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Research on Spatial Morphological Characteristics and Influencing Factors of Industrial Heritage: A Case Study of Nine Industrial Heritages in Guizhou Province

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Abstract: Industrial heritage, recognized as a significant aspect of historical and cultural heritage, has garnered considerable attention from scholars globally. To elucidate the spatial morphological characteristics and the underlying influencing factors of industrial heritage within karst regions, this study employs methods such as the interstice index, fractal dimension analysis, and spatial syntax. It conducts research on the spatial morphological characteristics of nine typical industrial heritages in Guizhou Province. The primary factors contributing to the variations in layout forms are the intricate karst topography and the functional requirements of production. The functional zoning of industrial heritage aligns with its layout, characterized by straightforward functional zones that have not developed into composite spaces. The overall connectivity of industrial heritage is relatively low, exhibiting weak integration, significant disparities in control values, low average depth values, and a deficiency in comprehensibility and diversity of options. This indicates that the internal connectivity of industrial heritage spaces is generally inadequate, with low accessibility, strong interrelations, average convenience, limited connectivity, and generally acceptable passage. The overall spatial, architectural, and roadway configurations of industrial heritage predominantly exhibit a uniform pattern. Importantly, industrial heritage reveals a highly variable overall spatial form, with an average fractal dimension of 1.57, complex architectural layouts (average fractal dimension of 1.50), and simplistic road network designs (average fractal dimension of 1.43), which collectively suggest high spatial complexity and irregular characteristics. This study can provide a reference for the analysis of spatial characteristics and influencing factors of other material cultural heritages, and it is of great significance for the systematic protection and revitalization of industrial heritage.

Keywords: industrial heritage; spatial structural characteristics; influencing factors; cultural heritage conservation; Guizhou Province

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1. Introduction

Cultural heritage encompasses both the tangible and intangible cultural wealth that has been created and preserved by a nation, region, or society over the course of history [1]. In contrast, industrial heritage pertains to the diverse material and immaterial assets that have emerged from the processes of industrial production and management. Industrial heritage functions as a testament to industrial civilization and serves as a vehicle for industrial culture, embodying historical, social, technological, economic, and aesthetic values [2]. As an important part of historical and cultural heritage, the characteristics and protection of industrial heritage have attracted the attention of scholars around the world [3]. Internationally, the study of industrial heritage has long been valued and initiated early, with the British scholar Donald Duddie proposing "industrial archaeology" in the 1960s as the starting point for formal research in this field; the existing research

outcomes are abundant [4]. China began its research and conservation efforts on industrial heritage relatively late, starting with the Constitutional document "Wuxi Recommendations" issued by the National Cultural Heritage Administration in 2006 [5]. However, the demand for the preservation and utilization of industrial heritage in China is substantial. Currently, there are 347 national-level industrial heritage sites, and the number of provincial-level sites has seen a significant increase [6]. The protection and utilization of industrial heritage have emerged as critical initiatives for the preservation of Chinese cultural identity and the advancement of tourism [7]. Currently, domestic and international research on industrial heritage primarily focuses on heritage value [8], conservation and utilization [9], tourism development [10], value assessment [11], distribution characteristics, and influencing factors [12,13]. However, studies specifically analyzing spatial structural characteristics of a particular type of industrial heritage are rare, and they mainly focus on the protection and restoration of a specific building or several buildings [14,15]. Existing research mostly remains qualitative, lacking detailed and systematic analyses combining qualitative and quantitative methods to examine the spatial structural characteristics of industrial heritage [16–24]. The spatial differentiation of industrial heritage reflects the social background, cultural characteristics, and industrial features of the time. Existing research often takes a macroscopic view in studying the spatial distribution and stylistic features of industrial heritage, while a microscopic perspective is often confined to the renovation and adaptive reuse of the internal spatial functions of specific industrial buildings. This limitation is particularly evident in karst regions, which are generally unsuitable for industrial development. The intricate karst topography results in high infrastructure costs, which frequently give rise to more complex political and social demands regarding large-scale industrial development. Furthermore, the historical connotations and cultural characteristics of these areas are notably intricate. In contrast to the "sprawling" layout patterns typical of conventional industrial complexes, industrial heritage sites located in karst regions demonstrate significant differences in terms of location, form, and layout. Existing research has seldom concentrated on the entirety of industrial heritage settlements, thereby complicating the analysis of their settlement distribution and the presentation and utilization of the spatial features of industrial heritage. Therefore, this study selects nine typical industrial heritage sites in the karst region of Guizhou to conduct an analysis of their spatial structural characteristics. The aim is to provide insights into the conservation and utilization of industrial heritage.

