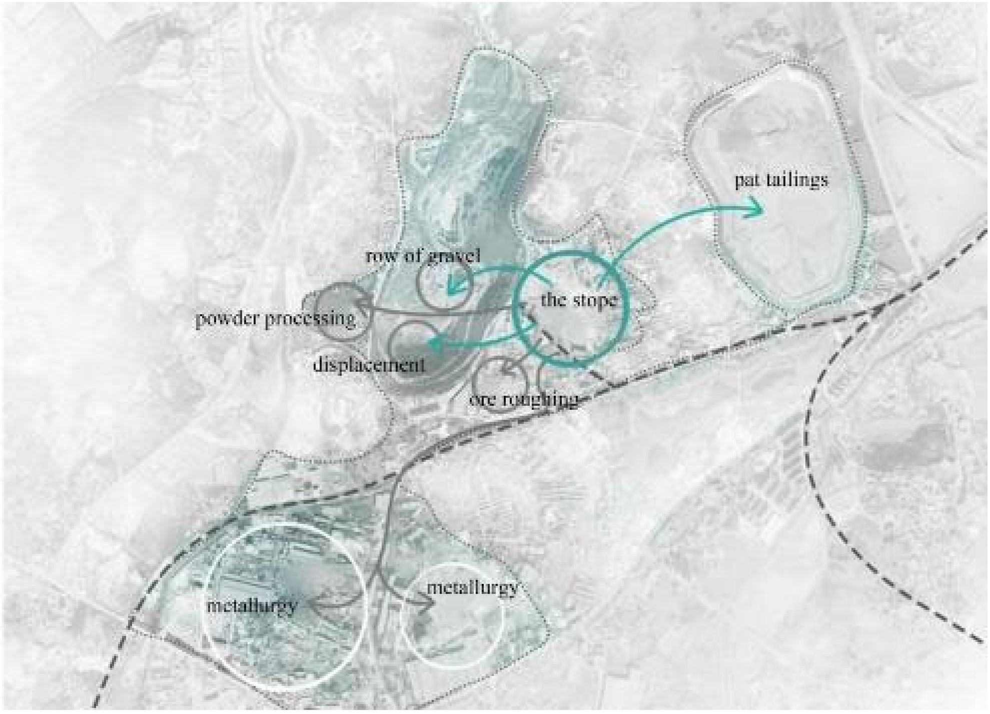

Figure 5.9 Schematic representation of the production process
Image Source: painting by author.

The water supply supporting system of Tonglushan is also representative (Figure 5.10). The overall water supply system is connected to the Daye Lake water system. The artificial outer lake and water storage port are constructed and connected to supply water for the mine production through a multi-stage pump house. The external wastewater is discharged into the mine pit on the south side through the sinkhole and drainage canal, or directly into the mine pit on the north side, from which water accumulates in the mine pit. The south pit is also used for water storage, with retaining walls placed along the slope at lower elevations to prevent landslides. The south pit is used for water storage, and retaining walls are placed along the slope at lower elevations to prevent landslides. Drainage tanks and sand wells are built along the edge of the retaining road. A pump is installed at the bottom of the south pit for firefighting and for filling the pit in the underground quarry. Except for the thickening machines lined up in the production space, other landscapes are relatively poor. However, they still have the value of storing certain character information due to the special nature of the production line as a whole.

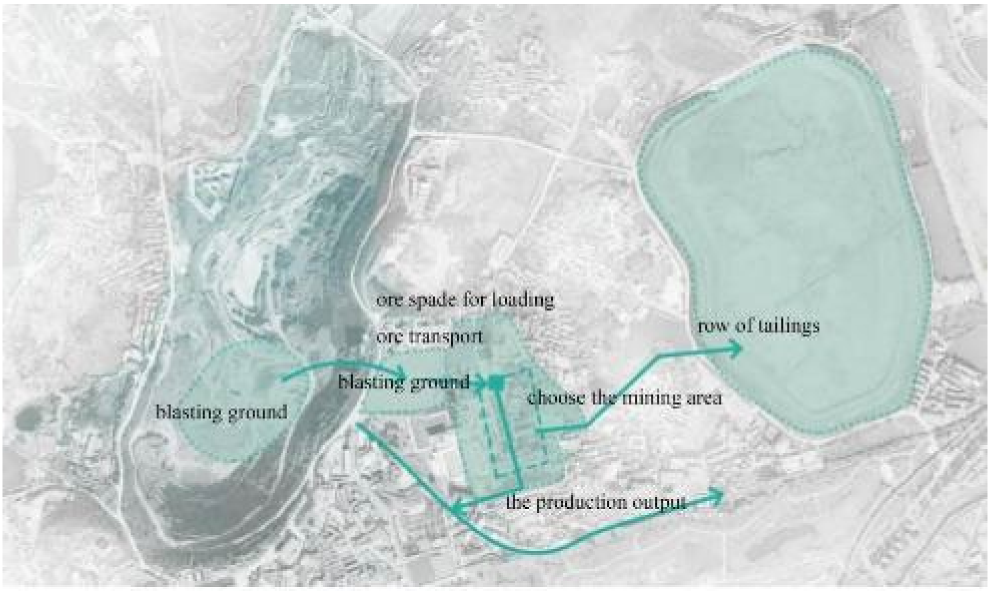

Figure 5.10 Schematic diagram of water supply supporting system
Image Source: painting by author.

（3） Building structural and facility characters

In the case of using originality to preserve old industrial buildings, the main factors affecting the spatial form of the building are the flat form and area of the building. The old industrial buildings in Tonglushan are divided into regular plane buildings and irregular plane buildings according to the flat form of the building. In industrial buildings, form and industrial function absolutely correspond, that is, the industrial function determines the form of the building. To meet the different needs in the process, regular and irregular planes are created in industrial buildings. this research defines buildings with special plane forms as irregular flat buildings, such as silos, cement warehouses, grain silos, etc. In existing industrial buildings, irregular plane buildings mostly present a cylindrical shape.

According to the span size of the building, old industrial buildings should be divided into large-span and small-span buildings. Among them, the large-span buildings refer to the industrial plant with the span of 12 meters or more. For cylindrical-shaped irregular plane buildings, their span can be understood as the diameter.

Considering the above two factors, the old industrial buildings in Tonglushan are divided into four categories, that is, regular plane buildings with a small span, irregular plane buildings with a small span, regular plane buildings with a large span and irregular plane buildings with a large span.

The first kind is regular plane buildings with a small span(Figure 5.11). This kind of buildings is characterized by a regularplan and low floor height, and most of them have mediocre artistic value and cultural value, and only a small number have high cultural value.

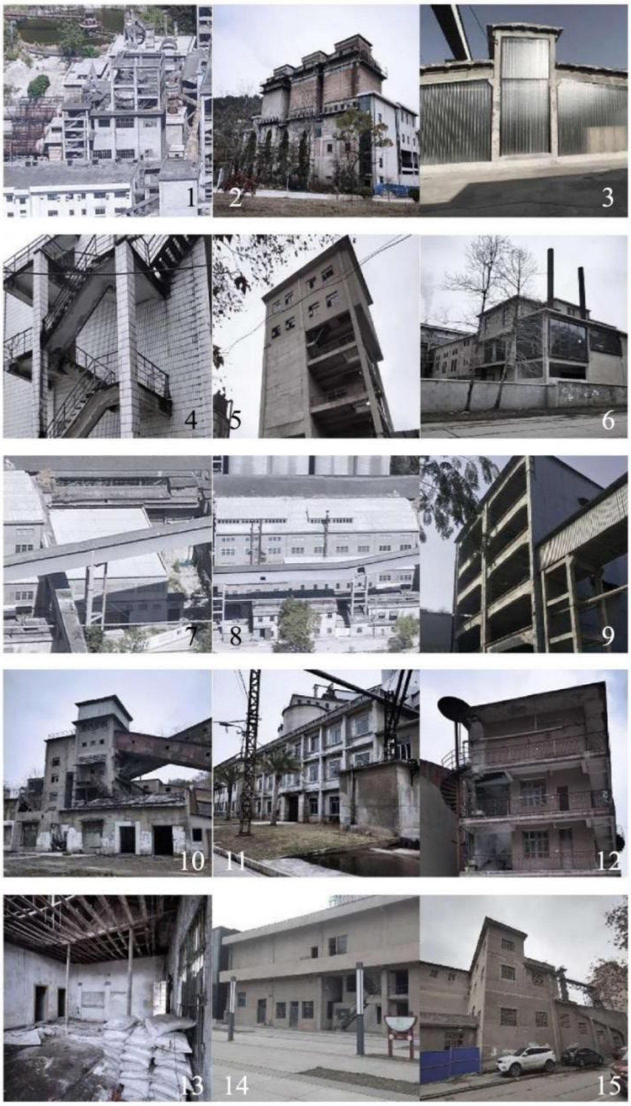

Figure 5.11 Regular plane building with a small span
Left (1): Rotary kiln head
Middle (2): Rotary kiln tail
Right (3): New process packaging workshop
Left (4): Storage Room
Middle (5): Grinding head bin Right (6):Drying workshop Left(7):Rough grinding workshop
Middle (8): Fine grinding workshop
Right (9): New fine grinding workshop
Left (10): Transfer building
Middle (11): Quality building Right(12):Complex building
Left (13): Warehouse
Middle (14): Ancillary buildings
Right (15): Ancillary buildings
Image Credits: Qipeng Liao, 2020.

The second kind is irregular plane buildings with a small span (Figure 5.12). This kind of buildings is characterized by a rounded plan, a smaller scale, and higher artistic and cultural value.

Figure 5.12 irregular plane buildings with small span
Left(1): No.2 cement silo
Right(2): No.3 cement silo
Left(3): water tower
Right(4): Large industrial funnel
Left(5): Large industrial funnel
Right(6): Railway bulk station
Image Credits: Qipeng Liao, 2020.

The buildings and structures that serve the daily needs of the mine residents in the Tonglushan mining area are also distinctive. The living buildings mainly include modern buildings and some self-built houses, and the landscape characters show heterogeneity (Figure 5.15). Modern buildings were designed and built in 1954, mostly distributed around the production space, with a total of 24 brick and wood modern buildings. The complex is uniformly 3-story high, and axially symmetrical in nature. The building surface is orderly plan, with a brick structure and red tile roof. Within it, there are corridors, woodendoors and windows, and red brick walls (Figure 5.16, Figure 5.17).

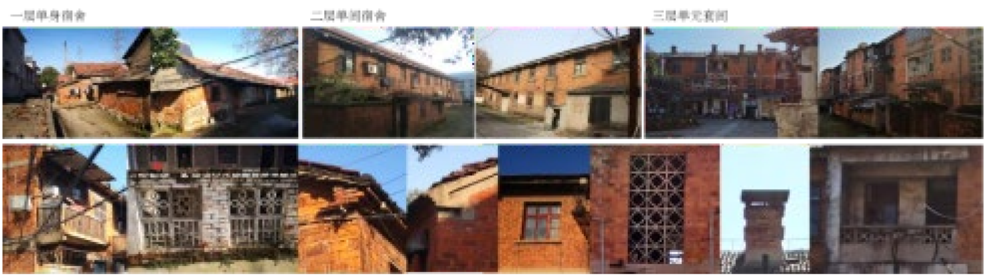

Figure 5.15 Heterogeneous performance of modern architectural landscape genes in Tonglushan community. Left: one storey dormitory building. Middle: Two storey dormitory building. Right: Three storey apartment building. Image Credits: ©Qipeng Liao, 2020.

Figure 5.16 Front elevation of modern building
Image Source: painting by author.

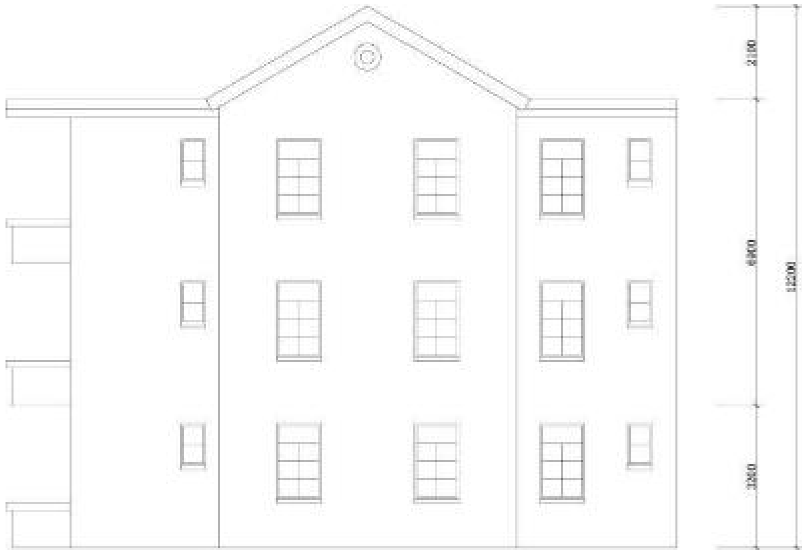

Figure 5.17 Side elevation of modern building
Image Source: painting by author.

The building is currently inhabited by factory and mining employees. Two or three households share a kitchen, and each household has a living area of about 30 square meters. In the 1970s, most houses were renovated to add kitchens, bathrooms and other living rooms, and the residents on the first floor added their own storage rooms on the basis of the renovation. In wider areas around the complex lies some self-built houses (Figure 5.18). After the renovation, the buildings showed a U-shaped corridor pattern to facilitate residents' access, with a multi-family layout of one staircase, and mostly in types of one-bedroom-one-hall, and one-bedroom-two-hall. In its early construction, a large number of factory workers moved in, with eight households on one floor with private kitchens (Figure 5.19).

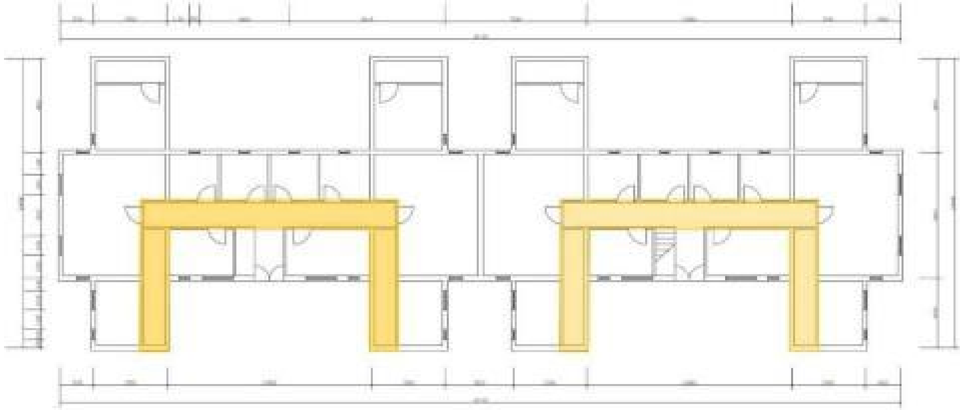

Figure 5.18 Building additions
Image Source: painting by author.

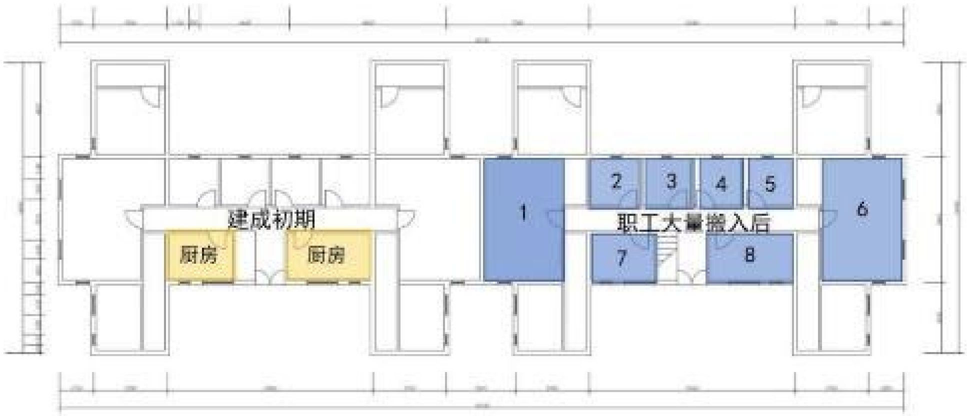

Figure 5.19 Functional layout of the interior space of the building at the early stage of construction and after the employees moved in
Image Source: painting by author.

In the 1990s, the enterprise factory sold the property rights of the modern building complex to the factory workers and nearby residents, and now the living pattern is divided into three types: 1) eight households on one floor (Figure 5.20); 2) two households sharing one floor with a partition in between (Figure

5.21); 3) one household using one floor alone (Figure 5.22).

Figure 5.20 Dwelling pattern 1
Image Source: painting by author.

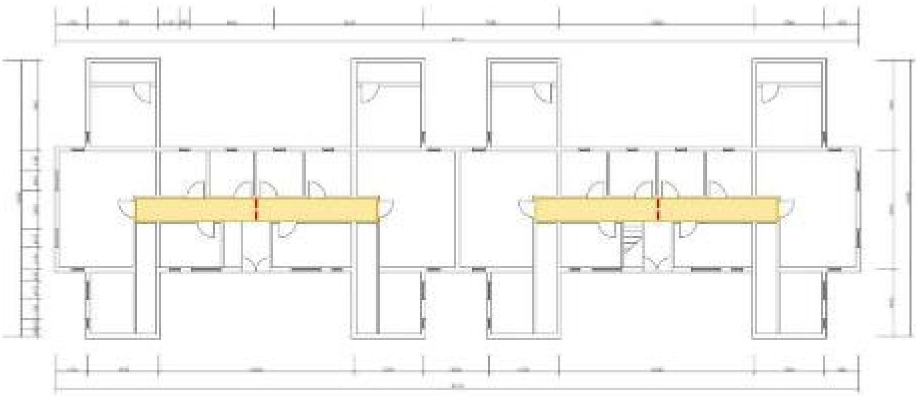

Figure 5.21 Dwelling pattern 2
Image Source: painting by author.

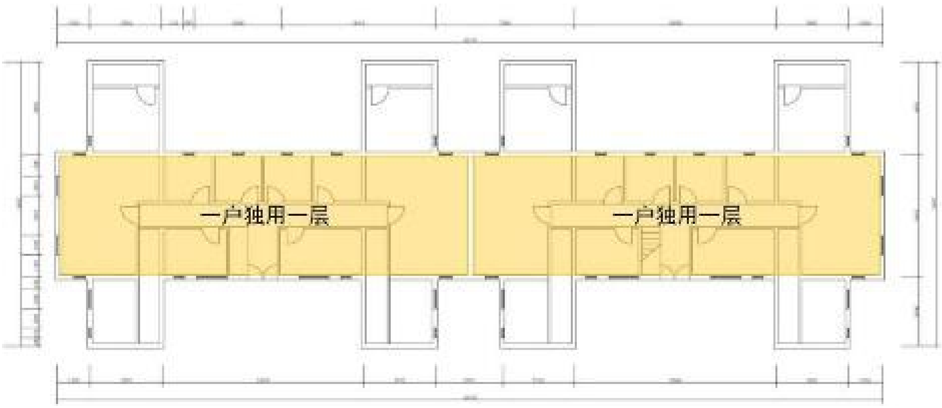

Figure 5.22 Dwelling pattern 3
Image Source: painting by author.