2. Materials and Methods

2.1. Research Object

The subject of this study is the industrial heritage of Guizhou Province. This includes the entire factory area space, various buildings and ancillary structures, bridges, roads, and other related facilities that constitute the material spatial remnants [25]. Guizhou Province is located in the southwestern inland region of China and serves as a transportation hub in the southwestern region. It is an important part of the Yangtze River Economic Belt and a significant distribution area for China's industrial heritage in the context of defense preparedness [26]. Guizhou Province is the only region in China without plains; the karst landform brings rich and unique topography and natural landscapes, and the construction of architectural settlements is also very characteristic of a mountain city (see Figure 1). Zunyi City, Bijie City, and Liupanshui City are areas in Guizhou where a substantial amount of industrial heritage remains preserved relatively intact [27]. Based on principles of typology, authenticity and scale identify industrial heritage sites in Guizhou that are well-preserved, possess a certain scale, and hold considerable historical and social significance. Taking into account the impact of various industrial types, the research encompasses the primary industrial sectors in Guizhou, including coal mining, machinery, defense, and chemical industries. Ultimately, nine industrial heritage sites located in Zunyi, Bijie, and Liupanshui are selected for an analysis of their spatial morphological and structural

characteristics (see Figure 2). The specific overview of the research subjects is detailed in Table 1.



(**a**) (**b**) (**c**)

Figure 1. A partial map of the current status of the industrial heritage of this study. (**a**) Industrial Chimney; (**b**) Cave Workshop; (**c**) Production Workshop.

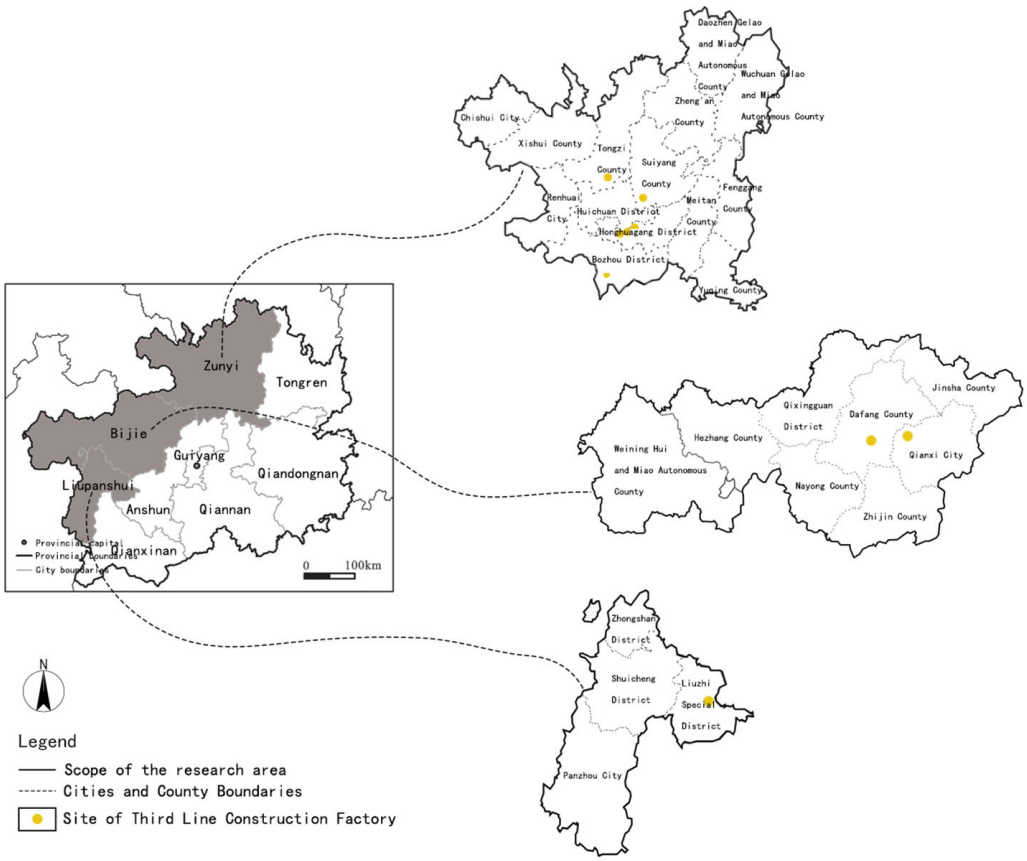


Figure 2. Demonstration of Research Scope.

Table 1. Study Subjects Overview.

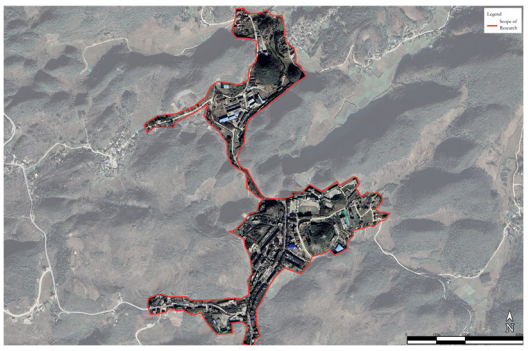
Name	Introduction
The Liuzhi Dizong Mine (hereinafter referred to as Liuzhi Mine) 	The Liuzhi Dizong Mine is located in Liuzhi Special District, Liupanshui City, Guizhou Province, China. Established in the 1960s, the mine was primarily developed to meet national defense and economic development needs. At its peak, the mine ranked among the largest in the country, equipped with advanced production facilities and comprehensive supporting infrastructure. These locations are presently acknowledged as national-level industrial heritage sites in China that are associated with mineral resources.
The former site of the "First Aviation Engine Factory of the Chinese Air Force Aviation Committee" (hereinafter referred to as the Aviation Site) 	The former site of the "First Aviation Engine Factory of the Chinese Air Force Aviation Committee" is located in Yangchang Village, Yangchang Town, Dafang County, Bijie Prefecture, Guizhou Province, China. It has witnessed the development of China's aviation industry. Established in 1939, the site covers an area of approximately 2 square kilometers. These sites are extensive in scale, exhibit functional diversity, and are well-preserved, thereby representing a significant aspect of industrial heritage within the aviation sector of Guizhou Province.
The former site of Qianxi Honglin Machinery Factory (hereinafter referred to as Qianxi Machinery Factory) 	The former site of Qianxi Honglin Machinery Factory is located in Honglin Yi and Miao Ethnic Township, Qianxi County, Guizhou Province, China. Established in 1968, the factory was a significant engineering project of its time in China, specializing in the production of agricultural machinery and other industrial equipment. It played a crucial role in China's economic development and contributed actively to the advancement of modern agriculture. These sites represent significant industrial relics associated with machinery in Guizhou Province.
The Wujiang Power Plant (hereinafter referred to as Wujiang Plant) 	The Wujiang Power Plant is located in Zunyi City, Guizhou Province, China. Established in the 1970s, this site represents the first large-scale hydropower plant constructed in the karst regions of China and has historically served as a significant representative of China's electric power industry. The facilities are relatively well-developed. The commissioning of the Wujiang Power Plant greatly improved the electricity supply in Guizhou Province. It is a representative of Guizhou's power generation industrial heritage.