There are also variances in the architectural characters of Tonglushan land in disuse. There are many natural villages mainly living on farming distributed around the mining area. They are mainly Tongshan Village, Shihua Village and Quantang Village. The early village architecture is dominated by the traditional residential style of southeastern Hubei Province, with mainly gray, red or white masonry as façade materials. The entrances of the villages usually have circular ponds with *feng shui* symbolism. The ancestral shrine is located in the center of the village, facing the entrance pool (Figure 5.23).

Figure 5.23 Traditional village architecture and its layout
Left: village pond. Middle: village layout. Right: ancestral hall.
Image Credits: ©Qipeng Liao, 2021.

Local residents worship clan and Taoist culture, which emphasize doing nothing and following nature’s course. The concept of *feng shui* is also deeply rooted in the residents' minds, such as placing the Eight Trigrams in front of the door, backing the wind behind the door, and choosing a site surrounded by the mountain and water. There are also cultural activities such as weeping, ancestor worship, worshiping the Kitchen God, bathing for a three-day-old baby, and folk rhymes. The inhabitants are mainly self-sufficient, including tilling the land, weaving, digging for water, studying and learning.

After the beginning of mining activities, the influence on the genetic radiation of the landscape of mining and metallurgical communities has produced formal intermixing and variation, mainly reflected in architectural layout, structure, form, decoration, as well as human activities and ideology. Most of the newly built villages are more regular, and arranged in the form of the Chinese character “川” (Figure 5.24). The structure is simplified, and appears in the form of a two-story gray space, platform, etc. (Figure 5.25). Some of the villages have a completely different style from that of the southeastern Hubei Province. The decoration of some of the buildings' front windows and the semi-permeable windows and patterns of stairwells show modern architectural patterns (Figure 5.26),with obvious character variation.

Figure 5.24 Newly placed layout of character “川”
Image Credits: ©Qipeng Liao, 2021.

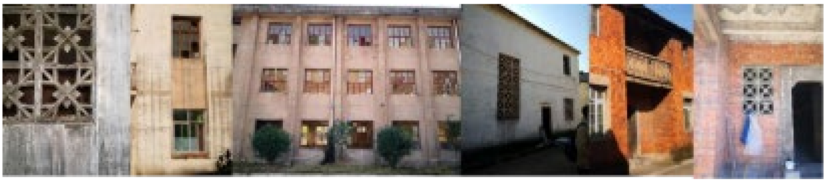

Figure 5.25 Character variation on formImage Credits: ©Qipeng Liao, 2021.

Figure 5.26 Decorative patterns
Image Credits: ©Qipeng Liao, 2021.

（4） Cultural characters

The ancient copper mine site of Tonglushan is an important mining site of ancient Chinese copper mines. Within the ancient mining area, which is about 2,000m long from north to south and 1,000m wide from east to west, hundreds of shafts, inclined shafts, blind shafts and more than 100 large and small flat alleys of different structures and support technologies from the Western Zhou Dynasty to the Han Dynasty are preserved. The surface of the site area is covered with ancient copper refining slag and is several meters thick and about 400,000 tons weight. It represents the highest level of bronze mining and smelting technology in the Shang Dynasty and Zhou Dynasty in China, showing the diversity of Chinese civilization origin and witnessing the emergence of Chinese bronze civilization.

5.2.3 Mapping of landscape character atlas of Tonglushan land in disuse

The architecture characters, structure characters, layout characters, environmental characters, and potential characters in the landscape characters of Tonglushan land in disuse have spatial properties. Therefore, the refined landscape characters of the industrial land in disuse can be encoded in GIS with “point”, “line” and “surface” information to establish a character base (Figure 5.27), and use it as the basis for landscape character atlas (Annex 1).

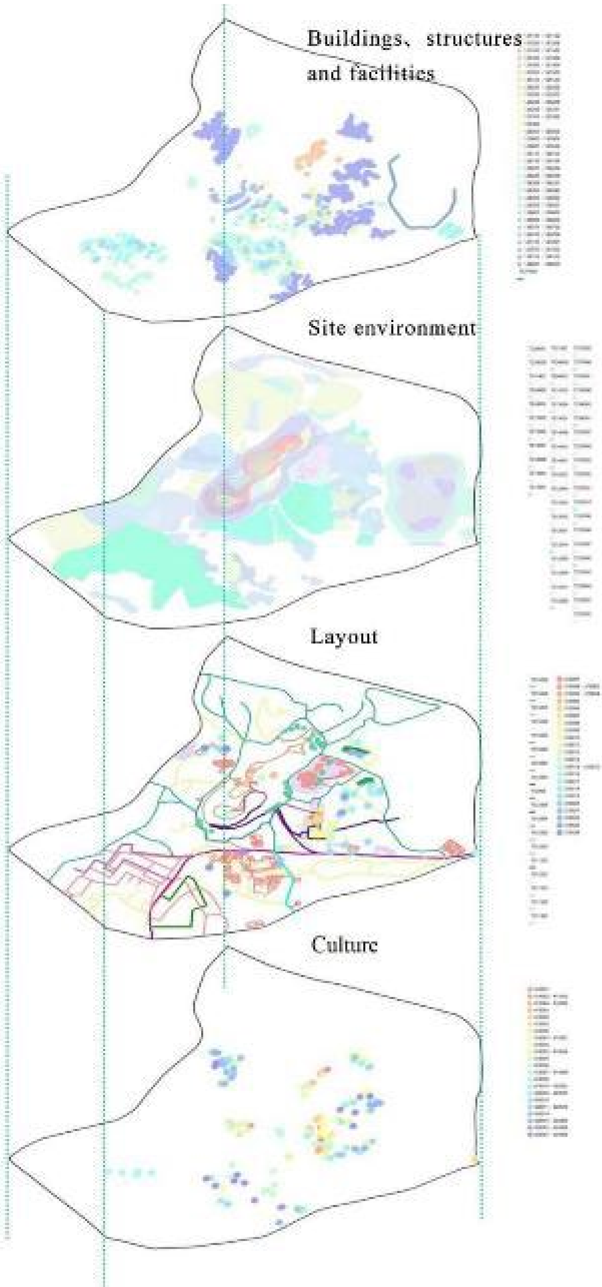

Figure 5.27 Landscape character base
Image Source: painting by author.

5.3 The Hanyeping Railway Landscape Character Extraction and Atlas Mapping

5.3.1 Overview of the Hanyeping Railway Line

The Hanyeping Railway, also known as the Daye Railway, Daye Iron Mine Transport Railway or Tieshan Canal, is the surviving urban railroad that has the longest running time in China. Its intermodal transportation with the Yangtze River waterway is also the first intermodal transportation system between railroad and inland waterway in China. The Hanyeping Railway traverses the whole Huangshi city from east to west and serves as a landscape character chain linking the scattered industrial lands in disuse in Huangshi city. The value of the Hanyeping Railway is buried because there are few supporting structures left in the vicinity due to its multiple renewals and because it is still in use as a freight line (Figure 5.28).

Figure 5.28 Current situation of Hanyeping Railway lines
Image Credits: ©Qipeng Liao, 2021.

(1) Development history of the Hanyeping Railway

In modern times, Huangshi City was called Daye or Daye Industrial and Mining District, and the Hanyeping Railway and the Xiangyeshan Railway were built in succession in the region. Among them, the Hanyeping Railway is also known as the Daye Railway, the Daye Iron Ore Mining Railway or the Tieshan Canal, and its development history can be simply divided into three stages (Table 5.1).

Table 5.1 Development history of the Hanyeping Railway

	Railway line conditions
Construction period (1891-1938)	Construction of the section from Tieshan to Lime Kiln. Expansion of branch lines such as Lion Hill. Expansion of the railroad from Lime Kiln to Daye Iron Works.
War of Resistance against Japan Period and People's Liberation War in China Period (1938-1949)	The National Government was forced to dismantle the railroad. Reconstruction of the entire HanyePing Railway line by Japanese. Expansion of the railroad from Lime Kiln to Shenjiaying. Part of the railroad was destroyed during the Liberation War.
PRC Period (1949 - present)	Restoration of the railroad by the Huazhong Steel Factory. Expansion of the Wuhan-Dye Railway from Tieshan to Wuhan. Speed increase by replacing steel rails on the whole line.

1) Construction period (1891-1937)

In 1890, Zhang Zhidong, the governor of Huguang (Hubei and Hunan province), promoted the development of iron ore in Daye city, after which it was decided to build the Hanyeping Railway to facilitate iron ore transportation. The railroad was designed by German engineers and took one year to complete the construction, with a total length of about 26.3 km [23]. The train of the Hanyeping Railway started at Tieshan Station, stopped at

Shenghongqing Station, went to the central station in Xialu, then stopped at Lijafang Station along the south shore of Cihu Lake, and ended up at Lime Kiln Riverside Wharf. In order to expand the scale of resources, in 1896, Sheng Xuanhuai ordered to excavate Lion Mountain, Wild Duck Ping and other mines in Hubei Province and expand six branch lines of the Hanyeping Railway. In 1916, Lijiafang station was abandoned and Gongjiaxiang station was built. In 1919, Shenghongqing station was abandoned and Tonggudi station was newly established. In the same year, after the establishment of the Hanyeping Company, the Daye Iron Works was built near Xisai Mountain, the Hanyeping Railway was built again to the southeast, and the factories such as the Xialu Machine Repair Factory and the Sleeper Factory were expanded at the same time. At this stage, many industrial enterprises mushroomed around the railroad to build factories and production, such as Wangsanshi Coal Mine, LiShidun Coal Mine and Hubei Cement Factory. The Hanyeping Railway was an important part of the huge transportation line of the Hanyeping Company. After Daye Iron Mine started to make iron, coal from Pingxiang Coal Mine was transported to Daye Lime Kiln via Wuchang along the Yangtze River, and then transported to the Daye Steel Plant via the HanyePing Railway. The Hanyeping Railway and the Yangtze River Waterway formed an intermodal transportation system, which was the first intermodal transportation system of railroad and inland waterway in China.

2) War of Resistance against Japan Period and
People’s Liberation War in China Period(1938-1949)

When the Japanese militaries invaded China in 1938 and approached Huangshi city, the National Government was forced to destroy two urban railroads and sink the unshipped railroad equipment into the Yangtze River. The bridges, locomotives, mining vehicles and the roadbed of the section from Xialu to

Daye Iron Works were all blown up. After the Japanese occupied Huangshi and salvaged the sunken equipment, rebuilt the Hanyeping Railway and expanded the transportation capacity for the Japanese iron ore resources, which was officially opened to traffic in 1939. After that, in order to replace the original Xiangbishan Railway and connect Daye Power Plant, Daye Cement Plant and other important industries, the Japanese militaries built a branch line of the Hanyeping Railway from Lime Kiln to Shenjiaying in Huangshigang Port and changed its original railroad line to the Xiangbishan Highway. The Hanyeping Railway was taken over by the Kuomintang Government for restoration in 1945, since then the length of the whole line of the Hanyeping Railway reached about 36.7 km.

3) After the founding of People's Republic of China (1949 - present)

After the founding of the People's Republic of China, due to the serious damage to the Hanyeping Railway after the People's Liberation War, the government sent the Huazhong Iron and Steel Company to build the railroad. In 1955, the Ministry of Railways approved to make the Hanyeping Railway to the northwest to connect Wuhan, and the way of transportingraw materials changed to direct railroad transportation. After that, in 1980, the whole line of the Hanyeping Railway was replaced and speeded up, and in 1990, the Wuhan-Dye line wasconnected with the Daye-Shahe line, renamed as Wuhan- Jiujiang line, and connected to the Tonglushan Copper Mine relics. The Hanyeping Railway line was only for intercity passenger and cargo transportation, and special intercity trains were opened.

In 2013, the Hanyeping Railway has canceled passenger transport, and there are only 2 special trains per day between Tieshan and Xinye Iron and Steel Factory, and many industrial enterprises built along the railroad still stand on both sides of the railroad in the shape of a belt, which together constitute the Huangshi industrial landscape. The central city railroad section has been abandoned, part of which has been demolished.

(2) Function change of the Hanyeping Railway

It has been nearly 130 years since the birth of the Hanyeping Railway. It has experienced not only the development of history, but also the continuous changes of railroad function and nature in the historical background (Table 5.2). Firstly, the Hanyeping Railway is engraved with many kinds of railroad legacy and the process of Chinese rail technology tracing from material import to independent production and from introduction to independent design. Secondly, the Hanyeping Railway has undergone many times, complex transformations, such as joint ventures with insufficient income, colonial operations, independent enterprise franchises and state government, which mapped the rise and fall of Huangshi's industrial development. Finally, the Hanyeping Railway has the process of transformation from a special line for iron ore materials, to multiple, multi-directional freight and from city transportation for mine workers, to mixed passenger transport and freight, which visually reflects the modern industrial process of Huangshi City.

Table 5.2 Changes in the functional nature of the Hanyeping Railway
Source: Field research and "Huangshi Urban Planning Almanac"

Period	Constructor	Function
Beginning of construction (1892-1938)	Sino-German joint venture	Transporting raw coal and iron ore materials. Transporting industrial and mining plant workers.
War of Resistance against Japan period (1938-1945)	Japan	Transporting raw coal and iron ore materials. Transporting expropriated labors.
Early years of People's Liberation War in China (1945-1948)	The Kuomintang government	Transporting raw coal and iron ore materials and processed industrial products. Transporting industrial and mining plant workers.
Late years of People's Liberation War in China Period to early years of the founding of PRC (1948-1955)	Huazhong Iron and Steel Co., Ltd.	Transporting raw coal and iron ore materials. Transporting industrial and mining plant workers.
1955-2013	National Railway Administration of the PRC	Two-way transportation of coal, iron, oil, cement, etc. to Wuhan. Intercity tourist passenger trains.
2013-present	National Railway Administration of the PRC	Passenger transport canceled in Tie-huangshi section, Wuhan-Jiujiang section still in use. Two new transport trains per day.

Although the Hanyeping Railway is not currently recognized as a separate national cultural relics protection unit, it is indispensable in the genetic structure system of Huangshi's landscape. First, the Hanyeping Railway can be called the transportation line of modern Huangshi industrial production, different from the railroad for transportation purposes. Starting from being the only delivery line of raw materials between Hanyang Iron Works and Daye Iron Mine, the Hanyeping Railway did not exist in isolation, whether it was coal mine development and transmission or cement production and export, etc., it appeared as part of the whole production chain and industrial flow line. Secondly, in the landscape genetic structure system, the railway line not only connects various industrial land in disuse in space in a corridor style, but also records history and today in time. Thirdly, from single iron ore transportation to multiple industrial raw materials and products transportation, from the support of its own such as Xialu Machine Repairing Plant, to the creation of the surrounding Wangsanshui Coal Mine, Huaji Cement Company, etc., to the construction of Fuxing Aluminum Company and other enterprises at present, the convenience of transportation is an important standard for selecting the site. It is confirmed that Hanyeping Railway transportation has a radiating and guiding effect on the industrial development of Huangshi city.

5.3.2 Classification of landscape characters of the Hanyeping Railway line

(1) Railway facility character

The railroad facility characters include all facilities and equipment of the railroad project. This study classifies landscape characters in terms of railroad relevance, taking the railroad and the infrastructure of the railway line (station platform, equipment, etc.) as the main body, covering the functional service facilities of the railway line (locomotive factory, work area, etc.), which constitute the complete railroad facility characters.

The Hanyeping Railway is relatively well preserved, and the section from Lime Kiln to Huangshigang has been abandoned but is still preserved. The railroad used German rails and steel sleepers in the early days, and then they were replaced with steel produced by Hanyang Iron Works in the Republic of China. Two German-made steel sleepers are found, which are now preserved in Daye Iron Mine Museum, and one German-made steel rail, which is preserved in Xinye Iron and Steel Works. At present the railroad has been speeded up for several times, the rails have all been replaced, but there is still locomotive equipment such as steam locomotives and wagon trailers preserved.

As for the main structures of the railroad line (Table 5.3), there were only 5 stations at the beginning, and later 6 stations were added, and now only Tieshan station, Xialu station and the site of its new waiting hall remain, among which Xialu station is the center of the Hanyeping Railway, also called Xialu central station. This station was designed by German engineers, equipped with automatic weighing machines, and with coal stacks and water towers, while a garage was built on the south side of the station for train stopping(Figure 5.29).

Figure 5.29 Site of Hanyeping Railway line
Upper left：*Tieshan station. Upper right*：*New Xialu station.*
Lower left：*Xialu station. Lower right*：*Details of Xialu station*
Image Credits: ©Qipeng Liao, 2021.

The station was built at different times and in different architectural forms, reflecting cultural richness. In addition, a railroad bridge called Xiangyang Bridge (Figure 5.30) is preserved at the Lime Kiln three-line common rail division to realize the limited space for turning near the river in a staggered manner within a short distance. The service industries and buildings of the Hanyeping Railway are mainly concentrated in the area of the Xialu Station, and at present, there is the Workers' Club of the Machine Shop, which was established in 1922 as the command site of the "Xialu Strikes"" and was abolished after the "February 7 Tragedy"".

Table 5.3 Existing main structures of the Hanyeping Railway

Name	Construction time	Initial functions	Current status of structures	Features
Tieshan Station	1894	Two-story "cross" shaped main building, including waiting and ticketing functions.	The main building was converted into an office building, and a flat building was added to the east, which is now abandoned	The European-style brick building is located at the western end of the Hanyeping Railway and is the largest among the stations.
Xialu Station	1892	The waiting hall was located in the center of the main body of the building, equipped with weighing apparatus.	The existing building, station sign and railroad have been protected and renovated.	German-designed brick cottage with a porch consisting of Corinthian columns; 20.5m long from east to west, 8.4m wide from north to south, covers an area of 172.2 ㎡
Xialu Station New Waiting Hall	1958	The main body of the building center was originally a waiting hall, with two wings for ticketing and offices.	Now the main body and the west wing are converted into an outsourced Internet cafe, and the office is on the east wing.	The Hanyeping Workers' Club is an imitation Soviet-style building of the same period; the building is 57.6m long from east to west, 23.6m wide at its widest from north to south, and covers an area of 939.2 ㎡.
Xiangyang Bridg	1940s	Converting ground for train tracks	The railroad on the bridge was abandoned for residents to pass.	Open sight and rich layers.

Figure 5.30
Xiangyang Bridge
Up: Aerial view of the bridge
Down: Landscape under the bridge

Image Credits: ©Qipeng Liao, 2021.

(2) Layout characters

Unlike other cities, the spatial development of Huangshi city presents a top-down pattern, that is, railroad transportation establishes the basic layout of Huangshi city, and the construction of industrial and mining enterprises drives the formation of the urban pattern (Table 5.4), (Figure 5.31). From the process of urban space evolution, the Huangyeping Railway has played an important role in the development of Huangshi city and towns in different periods and stages since modern times. The railroad station is the beginning of urban space, and the railway line is the link of urban space. The urban transportation network is also woven on the framework of the Hanyeping Railway and the Yangtze River Intermodal Transport.