Table 1. *Cont.*

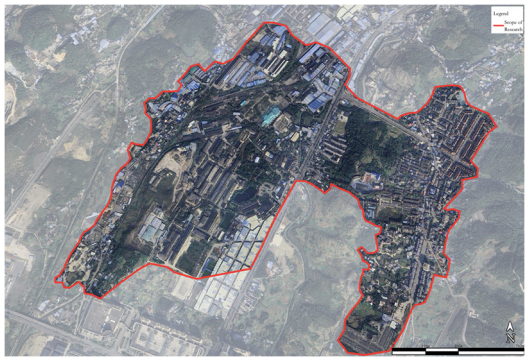
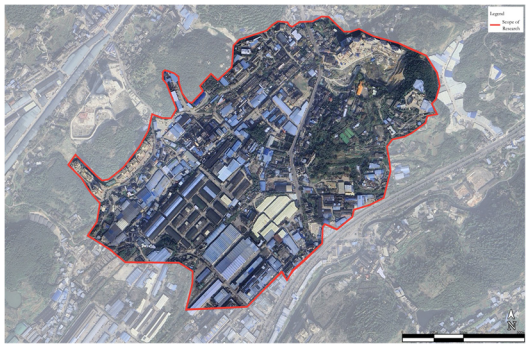
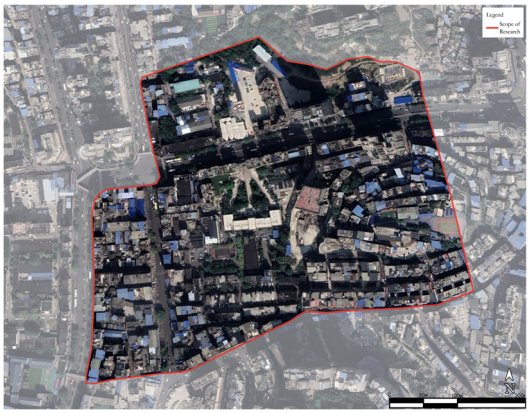
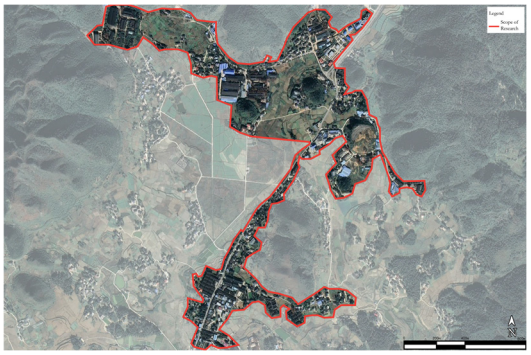
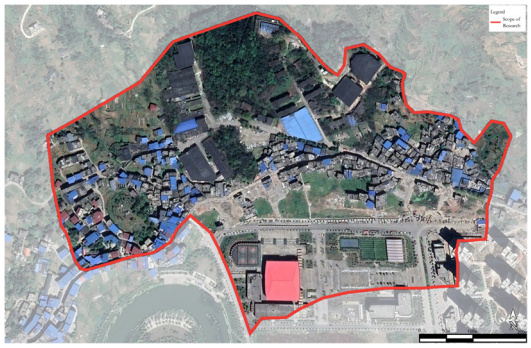
Name	Introduction
The former site of Zunyi Titanium Plant (hereinafter referred to as Zunyi Titanium Factory) 	The former site of Zunyi Titanium Plant (hereinafter referred to as Zunyi Titanium Plant) is located in Zunyi City, Guizhou Province, China. Established in 1965, it primarily produced titanium and titanium alloy products, making significant contributions to China's aerospace, aviation, chemical, and medical industries. The former site of the Zunyi Titanium Plant encompasses a substantial area featuring well-preserved and fully operational facilities. Historically, it was a leader in production processes and technological advancements in China, serving as a quintessential example of Guizhou's metallurgical industrial heritage.
The former site of Zunyi Alkali Factory (hereinafter referred to as Zunyi Alkali Factory) 	The former site of Zunyi Alkali Factory (hereinafter referred to as Zunyi Alkali Factory) is located in Zunyi City, Guizhou Province, China, and stands as an important industrial heritage from China's Construction period. Established in 1966, the Zunyi Alkali Factory primarily produced soda ash and other chemical products, making significant contributions to China's chemical industry. The site covers a vast area, including production workshops, office buildings, dormitories, and other facilities. The production processes and technologies employed in this context exemplify advanced craftsmanship and represent a significant aspect of the industrial heritage of Guizhou's chemical industry.
The former site of the Headquarters Building of Zunyi 061 Base (hereinafter referred to as 061 Headquarters) 	The former site of the Headquarters Building of Zunyi 061 Base (hereinafter referred to as 061 Headquarters) is located in Zunyi City, Guizhou Province, China. It covers a large area, including office buildings, laboratories, dormitories, and other facilities within the factory area. Inside the buildings were advanced research and production facilities, making it a significant research and development base in China's aerospace, aviation, and electronics sectors. Currently the factory area currently preserves numerous historical sites and serves as a significant heritage site for China's national defense technology industry in Guizhou.