The intermodal transportation system composed of the Hanyeping Railway and the Yangtze River is an important part of the industrial industry chain. The system radiates the main industrial areas of Huangshi City, influencing the location of various types of enterprises and greatly enhancing the regional service and radiation capacity of enterprises. The system continues to promote the development of regional industry and the formation of a T-shape urban pattern in Huangshi with the coupling of the railroad urban spatial belt and the riverside urban spatial belt. In general, the initial framework of Huangshi's modern urban space was formed along with the Hanyeping Railway.

Table 5.4 Temporal relationship between the Hanyeping Railway and the evolution of modern Huangshi

Time Period	Mode	Characteristics
1891-1938	Multi-point layout guided by industry and transport stations	Hanyeping and Xiangyishan railroads as axes. Tieshan station and Xialu station as the core industrial concentration areas. Riverfront commercial area with Lime Kiln and Huangshigang stations as the core. Railroad station area supported by residential space
1938-1949	"Bipolar" development oriented by industrial plunder	The Hanyeping Railway functions as the link. Restoration and reconstruction of Tieshan and Iron Factory, expansion of regional scale, improvement of regional support, such as housing and schools. Lime kiln, Tieshan Mountain and Iron Factory were supported by commercial, entertainment and medical space.
1950s and 1960s	Spatial layout and expansion guided by industrial resources	Railroad Yangtze intermodal transportation as a condition. Construction of Huangshigang light industrial zone, heavy industrial zones such as Tieshan, Xialu, Lime Kiln and Iron Factory. Large industrial enterprises supported by living, commercial and social service space.
1970s and 1980s	Industrial linkage led to the extension of the belt	urban transportation system with the Hanyeping Railway and the Yangtze River Intermodal Transport as the skeleton was established. Industrial enterprises expand radially and form urban space by horizontal connection.
1990s-present	Urban pattern in the form of Chinese character "入"	The Hanyeping Railway and the Yangtze River Intermodal Transport as the guide. Huangshigang and the old city of Lime Kiln are the main cities with large scale and diverse functions. Xialu District and Tieshan District as two auxiliary cities with small scale and single function.

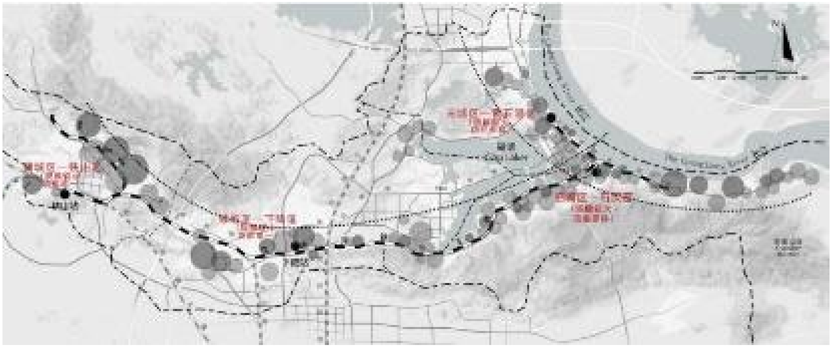

Figure 5.31 Spatial relationship between the Hanyeping Railway and the modern evolution of Huangshi city
Image Source: painting by author.

(3) Environmental characters

The general topographic trend of Huangshi city is higher in the southwest and lower in the northeast, sloping from southwest to northeast. The Hanyeping Railway runs through the urban area of Huangshi City from west to east, and the most representative mountain landscapes and water landscape of Huangshi City are gathered along the route. Among them, the mountain landscapes mainly include Golden Mountain, Stone Mountain, Tuanchengshan Mountain, Dongfangshan Mountain and the famous Xisaishan Mountain and Tonglushan. The water landscapes are not only surrounded by Yuanmen Reservoir and Cihu Lake Scenic Resort, but also the Yangtze River, the longest river in Asia (Figure 5.32).

Figure 5.32
Landscape along the Hanyeping Railway
Left(1): Xisai mountain
Right(2): Dongfang mountain
Left(3): Daye Iron Mine
Right(4): Tuancheng mountain
Left(5): Cihu
Right(6): Yangzi river

Image Credits: ©Qipeng Liao, 2020.

(4) Cultural characters

The Hanyeping Railway is an important component of the chain of Huangshi industrial land in disuse. It has been the best in a number of areas of the Chinese railroad. The cultural characters of the Hanyeping Railway are mainly composed of history, science and technology, art and aesthetics, social culture, cross-cultural communication, and emotion.

1) History

The Hanyeping Railway is a city railway that has run for the longest time in China. It is the first railroad built by the local government and joint venture between China and foreign countries. The Hanyeping Railway and the Yangtze River Intermodal Transport are also the first railroad and inland waterway in China. And because of its industrial relationship with Hanyang Iron Works, it was called by some scholars the lifeline of modern East Asian steel industry, and this waterway is later connected to Japan, becoming the main way for Japan to plunder Chinese resources. The historical value of the Hanyeping Railway lies not only in its own experience of expansion, reconstruction, restoration and speed-up, but also in the historical events and natural changes of different periods and stages in the region under its influence, which also depicts the spatial and temporal picture of the development of industrial cities in the Yangtze River basin. The railroad was a channel for industrial transportation, and the forerunner of the mine plants and iron works as well. There are still mining vehicles and transportation steam locomotives related to this railroad left behind. It also undertook the connection of the lives of the residents of Tieshan, Xialu, Lime Kiln, Xisaishan and other areas for a long time (from 1892 to the middle of the 20th century). Around the industrial production and transportation chain, there are also many leading figures, for example, those who guided the initial exploration and planning of the railroad, such as Zhang Zhidong and Sheng Xuanhuai, and those who led the workers' movement in the Xialu area, such as Lin Yuying and He Huilin.

2) Science and Technology

Since 1881 when the railway from Tangshan to the Xugezhuang Railway was built, China entered the first major period of railroad construction, and the Hanyeping Railway was the product of this period, even before most of the railroads that have been listed on the protection list of China's industrial heritage items, such as the Jiaodong Railway and the Middle East Railway. The Hanyeping Railway have been in operation even longer than the Tangshan Railway as one of the few modern urban railroads. Its design was originated from Germany, and the rails and steel sleepers were imported from Germany, which was in the leading position of technology at that time. After that, the Hanyeping Railway was in the first group of railways restored by using railroad steel produced by Hanyanng Steel Factory. When the Japanese militaries occupied Huangshi, the railroad was renovated to speed up and expand the carrying capacity, and the Xiangyang Bridge, a divided bridge near the river was built. In terms of architecture, each railroad station has the use of building techniques and structures from different periods and countries. Together with the railroad and the surrounding industrial lands in disuse, it is a living specimen library of Western science and technology introduced by modern Asian heavy industry.

3) Art and Aesthetics

Hanyeping Railway station is a landmark building of Huangshi, which has a certain aesthetic value. There are some typical examples: European style and delicate column style old Xialu station; large volume and rich structure of the Tieshan station; and the magnificent imitation Soviet style Xialu new waiting hall. These railway stations are built in different times, with distinctive characteristics and different styles, reflecting the level of architectural art of their respective times. The rich landscape resources around the Hanyeping Railway line combined with the railway itself form the landscape belt together. Railway runs through urban areas, villages, mountains, lakes, parks, etc., forming a rich aesthetic experience.

4) Social Culture

The rise of Huangshi's industry attracted a large number of people from within and outside Hubei Province, and during the War of Resistance against Japan, Japan also immigrated a large number of people from its mainland for resource exploitation and industrial production, accounting for more than 70% of the total number of people. The railroad was not only a transportation channel between the excavation and production of industrial raw materials, but also a transportation channel for workers to go to and from work, and it intervened in the life andproduction of residents in various historical periods and participated in the formation and development of the urban layout. Around the Hanyeping Railway, China's first urban railroad regulations *Passenger Transportation Regulations*, *Safety Patrol Regulations* and *Locomotive Repair Regulations* were established, which record the facts of the impact of the Hanyeping Railway on the social system and other aspects. The railroad left many traces and marks in its development, which continue to be a cultural vein, including the cultural intermingling of the regions around Hubei Province, the legacy of western architectural culture, the chronicle of red revolutionary culture, the support of mining and metallurgical culture, and the representation of urban culture. At the same time, the railroad has a certain symbolic meaning in Huangshi, such as being known as a transportation line for Japanese invasion and resource plundering, the lifeline of the modern steel industry in East Asia, etc. There are also many literary works and documentary records about the life of mining and metallurgy life, such as the long novel *Zeilang Shoal* and the poem *Workshop Poetry Extract*.

5) Cross-cultural exchange

The exchange value of the Hanyeping Railway is different from the technology dissemination in the field of engineering or architecture under the perspective of World Heritage, and it is mainly reflected in the complex historical evolution and multicultural interweaving including technology. First, the Hanyeping Railway itself is the result of the introduction of Western engineering and architectural technologies, and in its subsequent development, the diverse and evolving railroad engineering technologies of Japan and the local community have been more or less used in building the Hanyeping Railway. Secondly, along with time and the change in its nature, the Hanyeping Railway formed a multifaceted blend of social life and economic communication.

6) Emotion

The Hanyeping Railway is related to the mining and metallurgical industry of Huangshi, which recounts the loss of sovereignty in the late Qing Dynasty, the oppression of colonialism, the independent development of enterprises and the leap of railroad technology and the prosperity of national industry, and also records the rise and fall of Daye Iron Mine and Hanyeping Company. And this series of historical memories evolved into a spirit of place, which contains the industrial spirit of Daye Iron Mine, and the spirit of enterprises including the Hanyeping Company and Huaxin Cement Company, etc. Most of the citizens of Huangshi are engaged in or have family members engaged in mining and metallurgy related work, which undoubtedly increases the audiences of heritage emotion. And because of the important role of the Hanyeping Railway in the development of the city, being close to the social life of the city, its emotional connotation is also constantly translated and created in daily activities and industrial production. Until now, the Hanyeping Railway and the Yangtze River Intermodal Transport have been noticed as representative urban features.

Chapter 6

Conservation and Innovation Strategies for Industrial Land in Disuse Based on Landscape Characters

Chapter 6 Conservation and Innovation Strategies for Industrial Land in Disuse Based on Landscape Characters

The holistic conservation measures and regeneration pathways of industrial land in disuse are put forward by implementing the protection of its authenticity and integrity, benign reorganization, functional grafting, and other systematic conservation methods in industrial land in disuse. In this chapter, two representative cases in the landscape character structure of industrial lands in disuse in Huangshi are selected for thick description of the conservation and innovation strategies of industrial lands in disuse. Tonglushan industrial land in disuse and the Hanyeping Railway represent the piece and chain of Huangshi industrial land in disuse respectively.

6.1 Protection of the authenticity and integrity of landscape characters

For industrial lands in disuse, the cultivation behavior is specifically manifested in the spatial protection of material characters and forming environment, the authentic record of industrial spirit, social emotion and other cultural characters, the original succession, stable continuation, and intergenerational transmission.

The landscape characters of industrial land in disuse are often mutated, broken and disturbed by external forces such as urban construction, forming diverse variants. For this reason, it is necessary to extract and cluster the characters, eliminate the mutated characters that have become irreversible and repair the reversible damaged character fragments to ensure that the characters can maintain the authentic state during the intergenerational replication and avoid the value decline that continues toward malignant mutations.

Graded protection of industrial land in disuse heritage can protect landscape characters from external interference and achieve stable characters replication. For example, in the historical district of Huangshi Huaxin Cement Factory, the heritage protection department strictly delineates the objects, contents and scope of protection, specifies the core protection zone space, maintains the original spatial layout and forming environment, and then realizes the protection of authenticity of landscape characters.

6.1.1 Case of protection of authenticity and integrity of landscape characters in Tonglushan land in disuse

(1) Multi-level protective development of the landscape characters of the Tonglushan land in disuse

The core area of Tonglushan includes the ancient copper mining site area and the modern mining area, with a relatively gentle terrain in general, but the deep pits in the mining area are treacherous, with a height gap of more than 160m and a maximum slope of nearly 80° (Figure 6.1). The ancient copper mining site area is divided into four pieces, namely the museum piece, the Tongshan village piece, the Kejia village piece and the Wangyue village piece. Among them, the sites in the Museum and Tongshan village sections have been excavated, while the sites in the other two areas have not been fully excavated. The modern mining area contains a main pit, a small auxiliary pit and woodland in the north, a former building materials factory in the south and a former quarry in the west (Figure 6.2). The ancient copper mining site is a key cultural relics protection unit in China, demonstrating the age-old Chinese bronze culture and the advanced bronze mining and smelting technology. The modern mining area retains a complete mining and smelting production process and regional culture, and thus has a high comprehensive value.

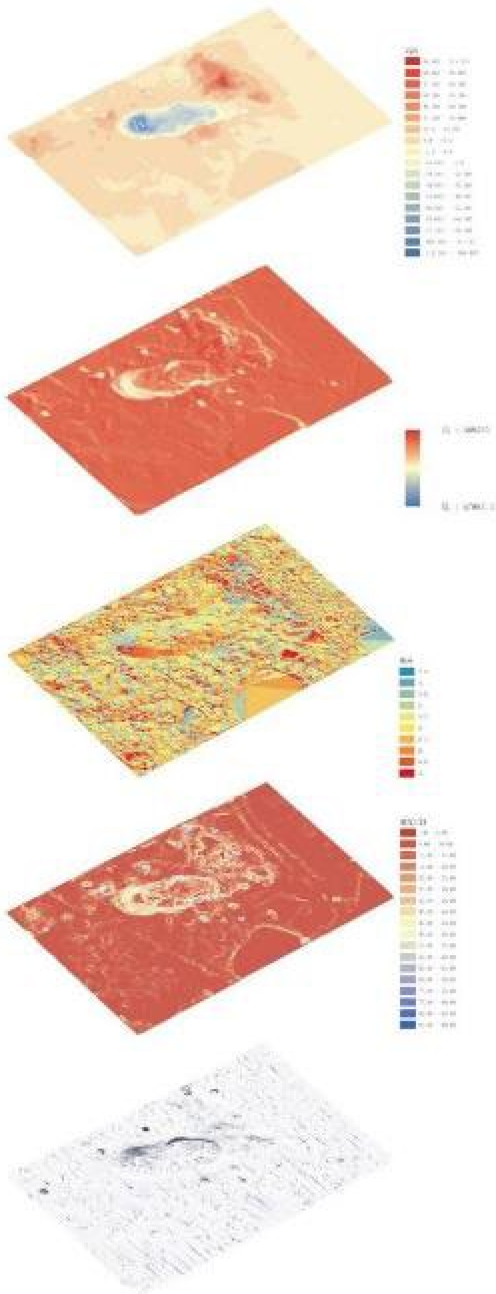

Figure 6.1 GIS analysis of the site and surrounding terrain
Image Source: painting by author.

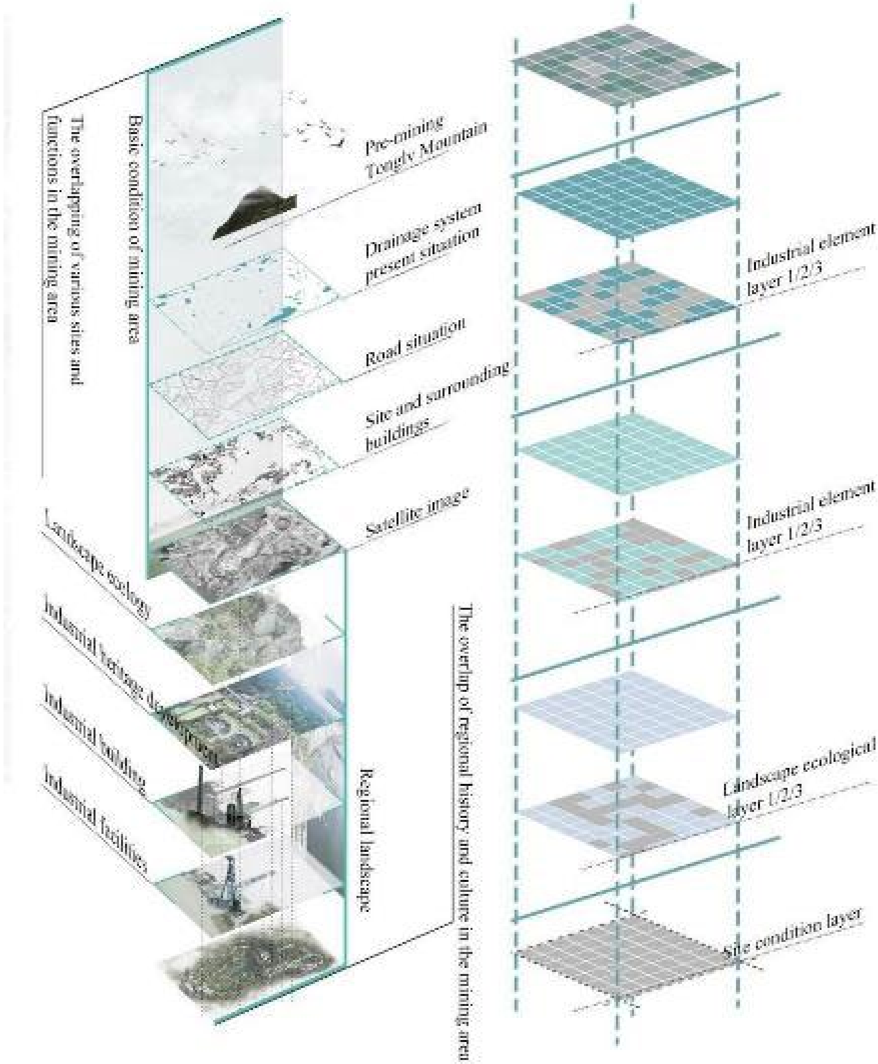

Figure 6.2 Character composition of the landscape in the modern mining area of Tonglushan area
Image Source: painting by author.

Based on the landscape character atlas, the multi-level conservation plan of Tonglushan landscape characters was determined. The plan takes “focusing on the overall protection of the site, preserving the integrity of the site itself and the related environment; minimizing the intervention of the site, preserving the authenticity of the site; adhering to the principles of scientific, moderate, sustainable and reasonable utilization, maintaining the continuity of the site” as the control requirements, and divides the protection scope into key protection zone, general protection zone, class I building control area, and class II building control area (Figure 6.3). Drawing on the theory of biogenetics, genetic isolation can provide a relatively stable and independent external environment for genetic inheritance, thus maintaining genetic authenticity. For the key protection area, strict control is imposed, and activities other than scientific research and science education are prohibited; the general protected area is mainly a modern mining area, where valuable mining and metallurgical relics are protected and moderately utilized to become a base for science education; the class I building control area strictly controls construction activities and strengthens environmental finishing; the class II building control area strictly controls the height and volume of new buildings and they cannot affect the skyline of the whole area, and the style of new buildings should be unified with the environment.

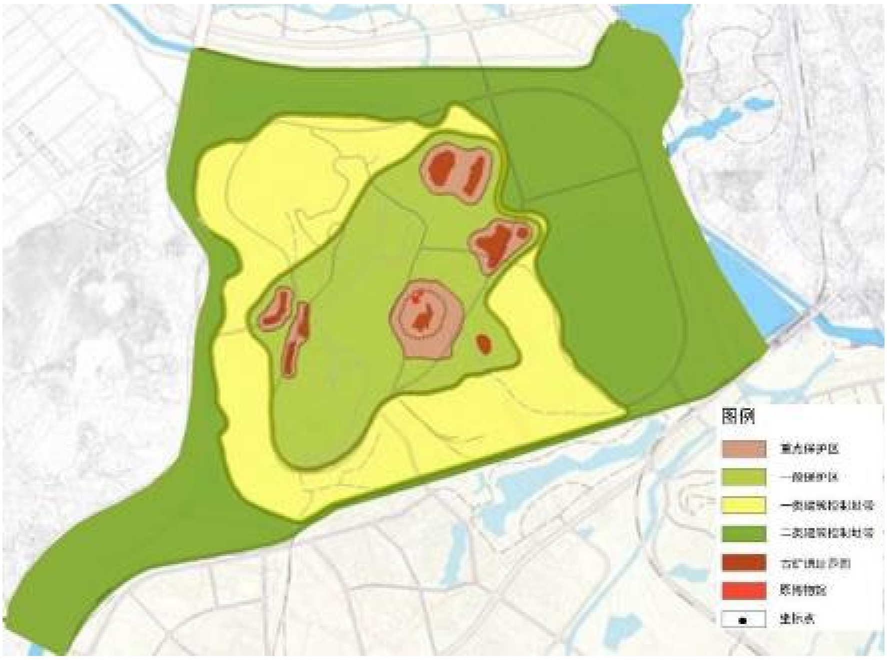

Figure 6.3 A multi-level conservation plan for the of Tonglushan landscape genes
Image Source: painting by author.

6.1.2 The Hanyeping Railway Landscape Character Authentic Cultivation and Grading Protection

Protection of the authenticity and integrity of landscape characters of Hanyeping Railway are mainly carried out from two aspects: natural space and urban space of the Hanyeping Railway.

The natural space protection is mainly based on the concept of ecological restoration as the main focus, supplemented by human intervention to restore the natural space of the Hangyeping Railway. The green space of the Hanyeping Railway is an important part of the green space structure of Huangshi City, and the linear space of the Hanyeping Railway creates an opportunity for restoring urban ecology. The plan adopts the strategies of increasing green space, linking green space and creating green space to restore the ecosystem radiated by the Hanyeping Railway and achieve the protection of the natural space of the Hanyeping Railway. To increase green space is to make full use of the abandoned railroad space to increase the green area for the city, to shape a large amount of green plants in a landscape environment with scenery in all seasons, and to create a multi-habitat where people and animals live together. It is also to make use of sponge facilities in accordance with local conditions to enhance the resilience of the city and increase the ecological value of the area. Green space in series means that based on abandoned railroads to build green corridors, using them as a link to link scattered green areas, and then linking the ecological restoration area of the Hanyeping Railway with the surrounding commercial and residential green areas to form a complete ecological green corridor. Creating green space is to make use of diverse and multi-functional greening forms such as tree array planting in parks and green roofs in residential areas to weaken the negative factors of the site, create a low-carbon and pleasant small environment, and build a rich and continuous small space.

Urban space protection is mainly based on the method of “urban weaving” to connect the urban space that was cut apart by the Hanyeping Railway into a whole. The Hanyeping Railway has cut the north and south urban space of the Huangshigang area in Huangshi city, and urban weaving is to mend the cracks in the north and south urban space of Huangshigang area. According to the characteristics of the region, urban space protection is to plan and utilize the stock space, to provide flexible and adaptable supporting facilities, to create a humane railroad heritage environment, and to improve the functional deficiency of the north and south urban space of Huangshigang District. The regeneration of the abandoned railroad needs to be closely integrated with the development of the city and the region, becoming a multifunctional link to rejuvenate the old city, connect the urban and rural areas, and stitch together the broken communities. The protection of the urban space of the Hanyeping railroad is to reach the unified and balanced development of north and south space in the future development of Huangshigang District of Huangshi city.

6.2 Benign recombination and functional grafting of landscape characters

Single static isolation and preservation cannot achieve the optimal value of industrial land in disuse. Relying on the free recombination and functional grafting of landscape characters, it can promote industrial abandoned land to reach the ideal state that adapts to external environmental changes best. Relying on the laws of landscape character recombination, in the process of character of daily production and life, spatial environment construction and technical and artistic expression, the landscape characters of industrial land in disuse are benignly recombined and functionally grafted to form new landscape character types and character expression to form new heritage types. Then, the external transmission and diffusion effect of landscape characters will be brought into play to enhance the value of industrial land in disuse. There are three strategies for the benign reorganization and functional grafting of landscape characters in industrial land in disuse, namely landscape juxtaposition, landscape translation and landscape symbiosis.

For industrial land in disuse, especially those with heritage value, the renewal will use new design methods and technical means, and the new elements thus created will inevitably have conflict with the original elements.

Under the guidance of landscape character theory, creative design methods are used to reconstruct the contradictory and conflicting vocabularies due to cultural heterogeneity and spatial and temporal differences to form a richer landscape that fits the characters of the local environment. The site texture, mining sites, historical buildings, structures, and intangible cultural heritage are all important landscape characters, which can best reflect the essence of industrial land in disuse culture and are the characters that should be inherited and integrated in the renewal of industrial land in disuse.

6.2.1 Creative strategies for landscape character

There are three main strategies for the creative design of industrial lands in disuse based on landscape characters: landscape juxtaposition, landscape translation and landscape symbiosis.

(1) Landscape juxtaposition

1) Characteristics of landscape juxtaposition

The new elements involved in restoration have distinctly different properties from the original elements. It is very easy to distinguish them visually, and the structure can be clearly dismantled. Interpreted as a specific design concept that “new is new, old is old", which means that the old and new are not confused, and visually there is no "chemical reaction" between the two. The discourse on the character restoration of the landscape can be understood in the context of the evolution of the Chinese concept of conservation of tangible historical heritage as a design approach.

For a long time, the basic idea of conservation and restoration of ancient Chinese buildings was to "repair the old as the new", which is to restore the building as it was when it was built, and this approach was widely accepted by the Chinese. As the awareness of the authenticity of heritage values has increased, the concept of "repairing the old as the old", led by historical expressionism, has gradually been accepted, and the "new elements" part of the restoration is applied with the "make it old" technique to achieve unity and harmony with the original elements.

The archaeological community also has a practice of "juxtaposing the old with the new" when restoring excavated vessels, which is intentionally using different materials from the original vessels when repairing the damaged parts, so that the historical information at the time of excavation can be maximized, which should be said to be a scientific approach to history for archaeology. This concept has been extended to the restoration of architectural sites, especially in Europe, where it is widely accepted. When repairing the necessary damaged parts, the method is different from the original elements, including different colors, textures, materials or old and new, so that the viewer can distinguish at a glance what is added and what is original.

In fact, whether it is "repairing the old as the new" or "repairing the old as the old" or "juxtaposing the old with the new", it is all about the "authenticity" of things at different stages. The concept of contemporary international heritage conservation is also evolving. With different cultures in different countries, ideas are different. Putting aside the controversy and looking at the characteristics of the products of these three concepts in parallel, it is easy to see that unlike the absolute harmony and unity of the first two, the "juxtaposition of the old and the new" in a scenario of intentional or tacit adoption of contradictory methods to achieve the same unified and holistic effects.

In the above-mentioned “juxtaposition of the old and the new”, the new elements exist according to the basic logic of theoriginal genes, so it is natural to achieve diversity and unity. The “juxtaposition of the old and the new” is more incompatible with the original genetic logic, and here we take the example of visiting archaeological sites. First of all, there is a need for the site to be visited, but at the same time there are strict restrictions on the protection of the site, and in general the designer is not allowed to touch the original site. New juxtaposition is therefore necessary as purely addition. These new elements often appear in the form of functional facilities. Designer uses modern materials such as glass and steel in a way that intentionally differentiates them from the original genes.

In a proper design, a new order is created when new elements are inserted into the original elements, and it is a new balance created by the joint logical action of the new elements and the original genes, in short, a chemical reaction in the structure of the site. As a design method, the so-called “juxtaposition” should be both independent and holistic. Being independent means relatively being separated and easy to dismantle. Being holistic means forming a system after juxtaposition, and becoming bigger than before juxtaposition, so holistic quality also becomes the evaluation benchmark of “juxtaposition”.

2) Aesthetic principle of landscape juxtaposition

The charm of landscape juxtaposition largely comes from the historical information implied in the original position, and the potential of the information is wonderfully stimulated by the increased "depth of field" after juxtaposition. The principle of juxtaposition is essentially derived from the related hierarchal laws of aesthetic principles. The multi-layered and multi-dimensional composite effect obtained by the depth of field is unmatched by any single element. Therefore, based on the sense of responsibility, the designer should respect and consider the original environment to the maximum extent possible. This historical information once lost cannot be compensated, and the creation of this depth of field level is beyond the ability of any designer to simulate and replicate.

3） Types of landscape juxtaposition

The types of landscape juxtaposition can be divided into two types: associated and non-associated juxtaposition from the micro level based on the strength of the association between the design language of reposition and the original position. And organic and inorganic juxtaposition from the macro structure level based on the degree of association between the new site organization structure and the original structure.

1) Non-associative juxtaposition *vs*. associative juxtaposition

The "non-associative juxtaposition" emphasizes the contrast between the reposition and the original position in terms of design language and elements, and reduces the synergy with the original position. The use of juxtaposition in architectural design, especially non-associative juxtaposition, is very common, especially in old building renovation types, such as the popular Loft Design, where the architects emphasize the use of new materials that contrast with the original materials, and dramatically direct the symbiosis of multiple cultural values through non-associative juxtaposition.

The renovation design of Shanghai Minsheng Pier uses the method of non-associative juxtaposition, and the Shanghai Urban Space Art Season, launched in 2017, is a direct vehicle for the Minsheng Pier renovation, of which the three main activity lines are art, daily life, and events. The 80,000-ton silo renovation is the core content. An escalator from the first floor to the third floor was added in the gap between the silo and the working building. At the same time, an escalator corridor was cantilevered on the north elevation to lead the flow of people directly to the top floor exhibition hall, where people can enjoy the magnificent view of the Huangpu River and the entire Shanghai Minsheng Pier while watching the exhibition. The newly added escalators and breezeway use modern materials and the silo's concrete materials to form a juxtaposition, which awakes the historical information contained in the site, enhances the quality of the urban space, and stimulates the vitality of the area (Figure 6.4).

Figure 6.4 Renovation of 80,000 tons of silo at Shanghai Minsheng Pier

Image Credits: ©Ronghua Luo, 2020.

The term “associative juxtaposition” means that the new elements intentionally emphasize some connection with the original landscape characters in terms of cultural lineage. The method of associative juxtaposition is fully applied in the design of Yangshupu Power Plant Heritage Park. The 105m high chimney of Yangshupu Power Plant was once a landmark for ships entering Shanghai port. The crane, coal transfer bridge, conveyor belt, water purification pool, wet ash storage tank, dry ash storage tank and other facilities on the riverbank are impressive. Based on these special remains of site, the power plant section was positioned as a power plant relic park (Figure 6.5).

The renovation of the industrial remains of the power plant section was based on an indepth understanding of the original power plant process. Fly ash for power generation was transported from the riverside crane and conveyor belt to the back of the combustion area via the coal transfer bridge. On the far west side of the site, a small hill was made from the excavated earth, and the cap sheet piles used to maintain the pond pit were used as the exterior formwork, with concrete poured on the inside to form the equipment room, washrooms, and pavilion. The coal hopper dismantled from the original building was inverted and placed on top of one of the ponds as a resting pavilion.

Figure 6.5 Yangshupu Power Plant Relic Park
Image Credits: ©Ming Zhang, 2019.

The design of the railings and lampposts in the riverfront section adjacent to the power plant is also very creative. The inspiration comes from the state of the pipes in the old factory. Through the combination of a single element "water pipe", a series of railings and lampposts are formed to suit different lines and positions. These vignette elements are gently separated from the existing environment while still maintaining a connection with it. Today, the “water pipe lights” have become a distinctive feature of the Yangpu Riverfront (Figure 6.6). Named the “Industrial Boat”, the landscape feature combines the functions of a flower pool and a seat, and is placed on top of the preserved steel rails at the pier in the form of wheeled support.

Figure 6.6 Water pipe light
Image Credits: ©Ronghua Luo, 2020.

The undifferentiated juxtaposition of artifacts from different periods in the transformation of Yangpu's riverfront section expresses a response to the superimposed different historical periods. The authenticity of history is no longer presented as a closed law or a system, but rather as overlapping historical processes of recognition, acceptance, and continuous overlapping with full respect for the original state (Figure 6.7).

Figure 6.7 Shanghai Yangpu Riverfront Section
Image Source: thepaper.cn.

2) Organic Juxtaposition vs. Inorganic Juxtaposition

In juxtaposition design there are two types of organic and inorganic structures, depending on the importance of the role played by the original structure in the structure of the new order. In “inorganic juxtaposition” the original landscape character is like a landscape sculpture, the original landscape character’s order is reduced to a unit of the new order. But 'organic juxtaposition' is different, where the original landscape characters are fully integrated as an integral part of the new structural order through the addition of new elements, resulting in an organic and holistic relationship. The American landscape gardener Richard Hag's famous 1970s design of Oil Depot Park on Seattle's lakefront caused great controversy and sensation at the time, transforming the abandoned oil refinery into an urban recreational park. This work brought to light the cultural value of the industrial heritage landscape and was a landmark in the post-industrial genre of landscape design. If analyzed from a design perspective, the park essentially adopts an inorganic juxtaposition, allowing the industrial site to become a sort of sculptural body within the scene, with little relevance to the organization of the site (Figure 6.8).

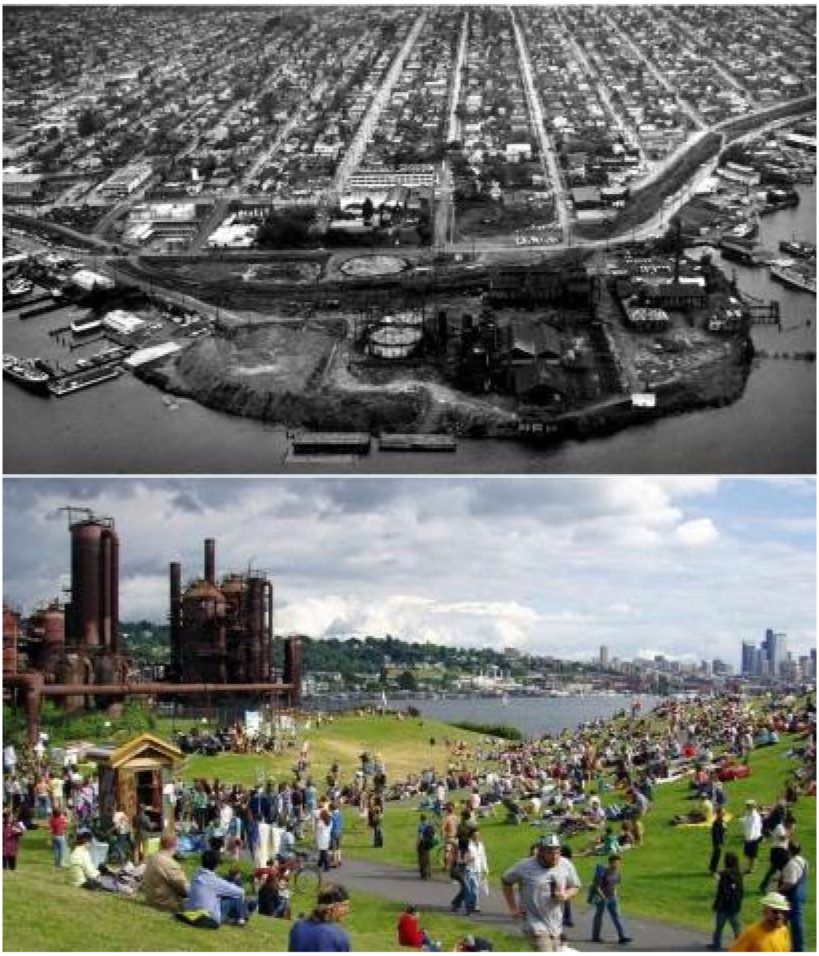

Figure 6.8 Gas Works Park in Seattle
Image Source: weekendnotes.com.

The design practice of the German Peter Latz in the Ruhr industrial area of Duisburg in the 1990s was a clear step forward. Using the same principle of juxtaposition, Latz has respected the layout of the factory as a whole to a greater extent, juxtaposing the facilities of the time, such as excursions, sports and leisure, within the context of the overall management of the site, and reshaping it into a post-industrial cultural park with a contemporary dynamic. This organic juxtaposition allows for a deeper balance between the original elements and the new elements that can be dismantled and interdependent. It has become by far the most successful example of the transformation of a post-industrial site into a park, and a fundamental reference point for post-industrial landscape design today (Figure 6.9).

Figure 6.9 Duisburg Landscape Garden in German
Image Credits: ©Hans Blossey, 2015.

The industrial land in disuse has a unique aesthetic of ruins, and the use of new media in the form of transient expressions that integrate sound, light and electricity with the original structures is also an organic juxtaposition. The SteelStacks Industrial Arts Park in Bethlehem, USA, has both short-term fashionable main events and temporary landscape interventions, as well as the use of light to create the conditions and visual impact of a newly placed landscape. The industrial abandoned landscape provides a backdrop for festivals, art events and musical performances throughout the year. The site's spatial experience varies from day to evening to night, providing a welcoming and friendly public space for families and individuals locally and around the world (Figure 6.10).

Figure6.10 The Steelstacks Industrial Arts Park in Bethlehem, USA
Image source: Archpaper.com

(2) Landscape transpose

The state of the original characters in the design site varies and not always "juxtaposition" is the only or necessary design method to effectively activate the site space. Under certain conditions, landscape transpose becomes another option. It is a design method that transforms, changes or reinforces the original organizational order through invisibility in order to generate a new design logic.

1) The characteristics of landscape transpose

It is worth suggesting that landscape transpose as a result is more general, since the design is generally accompanied by a transpose of the structural logic before and after the design, as in the case of the above-mentioned landscape juxtaposition, andthe result usually has the characters of a transpose. In order to avoid some methodological confusion, it is therefore important to distinguish between landscape transpose as a method and landscape transpose as a result. The definition of landscape transpose as a method emphasizes the invisibility of landscape characters after designing.

Unlike landscape juxtaposition, landscape characters do nothave direct visibility after landscape transpose. Because the skinof the landscape has been treated in some way, it is only through comparison that the logical structural relationship between the new elements and the landscape character can be discerned, and this relationship is characterized by either alteration or intensification or transformation. In other words, all that is visible after the transpose is the new element, and in the seemingly radical change, the inner structure of the landscape character actually profoundly influences the structural language of the new element, so that can’t be called transpose without either one.

2) The rationale for landscape transpose

From the point of view of respecting the landscape characters, there is a need for transpose as a design approach that is different from landscape juxtaposition.

Firstly, the poor condition of the original landscape and pattern is often a direct factor in the transformation or redevelopment of a site, and it is sometimes unwise to force juxtapositions to continue the so-called cultural lineage in the face of a poorly conditioned original landscape. The principle of the transpose of the landscape is that it addresses both the symptoms and the root causes of the problem, enhancing the immediate visual perception through the replacement of the original landscape surface, giving the landscape a new look; at the same time, through the transformation of the original landscape structure, the design is not simply a renovation, but an enhancement of the overall spatial quality of the context.