Table 1. *Cont.*

Name	Introduction
The former site of the 531 Factory at Zunyi 061 Base in Suiyang County (hereinafter referred to as 061-531 Factory) 	The former site of the 531 Factory at Zunyi 061 Base in Suiyang County, Zunyi City, Guizhou Province, China, was an important industrial project during China's Construction period. Established in 1969, the 531 Factory primarily produced specialized equipment and products for aerospace, aviation, electronics, and other fields, making significant contributions to China's defense science and technology sector. The factory complex covers a large area, including production workshops, office buildings, dormitories, and other facilities. The site is a significant heritage location pertaining to China's national defense technology industry, situated in Guizhou.
The former site of the 3651 Factory at Tongzi 061 Base (hereinafter referred to as 061-3651 Factory) 	The former site of the 3651 Factory at Tongzi 061 Base (hereinafter referred to as 061-3651 Factory) is located at Fu Jialong Cave, Guandu Village, Loushanguan Street, Tongzi County, Guizhou Province. The factory complex covers an area of approximately 200,000 square meters, consisting primarily of production workshops, office buildings, dormitories, and other facilities. The 061-3651 Factory specializes in producing equipment and products for aerospace, aviation, electronics, and other fields, making significant contributions to China's defense science and technology sector.

2.2. Research Method

The spatial form serves as a reflection of the organizational structure of industrial heritage shaped by human activities, thereby indirectly illuminating the spatial development patterns and historical evolution trajectories of physical spaces [28,29]. Consequently, this study utilizes indices such as the gap degree index [30], fractal dimension [31], and spatial syntax [32] to investigate the spatial form characteristics of the three-line industrial heritage.

2.2.1. Interstice Index

The void ratio in spatial structures is primarily employed to quantify the proportion of voids within the subject of study. This metric can be utilized to investigate the spatial distribution of industrial heritage, assessing whether the relationships are concentrated, random, or uniform [33].

$$N(r) = (M - r + 1)^2 \tag{1}$$

In the above formula, M represents the boundary length of the landscape map. Converting the frequency distribution $n(S,r)$ into a probability distribution $Q(S,r)$ [30]:

$$Q(S,r) = \frac{n(S,r)}{N(r)} \tag{2}$$

The mean square and variance of $Q(S,r)$ are as follows:

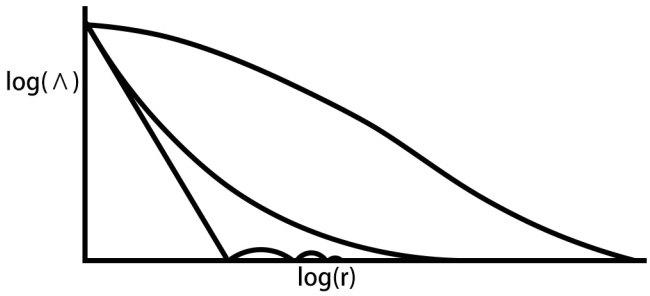
$$Z^{(1)} = \sum SQ(S,r) = S(r) \tag{3}$$

$$Z^{(2)} = \sum S^2Q(S,r) = S_s^2(r) + S^2(r) \tag{4}$$

Mandelbrot defines the interstice index as follows:

$$\wedge(r) = \frac{Z^{(2)}}{(Z^{(1)})^2} = \frac{S_s^2(r)}{S^2(r)} + 1 \quad (5)$$

Based on the above formulas, a set of data for the research object at different scales within unit 1 can be obtained. If the scale is the same (r is constant), $\wedge(r)$ larger indicates higher clustering (Contagion) of the research object, and vice versa [30]. By varying the scale r within the unit 1 grid for the same research object, a series of interstice index values varying with scale can be obtained, allowing analysis of scale effects (Scale effect) (Figure 3).



The upper line represents clustered objects, the middle line represents random objects, and the lower line represents uniformly spaced objects.

Figure 3. Function Plot of Interstice Data and Sliding Window Size.

2.2.2. Fractal Dimension

The fractal dimension can be used to compare the spatial forms of industrial heritage, analyzing the complexities or simplicities of their spatial distributions. Fractal dimension is introduced by Mandelbrot to provide a more precise description of complex spatial forms, based on the principle that natural forms exhibit self-similarity. The accuracy of describing form with fractal dimension is measured by the gaps left or densities within a unit area. A smaller gap or higher density indicates higher descriptive accuracy [33]. Let F be a bounded set of points on a plane. It is always possible to find a rectangle that contains F, which can be divided into several small squares of side length r. The number of these small squares occupied by F is denoted as $N(r)$.