3) Types of landscape transpose

The types of transpose can be divided into “additive transpose” and “subtractive transpose” from the perspective of local or superficial treatment of the original landscape, and “homotypic transpose” and “heterotypic transpose” from the perspective of the degree of transformation of the original landscape structure.

① Additive transpose vs. subtractive transposes

“Additive transpose” uses a masking or wrapping approach to the original landscape elements, while “subtractive transpose”, in contrast, achieves the same by removing parts of the original or cutting out the surface. The ASLA Universal Design Award-winning American steel mill compound is a typical example of additive transpose (Figure 6.11). The building is restored in a previously abandoned and fragmented factory space courtyard, while the original site of the factory is restored and renewed, giving the site buildings industry-related functions and main activities that evoke the residents’ historical memory of the place in multiple ways.

Figure 6.11 Reconstruction design of steel yard
Image Credits: ©Klopfer Martin Design Group,

② Homotypic transpose vs. heterotypic transpose

Homotypic transpose is a type of transposition that respects the original structure and creates a new design logic by transforming and enhancing it according to the specific site conditions. Heterotypic transposition is a transposition that reverses or largely reverses the original spatial logic of the site to make a complete transformation.

The transformation of the quarry in Nanning Garden Expo Park is a typical case of homotypic transposition. On the basis of inherited regional genes, the abandoned quarry is transformed into an exhibition park with garden expo characteristics. Appropriate artificial interventions reconfigure and enhance the landscape sequence, establishing a new landscape system that is integrated into the site but with distinctive artistic features. The current site has been crudely damaged by the mining enterprises, with quarry pits of enormous scale, broken cliff walls and uneven bottoms (Figure 6.12).

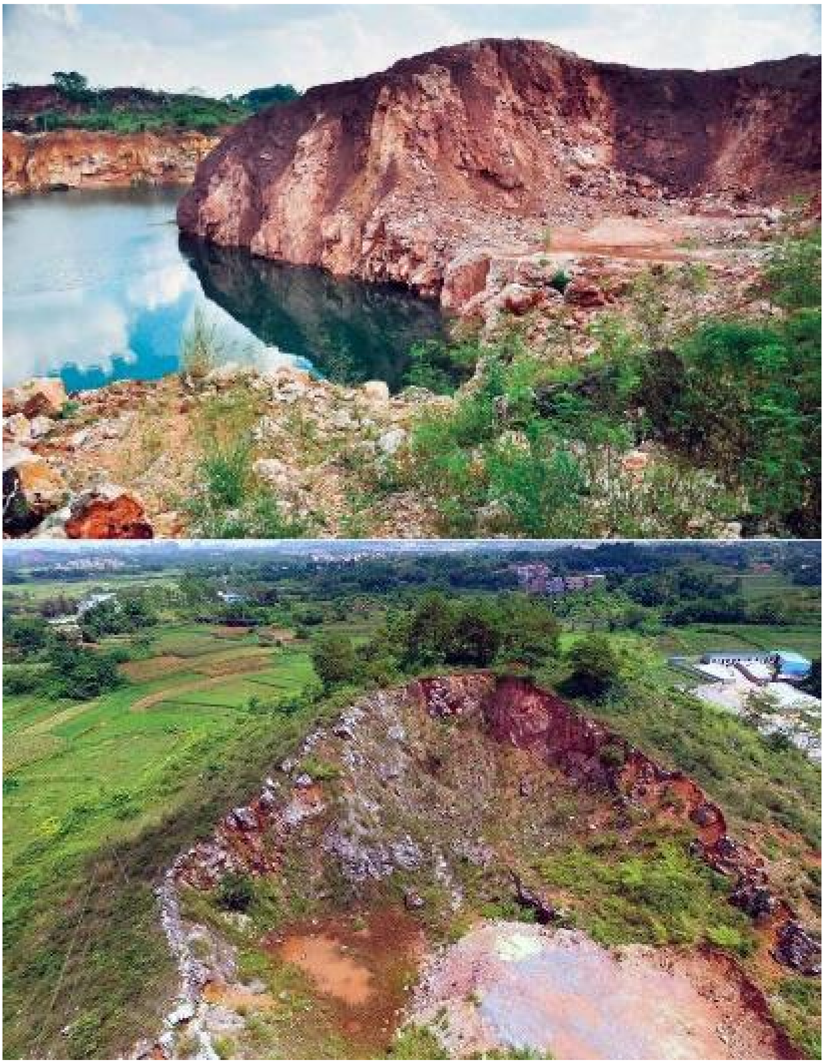

Figure 6.12 Current Status of Nanning Garden Quarry
Image Credits: ©Xiangrong Wang,2021

These quarries currently look dilapidated only because the destruction of the rock formations has just ended, the vegetation has not yet been restored and the water table has not yet stabilized. If the vegetation can be restored in accordance with the laws of nature, the quarries have the potential to gradually evolve into a unique landscape, as depicted in ancient Chinese landscape paintings. In natural conditions, it is impossible to restore vegetation on very steep rock faces, except for individual plants sprouting in the crevices, and only on gently sloping quarrying surfaces will different vegetation gradually grow as the soil is deposited. Quarry restoration should follow the laws of nature and ecological restoration where available, and there is no need to try to restore vegetation on all rock face extraction surfaces. Instead, the exposed rock joints, if preserved, can take on a unique natural beauty when set off by ground vegetation and water bodies, which is the object (Figure 6.13).

Figure 6.13 traditional Chinese landscape aesthetics
Image Source: 51miz.com

The entrance to the quarry is hidden in the surrounding farmland. The view from this opening into the pit reveals a large expanse of water and the tall, beautiful rock face opposite. An irregularly shaped pavilion with a combination of corridors and pavilions is embedded in the site, extending from the opening in the hills to the water's edge, and is called the "Water Bamboo House". A waterfall has been designed in the recess of the cliff face opposite the house, and the sound of falling water echoing in the pool of water surrounded by rock walls adds to the tranquil atmosphere of this quarry pit. The waterfront pavilion is the perfect place to watch the waterfall plunge across the river. The design reflects the traditional Chinese landscape aesthetic (Figure 6.14).

A trestle bridge leading from the side of the Water Bamboo House connects a path along the waterfront, along which four platforms of different elevations are hidden among the vegetation, allowing people to view the rocks, waterfall and buildings from different angles (Figure 11). Banks of the pond are covered in red trillium, with vines hanging down the rock face and reflecting in the water as beautifully as an evening sunset.

Figure 6.14 Water Bamboo House
Image Credits: ©Xiangrong Wang,2021

TANK Shanghai, located on the west bank of the Huangpu River in Shanghai, was designed by using a heterotypic transpose approach, transforming the fuel tanks in the abandoned airport into an art space through systematic layering and functional translation. Shanghai Longhua Airport was the earliest airport in China and was later abandoned. The five fuel storage tanks on the site, which originally provided fuel for aviation, have been preserved intact and are a testament to the history of aviation industry of Shanghai Longhua Airport. The designers replaced each individual function in the system with an art gallery or multifunctional exhibition hall, transforming the historical system into a new art exhibition system (Figure 6.15). The designers reconstructed the surface space through earth sheltered plantation, connected the five separate tanks, and added an open public green system to the site (Figure 6.16). The principles of design and construction were based on the premise that respecting the original structure and industrial aesthetics of the tanks, while structurally reinforcing and modifying them to incorporate a variety of cultural functions. For different structure status of each tank, the design and construction teams selected different basic construction techniques and strategies for reinforcement and modification. The systematic preservation of the five tanks is a reference and tribute to the one-hundred history of the airport. Their tall, rounded volumes and the surrounding undulating public green space formed a new urban landscape in the post-industrial period of Shanghai Longhua Airport, reestablishing the connections among art, nature and the city.

Figure 6.15 TANK Shanghai floor plan

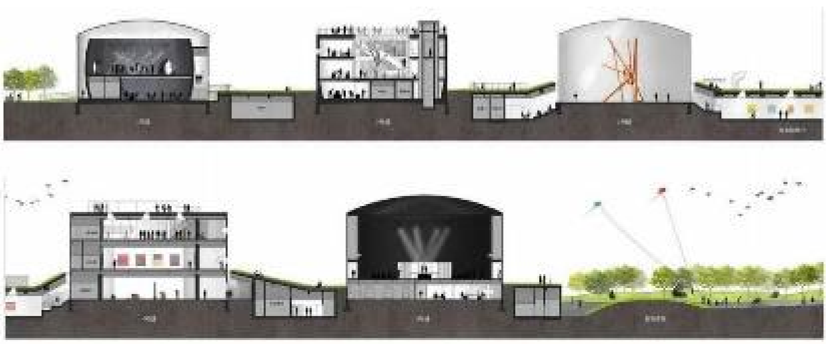

Figure 6.16 TANK Shanghai cutaway view

(3) Landscape Mediation

Landscape mediation is a way of coordinating the coexistence of the internal and external environments of a site. In the regeneration of abandoned industrial sites, the internal and external environment should be coordinated, from the perspective of the city and even the region, integrating economic, social, environmental and cultural factors, coordinating the internal and external conflicts of the industrial abandoned sites and the logical structure of the internal and external environment through a new vocabulary after regeneration design, so that the site elements and the regional environment can coexist as an organic whole. At the same time, through a landscape mediation strategy to balance the site and the surrounding environment, a dynamic equilibrium state is formed, so that the internal and external environment and other elements of the site interact with each other, and then evolve together. The external environment is an important driving force for the regeneration of industrial lands in disuse. If the industrial land in disuse is located in a rural area, it can be regenerated into agricultural, forestry and fishery land, or if the industrial land in disuse is located in an urban fringe area and has high value, it can be regenerated into a theme park.

1) The characteristics of landscape mediation

Whereas the juxtaposition and transposition described above are at the level of the internal environment, mediation is mainly used to solve the problem of harmonising outward-looking spaces with their environment, and in this sense it is not at the same operational level as juxtaposition and transposition. mediation has a strong organisational dimension, which means that the newly implanted genes have a clear organisational and coordinative character in relation to the many contradictions within and outside the site.

2) The principle of landscape mediation

mediation seeks a way to achieve an optimal balance between the many elements inside and outside the designed site, creating and directing a structure that makes the site and its environment a harmonious whole, its role equivalent to that of the greatest common denominator or least common multiple in the environment.

3) Types of landscape mediation

The presence or absence of landscape characters within an externally oriented site has no significant impact on the choice of type of mediation, the more complex the site, the less significant it is, as the whole does not care for more elements. The complexity of the designed site’s surroundings and its influence on the site directly determines whether the newly implanted elements will intervene in a low or high profile manner.

① Neutral mediation

Neutral mediation allows the newly implanted elements to evolve into a neutral that integrates the overall environment, while at the same time being culturally neutral, modest and rich in itself. However, there is no absolute conflict or separation between the implicit nature of symbiotic understatement and the manifestation of individuality, which belongs to a respectable personality in an era when high profile is the norm in a fickle society. Faced with the problem of reconciling various fiercely conflicting elements, the neutral mediation method is often the best way to solve it.

Wuhan's Daijia Lake, once a landfill site for fly ash, is now Wuhan's first integrated urban park built on the site of industrial waste. Using the neutral mediation approach, the overall ecological pattern of the area is improved, ecological corridors are bridged, ecological restoration within the area is carried out, and the memory of the site is passed on (Figure 6.15).

Figure 6.15 Wuhan Daijia Lake Park
Image Credits: ©Wuhan institute of landscape architectural design CO.,LTD, 2019.

② Personalized mediation

Some sites have less control over the overall environment, when the site itself may present the potential to dominate the space, and this is where a neutral mediation, which promotes individuality, is a necessary option that reinforces the integrity of the environment.

The Banyan Tree Nanjing hotel design uses the neutral mediation approach (Figure 6.16). The site is located in the Longquan Quarry in Tangshan, which has a 30-year history of mining. The architectural design uses natural forms that flaunt individuality and serve to unify the surrounding environment and shape the characteristic space. The intention of the landscape design is to slowly rejuvenate the existing exposed rocks, transforming the pit into a unique geological landscape experience. The project team has left the rocks of the site untouched and laid out in their rawest and most rugged state, blending in with the exposed pit. Here, the pit is transformed into a pristine and vibrant natural landscape that evokes a sense of reverence for nature.

Figure 6.16 Yuerongzhuang Hotel in Nanjing
Image Source: Design by China architecture design & research group,2019

Mediation is a benign response to the environment in which the mining area is located. Whether neutral mediation or personalized mediation, the aim of mediation is to achieve holistic harmony. If an open design site is in the strong logical magnetic field of the surrounding environment, with an obvious dominant-subordinate relationship, the so-called design should follow the surrounding environment, and vice versa.

The creative strategy of industrial land in disuse based on the landscape character is ultimately to deal with the relationship between the old and the new, the traditional and the contemporary, both inside and outside the industrial land in disuse, whether they are invisible or explicit. As Peter Latz repeatedly emphasized when talking about post-industrial landscape design, the treatment of industrial heritage is first and foremost a philosophical issue, instead of a design issue, and the history of post-industrial landscape design has fully illustrated that there is room for philosophical expansion of human understanding on the original landscape characters. We can understand the concept of "landscape characters" in the above three strategies as a tradition in some sense, and the attitude towards landscape genes also represents the philosophical origin of a designer, and the profound understanding of landscape characters may represent a certain priori nature of design. Landscape characters include not only material entities, but also immaterial culture. As Portuguese architect Alvaro Siza has said, "no site is a desert". Even if there are no material remains in a site, the immaterial regional context is sometimes still worth exploring and can have a profound impact on design as well.

Obviously, for the characters of industrial land in disuse, these three design approaches are applied with different emphases. "Juxtaposition" emphasizes the coexistence between the original elements and the present culture within the industrial land in disuse, provided that the original elements are of high quality or have very strong design potential; “transposition” emphasizes the formation of new elements by transposing the original landscape characters inside the industrial land in disuse; “mediation” emphasizes that contemporary culture can bring about a new mediation of multiple cultures within and outside the industrial land in disuse. “Mediation” is not so much a design method as a design feature, which itself represents a human spirit and will affect the expression of elements in “juxtaposition” and “transposition”. Whether “juxtaposition”, “translation” or “mediation”, in terms of design method or strategy, there is only one purpose, that is, to generate a new, symbiotic and overall logical order of design.

6.2.2 Creative strategies for the renewal of Tonglushan pit

Tonglushan Mountain and the surrounding large and medium-sized deposits form the “Tonglushan Mountain Mining Field” with an area of about 38km^2, which contains more than 65% of the copper reserves in Hubei Province, making it one of the richest copper mining areas in the entire middle and lower reaches of the Yangtze River (Figure 6.17).

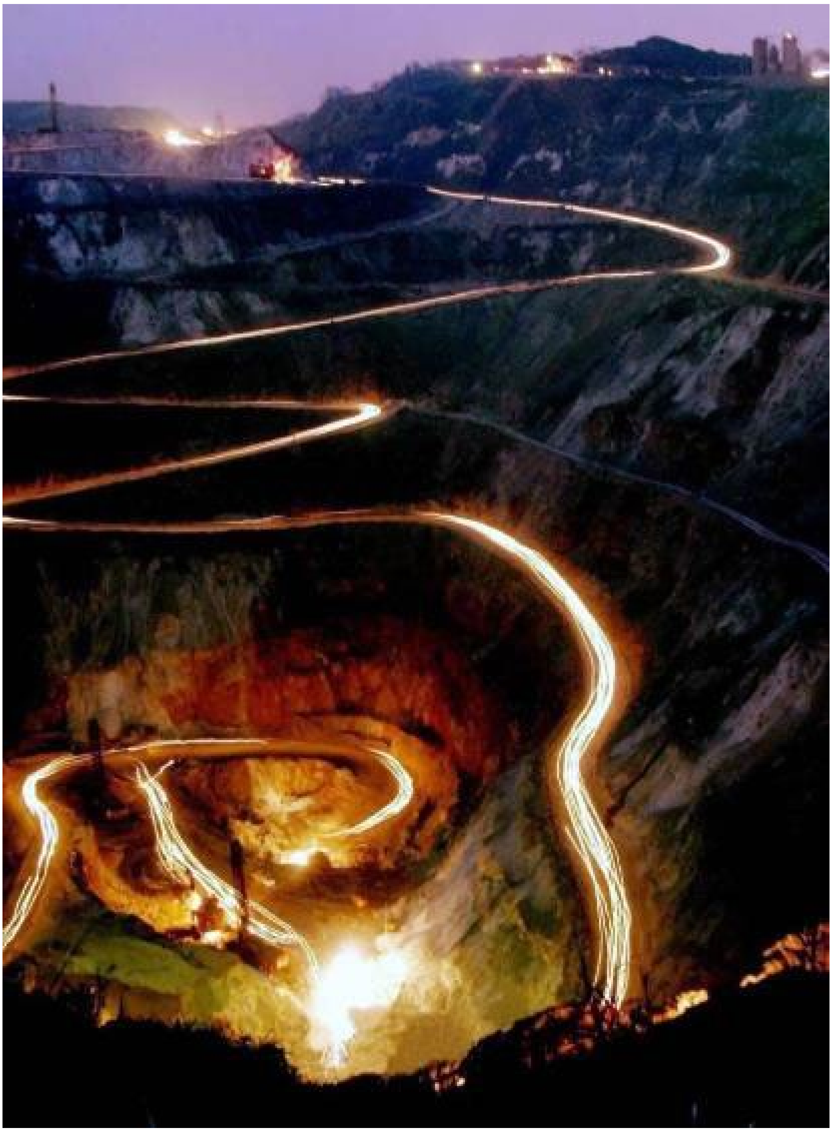

Figure 6.17 Current conditions of the Tonglushan pit
Image Source: Huangshi Industrial Heritage Protection Center.

The core pit of this design has been abandoned. The pit plus the surrounding land area is 0.7km^2, which was historically a 200m high mountain, but has been transposed into a huge pit more than 160m deep due to years of mining. The slopes around the pit are steep, soil runoff is severe, vegetation growth is difficult, and there is a large amount of standing water at the bottom of the pit. The original 2 meters ore haul road remains intact along the pit wall (Figure 6.18).

Figure 6.18 Night mining scene in the former Tonglushan pit
Image Credits: ©Qipeng Liao, 2020.

The hierarchical network of urban industrial land in disuse in Huangshi City provides macroscopic planning requirements for the site where Tonglushan pits are located. Based on this, this study applies three strategies of landscape juxtaposition, landscape transposition, and landscape mediation for the renewal design of the Tonglushan mine pit (Figure 6.19).

Figure 6.19 Floor plan for Tonglushan pit creative design
Image Source: painting by author.

(1) Industrial culture exhibition area design based on landscape juxtaposition

The industrial culture display area mainly adopts the method of landscape juxtaposition. Juxtaposition means that following the principle of reconcilability, the repaired part adopts a different form from the original elements, such as different color, material, texture, etc. Juxtaposition is not a simple extension of the original elements by new elements, but a way of integrating the original connotation and elements, and then improving and optimizing them. Through the conflict generated by the collision of old and new elements, the historical information contained inthe original element is stimulated, forming a multi-level and multi-dimensional aesthetic effect. Juxtaposition uses contrasting techniques to generate conflicts, thus revitalizing theregional cultural information contained in the original elements.