The value $\boldsymbol{Dc(F)}$ below 1.5 suggests that the spatial plane of the research object is simple and dispersed in distribution. Values of $\boldsymbol{Dc(F)}$ above 1.5 indicate that the spatial plane of the research object is complex and clustered in distribution.

$$\boldsymbol{D_C(F) = \lim_{n \to \theta} \frac{lnN(\varepsilon)}{ln(1/\varepsilon)}} \quad (6)$$

2.2.3. Spatial Syntax

Spatial syntax is a series of theories and techniques concerning the relationship between space and society, with the fundamental concept being space [34]. It is a spatial pattern language that describes basic geometric relationships such as segmentation, representation, and connectivity of various elements within space. By dividing space into scales and segments, it describes the relationships of topology, geometry, and actual distances between spaces, revealing their complex internal structures [35,36]. This study employs spatial syntax to elucidate the connectivity, accessibility, relationality, convenience, continuity, and permeability of the internal spaces within industrial heritage. It encompasses a comprehensive analysis utilizing specific metrics, including connectivity, global integration, control values, average depth, intelligibility, and choice.

(1) Connectivity

$$Ci = K \quad (7)$$

K represents the number of nodes directly connected to node i. In actual spatial systems, a higher connectivity of a space indicates better permeability, with more direct connections to many other spaces [37].

(2) Global integration

$$Ii = \frac{n-2}{2(MD_i - 1)} \tag{8}$$

n is the total number of nodes (axis lines) in the network; MDi is the mean depth value, representing the overall spatial properties of a specific area, reflecting its accessibility. A higher spatial integration indicates greater accessibility [37].

(3) Control value

$$Ctrl = \sum_{1}^{n} \frac{1}{C_i} \tag{9}$$

Ci is the connectivity of road i; it reflects the control value of a space over the spaces intersecting with it, indicating the capability of one space to influence its neighboring spaces [28].

(4) Average depth value

$$MD = \frac{D_i}{n-1} \tag{10}$$

Di is the global depth value, n is the total number of nodes in the network (number of axes), and MD is a relative measure of depth; the higher the value, the lower the convenience of the spatial node [37]. The depth value represents the shortest distance between the spatial units, which expresses the accessibility of the node in the topographical sense, i.e., convenience.

(5) Comprehensibility

Comprehensibility represents the perception of the overall structural characteristics from the structural characteristics at the local spatial level, indicating the degree of correlation between local and global aspects. If a spatial system has high connectivity, its comprehensibility is high, indicating the greater the correlation between the part and the whole. Comprehensibility can be measured using r, with the criteria as follows:

$$r \begin{cases} < 0.5 & \text{Moderate comprehensibility} \\ 0.5 \le r \le 0.7 & \text{Above-average comprehensibility} \\ \ge 0.7 & \text{Excellent comprehensibility} \end{cases} \tag{11}$$

The calculation formula is as follows:

$$r = \frac{\left[\sum\left(I_{(3)} - I\cdot_{(3)}\left(I_{(n)}I\cdot_{(n)}\right)\right)\right]}{\sum\left(I_{(3)} - I\cdot_{(3)}\right)^2 \sum\left(I_{(n)} - I\cdot_{(n)}\right)^2} \tag{12}$$

In the equation, $I_{(3)}$ represents the global integration value at step $n = 3$, $I\cdot_{(3)}$ represents the average integration value of three parts, $I_{(n)}$ represents the global integration value, and $I\cdot_{(n)}$ represents the average global integration value.

(6) Choice centrality

Choice centrality refers to the frequency with which a particular area in urban space serves as the shortest topological distance between two nodes. It examines the advantage of spatial units in providing the shortest path for travel, reflecting the likelihood of spatial traversal. The choice centrality represents the probability or number of occurrences of the shortest path of a street, which can be regarded as the probability of being "passed" [38],

and the higher the selectivity, the better the location and traffic conditions of the street in the industrial heritage area. Typically, areas with higher choice degrees can attract more pedestrian or vehicular traffic, indicating a greater likelihood of being traversed. Studying the choice centrality of urban space can reveal the economic value it holds. The calculation formula is as follows:

$$X = \frac{log_2 \left\lfloor \frac{1}{(a-)(a-2)} \sum_{i=1}^{a} \sum_{j=1}^{a} \sigma(i,x,y) + 1 \right\rfloor}{log_2[\sum_{i=1}^{a} d(x,i) + 3]} \quad (13)$$

In the formula, X represents the choice centrality value, where $i \neq x \neq j$. $d(x, i)$ denotes the shortest distance from x to j in the axial graph, and $\sigma(i, x, y)$ represents the shortest topological path in the axial space from x to j.