Although the new elements generated by the landscape juxtaposition strategy and the original elements have different attributes and visual differences, they can organically mediate with each other and form a diversified unity. The emergence of new elements has transposed mining land in disuse from a three-dimensional to a four-dimensional spatial object. At the same time, the regional cultural information contained in the land in disuse is stimulated by the new elements, and a harmonious unity is achieved in the midst of elements conflicts. In the design of Tonglushan land in disuse, some mining traces are preserved in the ecological restoration of the rock wall. Newly designed elements such as waterfalls, waterfront walkways, and restored cliff walls form a diversified unity with original elements such as mining traces, allowing visitors to experience the beautiful scenery while at the same time immerse themselves in theformer mining life.

In the industrial culture showcase area, there are a number of places of interest according to the order of the landscape tour, such as the mountain walkway with a number of corner resting platforms, landscape resting galleries, a small station at the mid-mountain, a restaurant at the bottom of the mine, a glass bridge, a small station near the water, mine eaves, a site interactive park, a mine rock exhibition hall, a mine machine site, a long bridge over water, a mountain square, a mid-mountain rock climbing and a mine cave reconstruction Figure 6.20).

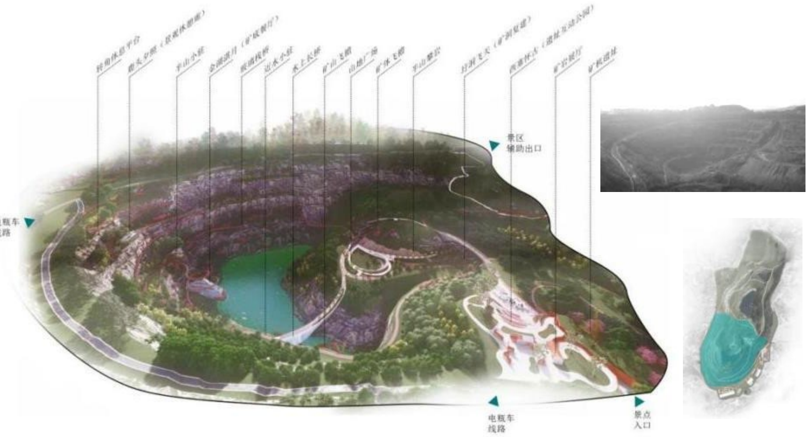

Figure 6.20 General overview of the industrial culture exhibition area
Image Source: painting by author.

On the basis of fully preserving the original pit texture, the landscape facilities are added carefully with small touch. The added landscape facilities form a juxtaposition with the original site's landscape characters. To enhance the experience of tourists, a trestle along the rock wall is designed. The trestle lifts and meanders longitudinally and horizontally with the change of terrain, and a resting platform is set up according to the local terrace (Figure 6.21). Different resting platforms on the corner can view different scenery due to the difference of its spatial orientations. Instead of destroying the landscape of the pit, the overall layout of the pit changes with the topography and strengthens the texture of the pit (Figure 6.22).

Figure 6.21 Resting platform on the corner
Image Source: painting by author.

Figure 6.22 The continuation of the trestle in the linear space of the pit
Image Source: painting by author.

The mountain plaza is constructed on the original platform and serves as the end of the trestle. The mountain plaza is also juxtaposed. With a spiral form echoing the mountain, weathering steel and glass are used as materials to conceal the artificial structure and add a public activity space (Figure 6.23).

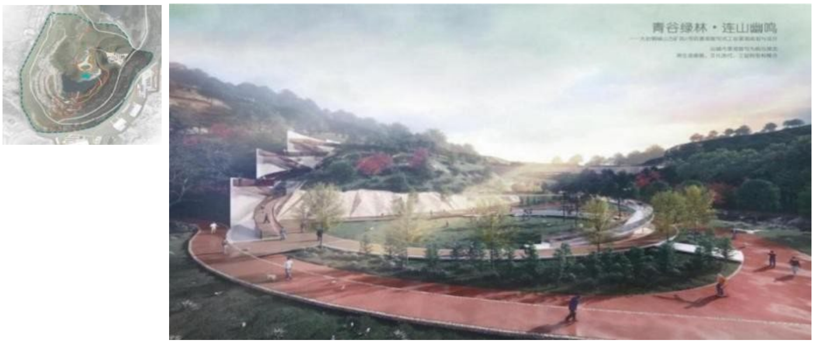

Figure 6.23 the mountain plaza
Image Source: painting by author.

The architectural form of the pit restaurant is designed by blurring the information of the form, structure and skeleton of the surviving production buildings in Tonglushan. The overall structure is still dominated by the metal frame with external pegs, and only the form has been distorted and exaggerated. The pit restaurant is partially embedded in the pit underwater, creating a unique experience for visitors (Figure 6.24).

Figure 6.24 Restaurant in the mine pit
Image Source: painting by author.

A large number of disused facilities such as derricks, rock crushers, and water storage tanks, which have witnessed the mining history, are located in the abandoned area of Tonglushan, and most of them are in a dilapidated condition. However, these disused facilities have certain scientific and recreational values, so they can be restored by juxtaposition and made into landscape installations with industrial landscape characters (6.25).

Figure 6.25 Reuse of industrial facilities on land in disuse
Image Source: painting by author.

The use of discarded steel and masonry from the site to create public art facilities for viewing and interactive play not only preserves the memory of the site but also enhances its vitality (Figure 6.26, Figure 6.27).

Figure 6.26 Public art facilities made from discarded steel
Image Source: painting by author.

Figure 6.27 Public art facilities made from discarded bricks and tiles
Image Source: painting by author.

Observation facilities can also be installed using abandoned mining caves. Constructed by fair-faced concrete, the viewpoint is hidden both in the trees and underwater, providing a rich spatial experience for visitors (Figure 6.28).

Figure 6.28 Viewing facilities
Image Source: painting by author.

The landscape juxtaposition can also be applied to the renovation of the Tonglushan cement plant. The Tonglushan cement plant ceased production in 2005 and most of the area is idle, with six cement silos as its landmarks (Figure 6.29). The cement silos can be converted into cultural and sports activities, including a gymnasium, rock climbing hall, and exhibition hall, and the top floor can be converted into a restaurant, overlooking the entire mining area. Preserving the form and basic structure of the cement silo will add new discourse and reshape new functions, thus juxtaposing the new elements with the original elements (Figure 6.30).

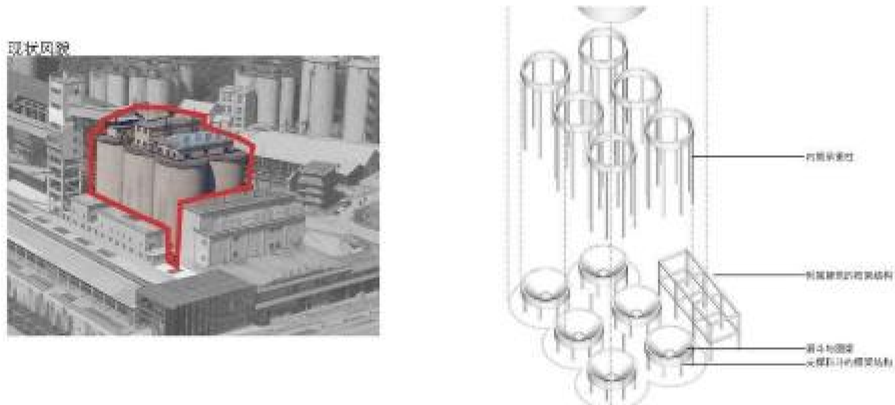

Figure 6.29 Status and internal structure of the silo
Image Source: painting by author.

Figure 6.30 Effect of silo renovation
Image Source: painting by author.

The specific renovation process is illustrated as follows (Figure 6.31): 1) the original building and its structure; 2) open the first floor. The inner cylinder bears the vertical load and the outer cylinder bears only self-weight. When holes are opened on the outer cylinder, they need to be reinforced to reduce the impact on the overall structural stability; 3) increase the horizontal floor slab to improve the efficiency of space use, while adding a ring beam to the inner cylinder to support the horizontal floor slab; 4) insert a spiral walkway. Remove the inner cylinder structure of a cement cylinder and add a new core cylinder as a vertical traffic passage; 5) increase vertical traffic passages to meet the evacuation demand. Demolish the original accessory room and add frame structure outside the cement cylinder; 6) partially open small windows in the outer cylinder to meet the lighting demand. The vertical floor part of the outer barrel will not be opened, and other places will be opened as small as possible, and the border of the hole should be reinforced; 7) remove the top floor of the outer barrel, add a glass outer wall, and use the top floor as a dining space. The inner barrel of the top floor is retained, and the outer barrel is not load-bearing and can be removed; 8) increase the ring beam to facilitate the opening of the skylight, and open the skylight at the top to improve the internal lighting.

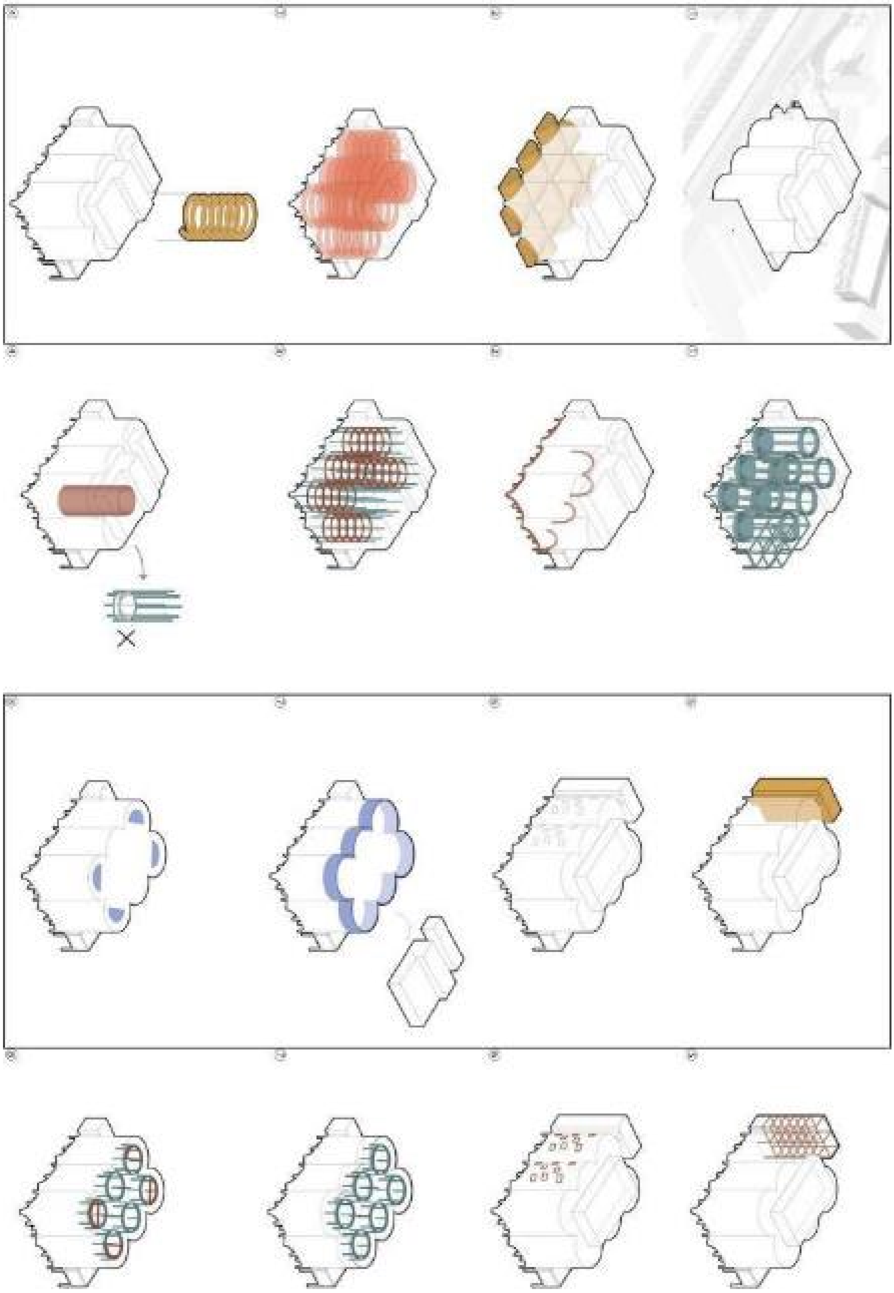

Figure 6.31 Renovation process
Image Source: painting by author.

(2) Scenic service area design based on landscape transposition

If the original landscape is not effective or the pattern is confusing, adding new elements by the method of juxtaposition will magnify the defects, then it is necessary to transpose the original elements and generate a new design logic. transposition is different from the reconstruction. It fully respects the original elements while creating new elements, extracts recognizable characters from regional culture, and applies them to new elements to realize genetic inheritance through transposition.

The current scenic service area is a chaotic and barren slag dump that includes abandoned factories, disused industrial facilities, and water towers. The elements are chaotic and fragmented, making it unsuitable for applying genetic juxtaposition strategies. Therefore, genetic transposition can play an important role in transposing the chaotic site into an orderly and monumental site full of regional characteristics.

When transposing the abandoned plant into a supporting service building, the plant sets up a visitor service center, a comprehensive service hall, a 3D guide hall, a mining and metallurgical production exhibition hall, a rooftop garden, a small tea and beverage station, and another commercial, service and leisure functions. Designing a memorial plaza in the slag dump and building a memorial pavilion and interactive devices for Tonglushan Mining and Metallurgy can make it the entrance marking space of the scenic spot, so that visitors can feel the strong atmosphere of mining and metallurgy when they first enter the scenic spot, and can also overlook the scene of the mine pit from the main road (Figure 6.32).

Figure 6.32 Overview of the scenic service area
Image Source: painting by author.

With inexplicit characteristics and buildings in general quality, the original building should carry out uniform restoration using genetic transposition, transposing the abandoned plant into a mining and metallurgy production exhibition hall. The metal skeleton structure with insulated metal panels and light-transmitting glass is used to extend the interior and improve exterior spaces. The characters of the industrial production material conveyor belt are extracted and transposed into a folded trestle wrapped in metal panels, which are interspersed into the building to create a rich spatial experience. The spatial layout of the original factory square combination arrangement are extracted and applied to the outdoor floor pavement (Figure 6.33)

Figure 6.33 Disused factory building transposed into an exhibition hall for mining and metallurgical production
Image Source: painting by author.

The visitor service center transformed from an abandoned factory also employs a transposition strategy. The main information of the original building form, structure, and frame is retained, and the external skin and internal space are reconstructed. The stacks passing through the building façade, together with the steel mesh curtain wall, will conceal the original chaotic building (Figure 6.34).

Figure 6.34 The visitor service center transformed from an abandoned factory
Image Source: painting by author.

Tonglushan Memorial Square is a typical case of using transposition. The site is located at the entrance of the scenic spot, which is a marking space for the scenic spot and plays an important role in shaping the image of the scenic spot. The site used to be full of waste slag and was a mess. The transposition strategy was adopted to translate it into a mining and metallurgy memorial square. The Tonglushan Memorial Pavilion is the core of the memorial square, and its form is extracted from the factory building structure. The base material of the pavilion comes from the pit rubble, and the metal frame and hollowed-out metal mesh are used to decorate the surface, through which the view of Tonglushan is partly hidden and partly visible, making the memorial square blend in with the surrounding environment (Figure 6.35).

Figure 6.35 Tonglushan Mining and Metallurgy Memorial Square and Memorial Pavilion
Image Source: painting by author.

The design of the memorial square fully respects the site's original characters, that a tract of waste slag is preserved, on which landscape interactive devices on the abandoned slag. The structure of the interactive devices echoes the memorial pavilion. It used a hollow metal reflector as the material of the surface to contrast with the waste slag, expressing the concept that the ore from Tonglushan has finally become the modern urban building material. The landscape interactive device starts from the same axis as the memorial pavilion, implying the metaphor of time and space (Figure 6.36).

Figure 6.36 The landscape interactive memorial device in mining and metallurgy
Image Source: painting by author.

There is an abandoned water tower located at the high point of the site, which can also become the material for transposition. The metal staircase of the surface of the water tower is preserved and renewed, and a hollow metal core structure with a wavy cross-section is newly added through the tower, which can make a wind sound when blowing, reminiscent of the roar of machines during mining. The staircase provides access to the top of the tower, from which one can overlook the view of the mine (Figure 6.37).

Figure 6.37 Transposition design of the abandoned water tower
Image Source: painting by author.

(3) Overall design of the mine pit based on landscape mediation

Landscape mediation is a strategy to coordinate the symbiosis of the internal and external environment of the site. Tonglushan pit is an integral part of the regional geographic environment and culture, representing a relationship between the part and the whole. Therefore, the internal and external environments of the pit should be coordinated comprehensively, and the internal and external conflicts and the logical structure of the internal and external environments of the site should be coordinated through the mediation design so that the pit and the surrounding environment can be symbiotic as an organic whole (Figure 6.38).

Figure 6.38 Comparison of Tonglushan mine pit before and after transformation
Image Source: painting by author.

The internal and external environment of the site was comprehensively analyzed, and based on the protection of the host elements of the site, the environmental landscape characters, such as the spatial layout, topographic features, vegetation, and so on, and the paths, such as production lines, transportation channels, and site texture and so on, are overall controlled, in-situ retained and partly transformed. It forms a symbiotic relationship with the land in disuse of Tonglushan and the surrounding environment. The mine pit scenic area is divided into six functional areas (Figure 6.39), which are: 1) the scenic service area transformed from the abandoned factory on the southeast side; 2) the interactive landscape area of mining and metallurgical culture renewed from the industrial buildings on the south side; 3) the ecological conservation landscape area composed of garden landscape areas; 4) the rock wall landscape area with obvious geomorphological and geological characteristics of the mine pit, mainly composed of the ecological restoration area; 5) the industrial culture display area coupled by the core area of landscape characters and part of ecological restoration area; 6) waterfront leisure landscape area coupled by the main part of the regulation area of original landscape elements and the waterfront landscape area.

Figure 6.39 Functional zoning of the mine pit scenic area
Image Source: painting by author.

Based on the multi-level protective planning strategy of the landscape characters of the Tonglushan industrial land in disuse, the potential of the current space of the mine pit was explored. According to the requirements of landscape ecological zoning and the level of original landscape characters, different degrees of conversion and differential renewal of functions andstructures were programmed. Tourism and spatial narrative routes were also planned according to the original landform andextraction and transportation paths of the site (Figure 6.40).

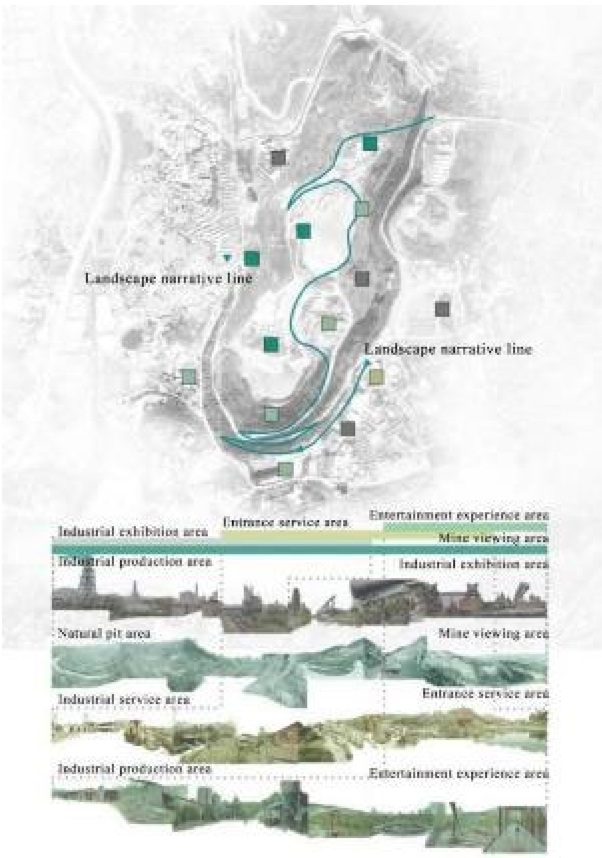

Figure 6.40 The space potential of the site landscape and the narrative routes Image Source: painting by author.

6.2.3 Creative strategies for the Hanyeping Railway renewal

The urban section of the Hanyeping Railway in Huangshi is abandoned (Figure 6.41). There are many residents around but a lack of space for activities and leisure, showing the problems of lack of culture, incomplete landscape facilities, and unused land in disuse (Figure 6.42). Taking the continuation of the industrial culture as the premise and renewing the design guided by those problems, link the renewed railroad space with the surrounding urban space, thus improving the chaotic traffic organization, increasing the utilization rate of the site, increasing the green space area, meet the daily needs of the residents in the surrounding communities, and restores the vitality of the urban center.

Figure 6.41 Collage of the current situation of the urban section of the Hanyeping Railway
Image Source: painting by author.

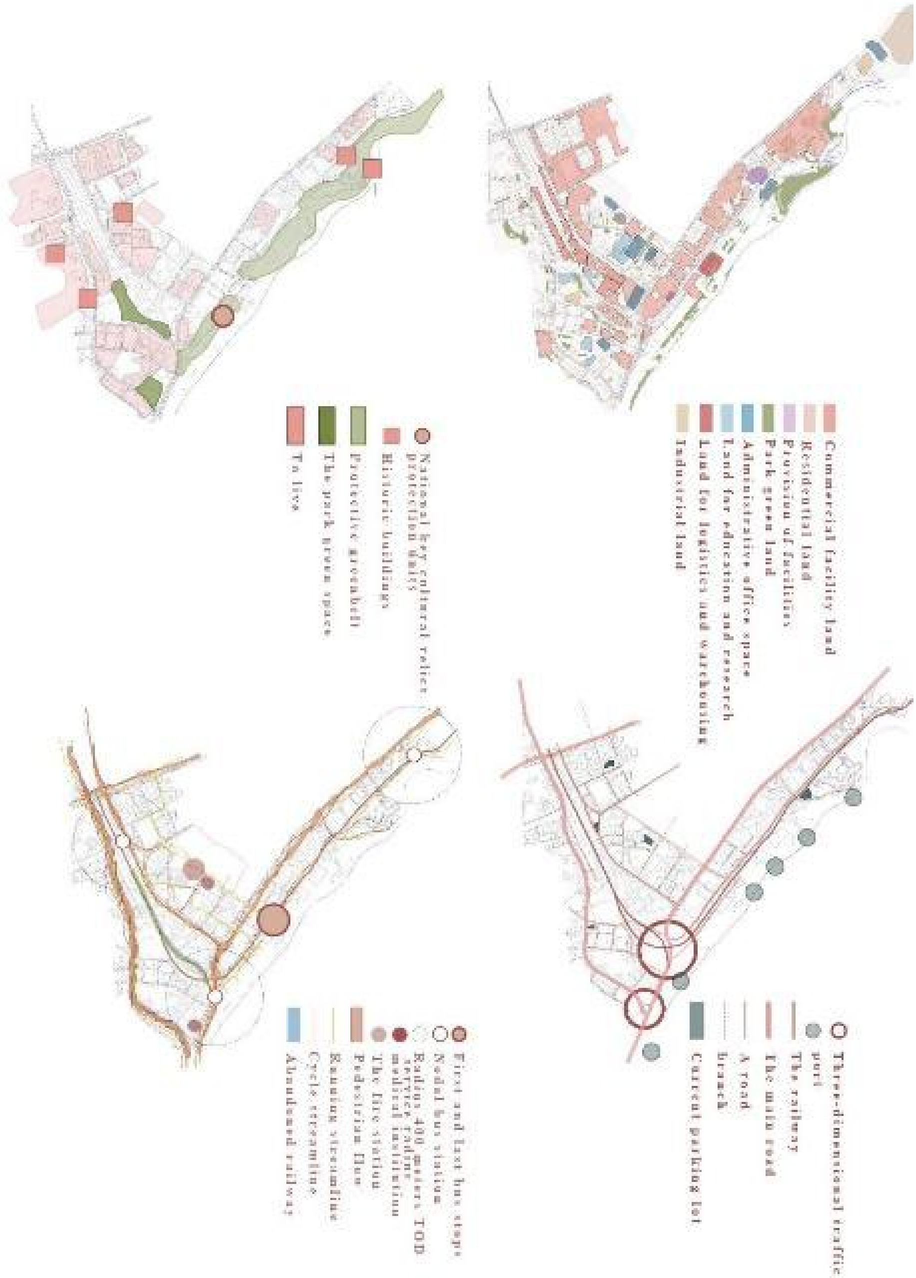

Figure 6.42 Analysis of the current situation of the urban section of the Hanyeping Railway
Image Source: painting by author.

(1) The landscape character juxtaposition of old and new fusion

Due to the termination of railroad transportation, the once prosperous area around the railroad gradually decayed and became an urban low-income class residential area with poor environmental quality and insufficient public space and supporting facilities. Due to the incompletion of the road system, the abandoned railroad became a substitute for pedestrian paths (Figure 6.43).

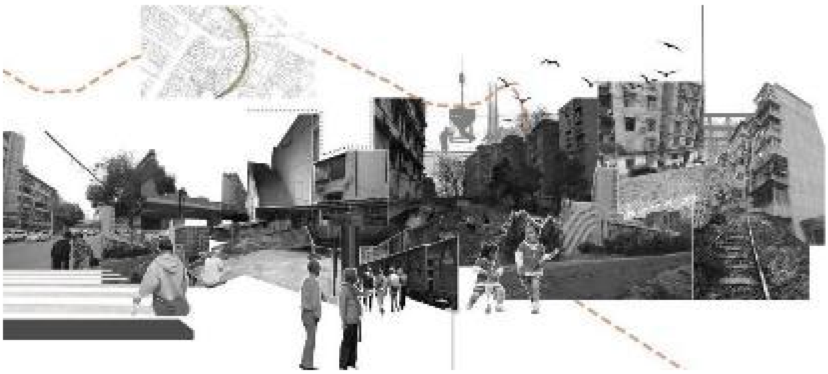

Figure 6.43 Environmental condition of the urban section of the Hanyeping Railway
Image Source: painting by author.

In the renewal plan, the original railroad is preserved and transformed into a linear open space and pedestrian corridor through the urban area. The newly added facilities and the original site characters are organically integrated, which not only shows the industrial characteristics but also integrates the new urban functions (Figure 6.44).

Figure 6.44 Design plan of the urban section of the Hanyeping Railway
Image Source: painting by author.

The design intention of the overpass crossing the railway line comes from the image of the swallow in Huangshi's industrial-themed ballad, recalling the once-thriving industrial scene (Figure 6.45). Linking the fragmented sites through the overpass creates convenient pedestrian access and a rich spatial experience. The overpass is sited in the corridor of the city, and people can stand on the bridge deck to overlook the city landscape. The material used for the bridge is weather-resistant steel, which fits the industrial style of the original site while creating a juxtaposition of old and new fusion at the same time, and a new landscape was created (Figure 6.46).

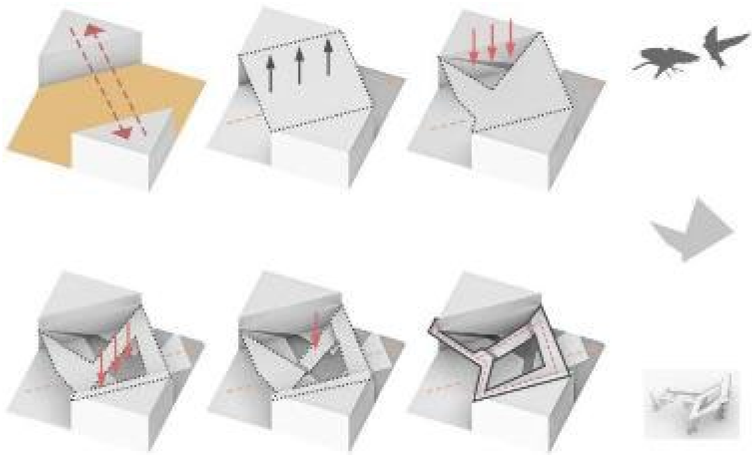

Figure 6.45 Generation of the design intention of the overpass
Image Source: painting by author.

Figure 6.46 Effect of the design of the overpass
Image Source: painting by author.

Figure 6.47 Artistic regeneration of abandoned industrial components
Image Source: painting by author.

(2) Landscape transposition integrating industrial features and multifunctional needs

Most of the current Hanyeping railroad has been abandoned, and part of it passes through the central city of Huangshi, cutting the traffic network of the city, affecting the travel of residents in the surrounding communities, and reducing the quality of the social environment. Using the method of transposition, the abandoned railroad space can be transformed into a multifunctional space that meets the functional needs of the city. At the same time, the original site's landscape characters are inherited to play the role of landscape cha chain, so that the regenerated abandoned Hanyeping railroad space can become a corridor linking the industrial land in disuse heritage of Huangshi city.

Through landscape transposition, the heritage resources along the Hanyeping railroad line are systematically sorted, protected, and revitalized, turning the original abandoned space into a corridor displaying the industrial heritage. In addition, the Hanyeping Railway line can also be turned into a slow passage linking the communities. The urban section of the Hanyeping Railway is relatively gentle and is well suited to be transformed into a roaming trail to meet the needs of citizens for walking, jogging, and cycling activities (Figure 6.48). The space that blocks community connections is turned into a link between communities and a space for public community activities.

Figure 6.48 Transformation effect of the abandoned railway line
Image Source: painting by author.

By preserving and reusing historical relics, abandoned facilities, etc., seats and other landscape facilities for rest are added, and urban public spaces with industrial symbols and historical memories are created to meet the multi-functional and multi-level needs of people in the surrounding area (Figure 6.49).

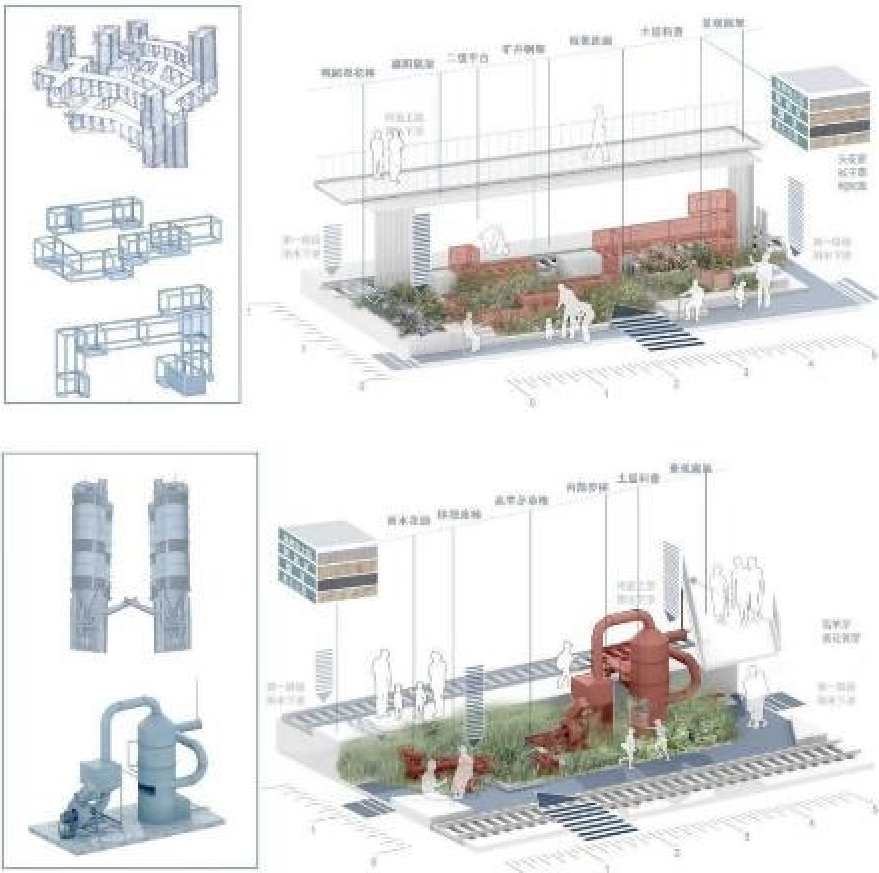

Figure 6.49 Transformation of abandoned facilities into public spaces
Image Source: painting by author.

To recreate a vibrant community life, the original vegetation was retained during the transformation process and matched with native plants. At the same time, herbs, vegetables, and flowers were planted to increase the interaction between residents and the land. At the square and grassland slope, plants serve to enclose the space, dispel the coldness of steel and concrete, and reconstruct the relationship between people and nature (Figure 6.50).

Figure 6.50 Plant landscape after transformation
Image Source: painting by author.

(3) Landscape character mediation integrated into urban space

While the “juxtaposition” and “transposition” mentioned above are for the level of internal environment, “mediation” is mainly used to solve the problem of coordinating the outward-oriented space and its environment. It coordinates the relationship between the site and urban functions and constructs a symbiotic relationship between the space of Hanyeping railroad space and its surrounding space. The curved “greenway” is introduced as the “reposition” of the site, organizing various elements in the core section, to form a symbiotic relationship between the site and the city. The greenway has the linear spatial properties of a corridor and the function of transportation. The curvedgreenway weaves through the middle of the site, forming an urban green vein. Planar urban green spaces are attached to it and appear alternately at the interface between the site and the city, allowing the green corridors connecting both sides of the core section to be unblocked and shared by the citizens of the city.

Under the ordinary circumstances, the transformation of abandoned railroads adopts the method of integrating "scenery" and "view", that is, the abandoned railroads are directly preserved and transformed into artificial trails, and the railways themselves being both the "scenic spot" and the "viewing" routes. However, due to the narrow space in the north and south of the core section, if we continue to adopt this traditional transformation method of integrating "scenery" and "view" and retain the straight-line railroad crossing, it will inevitably form a narrow and fragmented plot, with the middle greenway landscape interspersed by buildings on both sides, which is not easy to form a continuous urban open space. The curved greenway that abandoned the traditional straight form maximizes the effective contact between the greenway space and the city while integrating the site, and thus become the best way to integrate into the citizens' life (Figure 6.51).

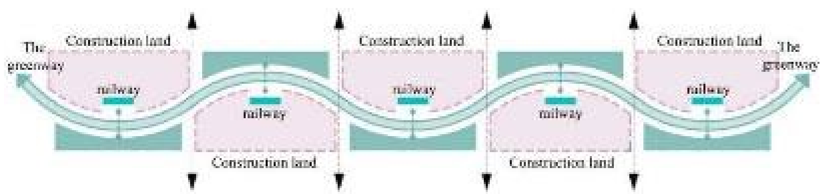

Figure 6.51 Mediation of abandoned railroads and urban space
Image Source: painting by author.

As a "reposition", the greenway reorganizes various elements of the core section by "abandoning the traditional straight form to taking the curved form" and separating the "scenery" and "view", and builds a new mediation space. First of all, this mediation has symbolic significance. The straight railroad is a symbol of high-speed industrialization, while the curved greenway embodies a low-carbon, harmonious, healthy, and romantic way of “slow life”. Similar to the concept of “between two lines” in the design of the Jewish Museum in Berlin, one is a straight line interrupted to form a scattered landscape point, serves as a hidden reminder of the historical memory of the railroad culture of Hanyeping; the other is a soothing curve, symbolizing the modern “slow life”, remind people to slow down to experience a happy life. Secondly, this mediation reflects the economic and social benefits. The curved greenway not only provides healthy leisure and tourism space for citizens and tourists but also has huge economic and social benefits in itself. At the same time, the greenway provides business opportunities for the surrounding plots and enhances their land value. It makes the greenway transformed from the abandoned railroad become a carrier to activate the urban space, which realizes the mediation between the railroad and the city.

Conclusion

1. Characteristics of mining cities and industrial land in disuse in China

Based on the history of the development of Chinese mining cities, this study proposes two main development patterns of Chinese mining cities: “mining first and then city” and “city first and then mining”. The spatial structure is characterized by loose structure, staggered urban-rural distribution and confusing functional zoning. The type of spatial structure is divided into multi-town type, multi-center scattered type and centralized distribution type. The main reasons for industrial land in disuse are: the decline of leading industries, the transfer of industrial enterprises, and the use of backward resource production technology and methods.

2. Theoretical framework construction for landscape characters

Landscape characters have spatial-cultural dual-system pairing characteristics: on the one hand, spatial characters are the characteristic landscape paradigm inherited and layered in the material space level, affecting the external form of the landscape; on the other hand, cultural characters are the typical value beliefs condensed and nurtured in the regional culture level, showing the inner meaning of the landscape. Both of them carry and transmit the genetic information of landscape development and derivation. Based on the characters of landscape, the principles of “base pairing” and “DNA sequence combination” of character storage and transmission, the epistemology of typology and interpretive anthropology and the methodology of design language and semiotics, a theoretical framework of landscape characters with landscape character structure system and landscape character atlas as the core has been constructed.

3. Applying landscape character theory to perceive industrial land in disuse

Industrial production activities with production function-oriented goals and logic give birth to industrial land in disuse. Therefore, industrial land in disuse has a spatial structure oriented to the production function, expresses the architectural characteristics and technology of the time, and shows the activities based on the material carrier and the culture and spirit under the time and space. These characters are highly consistent with the “space-culture” dual-system pairing characteristics in landscape characters. To comprehensively identify and systematically grasp the elements and characteristics of industrial land in disuse from both “space-culture” aspects of landscape characters is the basis for its conservation and utilization.

4. Application of landscape character theory to protect and utilize industrial land in disuse

The landscape character theory is applied to establish the “meta-piece-chain-domain” landscape character structure system at the macro level, which can efficiently analyze the characteristics and laws of the industrial land in disuse cluster. Based on this structure system, the coupling model of mining city space, industrial land in disuse cluster and green space can be established to support the transformation of the mining city, the shaping of urban characteristics, and the construction of a high-quality human living environment. The application of landscape character theory can support the conservation of authenticity and integrity, benign recombination and functional grafting of industrial waste landscape characters by mapping the landscape character atlas of industrial land in disuse at the micro level.