3. Results and Analysis

3.1. Characteristics of Industrial Heritage Site Selection in Guizhou

3.1.1. Site Selection Characteristics

According to Table 2, the site selection for industrial heritage spaces in Guizhou can be categorized into four types: concealed, comprehensive, convenient, and resource-based. The main reasons for these site selection differences are the demands of strategic policies in the context of defense preparedness and constraints imposed by the terrain. The 061-531 Factory, 061-3651 Factory, and 061 Headquarters fall under concealed site selection, driven by the need for secure production and convenient traffic flow. The Aviation Site and Qianxi Machinery Factory belong to comprehensive site selection, chosen for their abundant production resources and convenient transportation. Zunyi Alkali Factory and Zunyi Titanium Factory are categorized under convenient site selection, benefiting from proximity to production resources and advantageous geographical conditions for external transportation. Liuzhi Mine and Wujiang Plant are classified as resource-based site selection, catering to energy-oriented industrial sectors by fully utilizing and developing local resources.

Table 2. Characteristics of Site Selection for Industrial Heritage Spaces.

Site Selection Characteristics	The Name of Industrial Heritage
Concealed Site Selection	061-531 Factory, 061-3651 Factory, 061 Headquarters
Comprehensive Site Selection	Aviation Site, Qianxi Machinery Factory
Convenient Site Selection	Zunyi Alkali Factory, Zunyi Titanium Factory
Resource-based Site Selection	Liuzhi Mine, Wujiang Plant

3.1.2. Layout Characteristics

According to Table 3, the settlement layout of third-line industrial heritage sites in Guizhou can be categorized into four types: centralized, radial, series-parallel, and separated. The comparison in Table 2 reveals that there is no direct correlation between site selection types and the layout patterns of industrial heritage. The complex karst topography and production functional requirements are the main reasons for the differences in layout forms. For instance, the layout of the Zunyi Alkali Factory and 061 Headquarters is centralized and characterized by high efficiency and density. The production areas of the Aviation Site and 061-531 Factory adopt a radial layout, where production extends from a core factory area outward, resulting in some waste of production resources and time. The Wujiang Plant, 061-3651 Factory, and Liuzhi Mine exhibit a series-parallel layout, where factory spaces are arranged according to functional circulation lines, presenting a distributed and coordinated production characteristic reflecting the strategic thinking of dispersed production and collaborative operations in the context of war preparation at that time. The 061-531 Factory, Qianxi Machinery Factory, and Zunyi Titanium Factory feature a separate layout, interconnected through transportation networks between factory

areas, which partially meets defense requirements and reduces the impact of terrain on industrial production.

Table 3. Layout Characteristics of Third-line Industrial Heritage Settlements in Guizhou.