Prospect

1. Provide reference and guidance for designers with landscape character theory

One of the important epistemological foundations of this research is interpretive anthropology. Interpretive anthropology emphasizes an analysis-oriented rather than a therapeutic or corrective epistemology, in other words, interpretation is already its ultimate purpose, so to understand meaning is sufficient after the thick description and finding a suitable cognitive approach. However, as a theory of design discipline, this study, after spending a lot of time on the initial construction of the theoretical framework of landscape characters, needs to guide future research. The application part only proposes three creative strategies for benign reorganization and functional grafting of landscape characters, which is not solid enough. The focus in the future is to further study the design method of industrial land in disuse renewal based on landscape character theory.

2. In-depth analysis of more complex mining cities with landscape character theory

Due to time and energy constraints, this study only analyzes in depth the representative mining city of Huangshi, in China. This is a city born out of mining, with its production flow line preserved intact and its development lineage clear, which is very suitable for the interpretation and thick description of the landscape character theory. However, only taking this city as an example is not yet convincing enough in terms of the general applicability of the theory and the guidance to the real problems in China. Therefore, in the next step, the author hopes to apply the landscape character theory to analyze more mining cities, such as Xuzhou (a coal-based city that transformed the coal mining collapse area into Panan Lake Wetland Park), Shenyang, Fushun and Changchun (representative cities of the old industrial base in northeast China), and Panzhihua (an iron ore-based city in southwest China). It is also possible to verify the applicability of landscape character theory by analyzing representative international mining cities.

3. Landscape character bank project for industrial land in disuse

Drawing on the concept of "biological gene bank" and referring to the “Human Genome Project” and "Material Genome Project" which have been flourishing in recent years, the author proposes to carry out the “Landscape Character Bank for Industrial land in disuse Project”. The main goals and direction of the Landscape Character Bank are to establish an influential and credible public service platform for landscape characters, integrate spatial samples of mining city characteristics, digitally store and manage landscape character resources and landscape character analysis results of China's unique industrial lands in disuse, and provide basic information services for China's urban spatial research and urban planning and design. Based on the Landscape Character Bank for Industrial Land in Disuse Project, extensive international research and cultural exchange can be carried out, which will eventually promote the technical progress of the industry and maintain national spatial and cultural security.

In conclusion, theoretical construction and case analysis are mutually reinforcing, and there is still a lot of work to be done in the future to apply landscape character theory to further analyze more complex industrial lands in disuse.

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Figure 5.11 Regular plane building with a small span
Left(1):Rotary kiln head Middle. (2):Rotary kiln tail Right. (3): New process packaging workshop. Left(4):Storage Room. Middle(5): Grinding head bin. Right(6): Drying workshop Left(7):Roughgrinding workshop. Middle(8):Fine grinding workshop. Right(9):New fine grinding workshop. Left(10):Transfer building.
Middle(11):Quality building. Right(12):Complex building.
Left(13):Warehouse. Middle(14):Ancillary buildings.
Right(15):Ancillary buildings.
Image Credits: Qipeng Liao, 2020.

Figure 5.12 irregular plane buildings with small span

Left(1): No.2 cement silo. Right(2): No.3 cement silo. Left(3): water tower. Right(4): Large industrial funnel. Left(5): Large industrial

funnel. Right(6): Railway bulk station
Image Credits: Qipeng Liao, 2020.

Figure 5.13 regular plane buildings with large span

Left:Joint torage 1. Middle:Joint storage 2. Right:Automobile bulk station. Image Credits: ©Qipeng Liao, 2020.

Figure 5.14 irregular buildings with large span.

Image Credits: ©Qipeng Liao, 2020.

Figure 5.14 irregular buildings with large span

Left(1):No.1 cement silo. Right(2):Dry slag silo. Left(3):Six barrel cement silo. Right(4)Clinker silo. Left(5):Slurry storage tank
Image Credits: ©Qipeng Liao, 2020.

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Tables:

Annex

Appendix: Extraction of Landscape Character in Tonglushan Mining area

category	large class	Middle class	Small class	Extract content	Information coding
Major construction structures and facilities 01	General content 1	0	Structure 1	Reinforced concrete body	0110101
				Reinforced concrete virtual body	0110102
				Metal frame and metal hanging plate	0110103
				Underground reinforced concrete	0110104
				Metal truss	0110105
				Concrete inlaid structure	0110106
				Metal frame structures	0110107
				Metal mechanical construction	0110108
		0	Form 2	Solid column building	0110201
				Three-dimensional hammer column building	0110202
				The body building	0110203
				Gentle slope square building on both sides	0110204
				Square trough bucket equipment	0110205
				Transportation pipeline	0110206
				Reduced volume device	0110207
				Irregular cave	0110208
				Arch body piercing	0110209

				Cylindrical circular crisscross	0110210
				Bilateral slope top equipment	0110211
				Slope top multi-body splicing	0110212
				Flat top L-shaped square	0110213
		0	Group 3	Building package	0110301
				Architectural nesting	0110302
				Internal placement	0110303
				Mountain nesting	0110304
				Device nesting	0110305
				Building package	0110306
		0	Layout 4	The buildings are arranged in line	0110401
				Building forward dispersion	0110402
				Equipment interleaving	0110403
				Device array	0110404
				Underground longitudinal deep well	0110405
		0	Color texture 4	White concrete wall	0110501
				Imitation stone concrete wall	0110502
				Black insulated roof	0110503
				Blue metal roof	0110504
				Grey concrete	0110505
				Even a small window	0110602
				The blue line edge	0110603
				Transverse stripe window	0110604
				Vertical pinstripe window	0110605
	Historical content 2	The ancient 1	structure 1	Underground cavern wood frame is solid	0121101

			Underground square-pond civil burial chamber	0121102
		form 2	Modular frame flat layer	0121201
			Square section ore channel	0121202
			The underground cave	0121203
			The furnace	0121204
			Calcination kiln	0121205
			No Guo coffin	0121206
		combination 3	Hand tools	0121301
			Frame set	0121302
			Independent placement	0121303
			Inlay placement	0121304
		layout 4	Mountain mining, mountain dressing	0121401
			Shaft positioning	0121402
			adit	0121403
			Along the long side of the terrain	0121404
			North and south Wells are arranged	0121405
		Color quality of a material 5	Yellow rock cave	0121501
		decoration 6	Birds and beasts is grain	0121502
			Myth brick grain	0121503
			Bronze, bronze tripod, chisel, ring, hook and other bronze ware	0121504
			Jade Ring and other white jade stone tools	0121505
			Stone niche, anvil, hammer and other stone tools	0121506
		structure 1	Frame red brick building surface	0125101

	Sino-soviet hybrid 5		Red brick walls with metal frames	0125102
			Concrete inlaid structure	0125103
			Metal truss	0125104
			Reinforced concrete construction	0125105
		form 2	The fireplace chimneys	0125201
			Bidirectional steep slope square building with long eaves	0125202
			Continuous bidirectional steep slope with long eaves square building	0125203
			Bidirectional steep slope long eaves gabled square building	0125204
			Flat top italic straight italic square	0125205
			Reinforced concrete diagonal conveyor belt	0125206
			Red brick concrete diagonal conveyor belt	0125207
			Cylindrical circular interleaved body	0125208
		Group 3	Built-in facilities	0125301
			Facilities are nested	0125302
		The layout of 4	The buildings are arranged one word at a time	0125401
			Along the long side of the terrain queue	0125402
		Color texture 5	Orange rough surface, black tile roof	0125501
			Gray framework	0125502
			Gray mottled cement surface	0125503
			Brown mottled metal equipment	0125504

				Rough red brick	0125505
			Decorative 6	Frames highlight finishes	0125601
				Metal frame strut	0125602
				Metal frame beam-column construction	0125603
				Angle columns protrude from the side roof	0125604
				Small rounded window to side	0125605
				Tic-tac-toe window	0125606
				Mixed column type	0125607
				Moire window on the stairwell	0125608
				Gable top ornamentation protrudes	0125609
				Center type permeable brick flower	0125610
			Plane 7	Bilateral continuous square module	0126701
				Aisle free continuous square module	0126702
				The main module is connected to the partition wall	0126703
				Connect the whole plane	0126704
		late last century6	Structure of 1	Reinforced concrete	0126101
				Masonry beam frame structure	0126102
				Metal frame construction	0126103
				Metal truss hanging plate	0126104
			Form 2	The square building connects to the portico	0126201
				Gentle slope square building on both sides	0126202
				Long eaves with gentle slopes on both sides	0126203

		Long eaves with unequal gentle slopes on both sides	0126204
		Both sides of the steep slope square building on stilts	0126205
		Flat - roofed square building with protruding stairwell	0126206
		Long eaves with unequal gentle slope on both sides,	0126207
		A square metal frame is connected to a cylindrical device	0126208
		Cylindrical bucket device	0126209
		Folded truss network	0126210
		Frame metal plate oblique conveyor belt	0126211
	Group 3	Built-in facilities	0126301
		Building a nested	0126302
	The layout of 4	Along the long side of the terrain queue	0126401
		North and south Wells are arranged	0126402
	Color texture 5	Grey cement fine surface	0126501
		Orange brick rough surface	0126502
		Black tile roof	0126503
		Red tile roof	0126504
		Gray cement sand	0126505
		Yellow gray concrete surface	0126506
		Brown mottled metal equipment	0126507
		Blue rust metal rough surface	0126508
	Decor-ation 6	Continuous mesh arrangement rhombic transparent window sashes	0126601
		Oblique leaf transparent window	0126602

			Folding fence	0126603
			Crisscross fence	0126604
			Truss cross	0126605
			Metal checkered chequer	0126606
		Plane 7	Unit 4-family suite on the first floor	0126701
			Unit type two family suite on the first floor	0126702
			The corridor is centered and the rooms are set separately	0126703
			Unicom whole floor plan	0126704
			Main module connected to local partition wall	0126705
	No obvious features 7	Struct-ure 1	Masonry sink	0127101
			Concrete slope retaining wall	0127102
			Metal truss nozzle network	0127103
		Form 2	Arc structure along pit texture	0127201
			Horizontal and vertical staggered broken line	0127202
		Color texture 5	Yellow mottled concrete rough surface	0127501
			Orange broken brick surface	0127502
			Mottled metal pipe network	0127503
	Village houses 8	Struct-ure 1	Masonry beam wood structure	0128101
			Cement beam column structure	0128102
		Form 2	Traditional single storey folk houses in Southeast Hubei	0128201
			Traditional double-layer folk houses in Southeastern Hubei	0128202

		Folk houses with double deck balcony in Southeast Hubei	0128203
		Asymmetric folk house with balcony in Southeast Hubei	0128204
		Folk houses with non cantilevered semi open corridors in steep slopes on both sides	0128205
		Continuous slope roof connected with gable ancestral hall	0128206
		Continuous rolling shed roof connected with gable ancestral hall	0128207
		Cross ridge roof decoration front face continuous slope roof ancestral hall	0128208
	Layout 4	Strip column along contour	0128401
		Vertical contour line arrangement	0128402
		Column along path	0128403
		Vertical path direction column	0128404
		Column horizontal central layout	0128405
		Spindle center type	0128406
		Square Center	0128407
	Decoration 6	Cascading along the Angle	0128601
		Moire ridge.	0128602
		Cascading the roof	0128603
		Center type permeable window grilles	0128604
		Pisces permeable fence carving	0128605
		Double happiness permeable fence carving	0128606

				Wall painting of flowers and birds	0128607
				Wall small window	0128608
				Building patio	0128609
				Symmetrical door pier on the side	0128610
				Stone door frame, door head	0128611
			The plane 7	Concave plane	0128701
				Continuous progressive plane space	0128702
				Clan hierarchy layout	0128703
				The front hall carries a stage, the atrium is open, and the back hall is progressive	0128704
				The atrium is a single floor with two wings containing two floors	0128705
Site environment gene 02	The body area 1	Terrain space 2	0	Three bowls of flat land subsidence in succession	0212001
				Three pit mouth from south to north step - like space	0212002
				Mining scattered mound platform	0212003
				The tailings yard is intestinal mottled	0212004
				Narrow folk mining collapse zone	0212005
				Ancient ore hills spread over the hill platform	0212006
				Up the gentle slope of the hill	0212007
				Build platform plan on sloping land	0212008
				Built around a hill	0212009
				Along the main road	0212010
		Landscape performance 3	0	Mining yellow rock wall earth and stone	0213001
				Ore mining silty rock wall	0213002

				Drainage yellow gravel land	0213003
				Landslide collapse body	0213004
				Tailings yellow powder clay texture layer	0213005
				Weathered walls of ancient ore bodies	0213006
				Ancient weathered pits	0213007
		Green environment 4	0	Mining south pit covered with green	0214001
				Three bowl pit bowl along the green cover	0214002
				The ancient mine is surrounded by woodland	0214003
				Building green	0214004
				Door before the farmland	0214005
				Building green space	0214006
				Courtyard greening	0214007
				Mining north pit soil cover green	0214008
		Texture lines 5	0	The mining pit is broken and flexible	0215001
				Mining pits soften the cliffs	0215002
				Corrugated hillock terrace edge	0215003
				Plaque fields	0215004
				Echelon terraces	0215005
		Unit elements 7	0	Copper sucks	0217001
				Embalmed grass	0217002
				Duck plantar grass	0217003
				Malachite	0217004
				Wire the rock	0217005
	The surrounding	Place function 1	0	Mining southeast for the mining production belt	0221001

	environment 2			The mining plant is adjacent to the pelletizing plant in the southwest, the pit in the west, and the tailings field in the east.	0221002
		Terrain space 2	0	The terrain is not undulating, small hills scattered around	0222001
				The ancient mine remains are surrounded by woodland	0222002
		Green environment 4	0	Farmland around, part of the formation of mountain terraces	0224001
				Shelterbelt is set up along the hills in the northwest and north	0224002
				The tailings are surrounded by farmland and woodland	0224003
				Surrounded by farmland	0224004
				Surrounding farmland	0224005
				The hills are half forest and half field	0224006
				High in terrace	0224007
				Shelter forest land	0224008
		Landscape pattern 6	0	Tailings east daye Lake artificial diversion	0226001
				Pillow mountain surface water	0226002
				Xiangyang	0226003
	In the overall 3	Terrain space 2	0	Terrain area flat, local hilly forest, mine for valley	0232001
		Landscape performance 3	0	The north is unstable or collapsed area and the central mine is naked soil rock	0233001

		Green environment 4	0	The overall proportion of green space is high, most of the area is farmland	0234001
		Texture lines 5	0	Twig texture around two necklaces	0235001
		Landscape pattern 6	0	Longjiao Mountain in the south, daqingshan in the west, daye Lake artificial drainage section in the east, sanli seven lake city green lung in the north	0236001
Layout of the gene 03	Unit layout 1	Spatial pattern of 1	0	Mining on the ancient mine, the foot of the mountain, the bottom of the mountain tomb, adjacent to the water smelting	0311001
				Open pit mining lays out production lines around the pit and along the railway	0311002
				Vertical distribution of ore fragmentation and ore separation in underground mining	0311003
				Open pit mining production line	0312004
				Mining plant production line	0312005
				Ironmaking production line	0312006
				Steel production line	0312007
		Node distribution 3	0	Ancient copper pit group	0313001
				Sifangtang site group	0313002
				Ancient smelting site	0313003
				Open pit mining crusher	0313004
				Open pit mining crushing machinery	0313005
				Beneficiation system	0313006

			Ground mining main lifting system	0313007
			Auxiliary lifting of ground production mixed well	0313008
			Filtration system	0313009
			Distribution station	0313010
			Sedimentation tank	0313011
			Thickener	0313012
			Mine bottom sewage tank	0313013
			Bottom return tank	0313014
			Artificial outer lake water supply pool	0313015
			External caisson	0313016
			Pillow mountain surface water	0313017
			Village entrance - circular pool	0313018
			Village entrance - square pool	0313019
			Community entrance - Market	0313020
			Community food market	0313021
			Entrance central axis - ancestral hall	0313022
			Central axis of pool - ancestral hall	0313023
			Path spindle - ancestral hall	0313024
			Village open space - earth Temple	0313025
			Spindle path - Community Service	0313026
			Village tail highland - granary	0313027
	Path channel 5	0	Circling down the ore gravel road relying on the platform	0315001
			Staggered transport belt path	0315002
			Production channel	0315003

				Original waterway output channel	0315004
				Leading roads and streets for daily life	0315005
				Dendritic	0315006
				herringbone	0315007
				Sichuan zigzag	0315008
				No clear path (dislocation alley)	0315009
	Overall layout 2	Spatial pattern 1	0	Distribution of modern production space along the railway line	0321001
				Form nested relationship with surrounding natural villages	0321002
				Distributed from east to west along the railway	0321003
				Above the copper and iron veins	0326003
Latent gene 04	Science and technology 1	Industrial Technology 1	0	The age of ore prospecting technology is advanced	0411001
				Advanced guidance of mineral processing technology	0411002
				Water supply balance and water treatment technology	0411003
		Production process 2	0	16 national patents	0412001
				Five scientific research projects	0412002
				Ancient copper mining smelting technology representative	0412003
				Composite technology of ground production and well extraction	0412004

				Multistage water transfer treatment process	0412005
				Power supply processing technology	0412006
		Important technolog y node 3	0	Mineral processing production line	0413001
				To the main shaft	0413002
				Ground production mixed well	0413003
				Ancient mining boom overall	0413004
				Pit drainage network	0413005
				Horizontal reservoir	0413006
				Pump room equipment	0413007
				Pellet solidification production equipment	0413008
				Ironmaking process	0413009
	Humanitie s 2	Spiritual belief 1	0	Clan relatives	0413001
				The Taoist inaction	0413002
				Buddhism to	0413003
				The metaphysics of feng shui	0413004
				Labor to get rich	0413005
				Red faith	0413006
		Cultural Customs 2	0	System culture of safety, manpower and equipment management	0422001
				Annual employee training	0422002
				Annual propaganda of culture and education	0422003
				Mining and metallurgy theme debate, poetry collection	0422004
				Labor model and recognition conference	0422005

			Copper Lushan Mining and Metallurgy TV station	0422006
			Xinxiu Cup and other sports league activities	0422007
			Mining and metallurgy large Spring Festival get-together	0422008
			Ancestor worship	0422009
			Worship the god of kitchen	0422010
			Land and water can	0422011
			The earth temple	0422012
			Crying marriage	0422013
			Pick up the panners	0422014
			Wash the same	0422015
	Public Life 3	0	The field production	0423001
			Sinking water	0423002
			Manual darning	0423003
			Manual darning	0423003
			Community construction	0423004
			The community party	0423005
			Reading books to study	0423006
			Added renovation	0423007
			Chisel to grow	0423008
	ideology 4	0	Work spirit	0424001
			Pioneer culture	0424002
			Innovation and creation culture	
			Safety and risk culture	
			Mining changes your fate	
	Craft art 5	0	Mining and metallurgy "Copper Soul" large-scale song and dance drama	

llaneous art	0424003
	0424004
	0424005
	0425001
	0425002

category	Categories	minor defects	subclass	Pen and ink style Extract the contents	0425003 Information coding
Building structures and facilities 01	General content 1	0	structure 1	Reinforced concrete body	0110101
				Reinforced concrete virtual body	0110102
				Metal frame is connected with metal hanging plate	0110103
				Underground drilling reinforced concrete frame	0110104
				Metal truss	0110105
				Concrete inlaid structure	0110106
				Roofed metal frame structures	0110107
				Metal mechanical construction	0110108
		0	form 2	Column building	0110201
				Column hammer building	0110202
				Square building connecting frame bottom	0110203