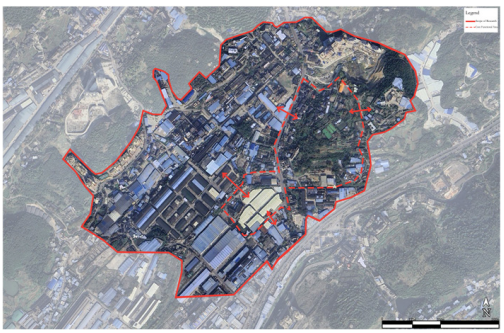
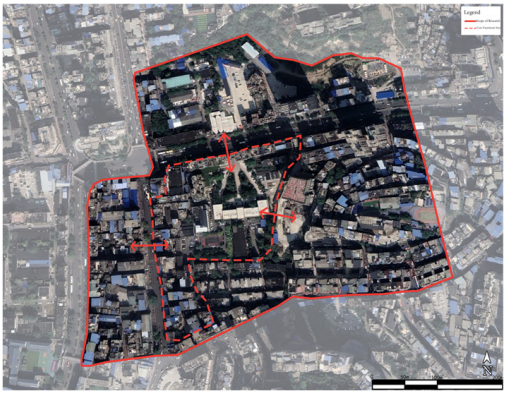
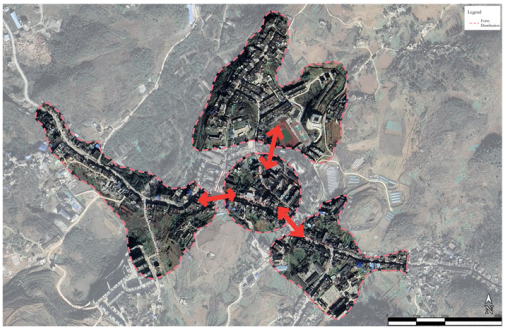
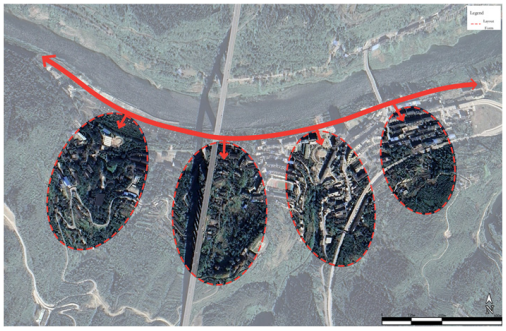
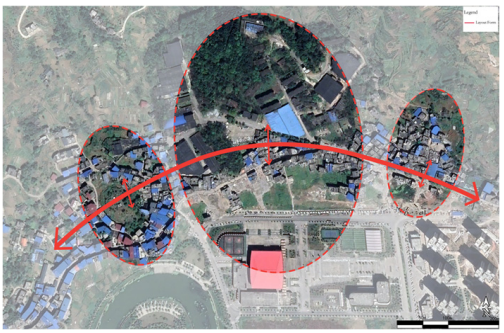
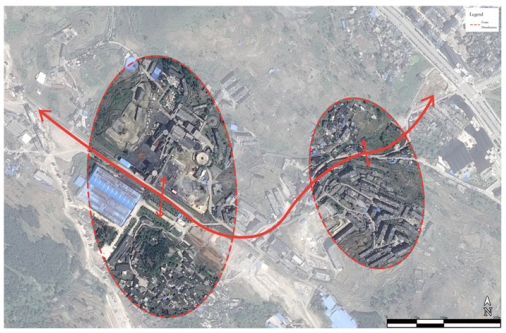
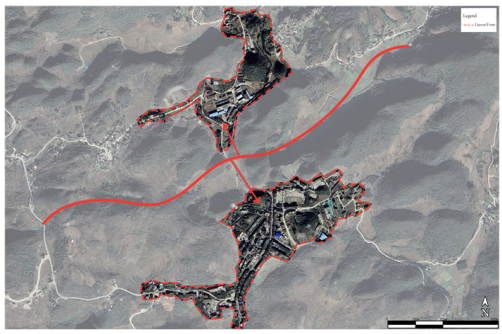
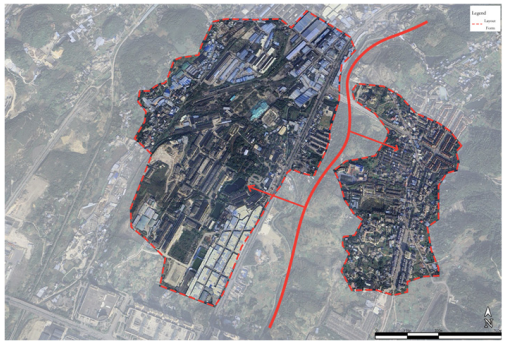
Layout Form Characteristics	The Name of Industrial Heritage	Layout Form Diagram
Centralized type	Zunyi Alkali Factory	
	061 Headquarters	
Radial type	Aviation Site	
	061-531 Factory	

Table 3. *Cont.*

Layout Form Characteristics	The Name of Industrial Heritage	Layout Form Diagram
Series-parallel type	Wujiang Plant	
	061-3651 Factory	
	Liuzhi Mine	
Separated type	Qianxi Machinery Factory	
	Zunyi Titanium Factory	

3.1.3. Functional Form Characteristics

According to Table 4, the industrial heritage of Guizhou can be categorized into production zones, residential zones, and public zones based on their functional divisions. As illustrated in Comparison Table 3, the functional zoning of industrial heritage aligns with its spatial arrangement; the functional divisions are straightforward and have not developed into composite spaces. The functional forms include separated, centralized, and serial-linked types. The separated types include the 061-531 Factory, Qianxi Machinery Factory, and Zunyi Titanium Factory, where the spatial layout of factory areas exhibits a certain degree of fragmentation and separation. The centralized type includes Zunyi Alkali Factory, Aviation Site, and 061 Headquarters, characterized by relatively flat and spacious construction areas where functional zones are often clustered and centralized. The serial-linked type includes Liuzhi Mine, Wujiang Plant, and 061-3651 Factory, where the layout of functional zones within the factory areas shows a linear distribution trend.

Table 4. Functional Form Characteristics of Sampled Industrial Heritage Sites.

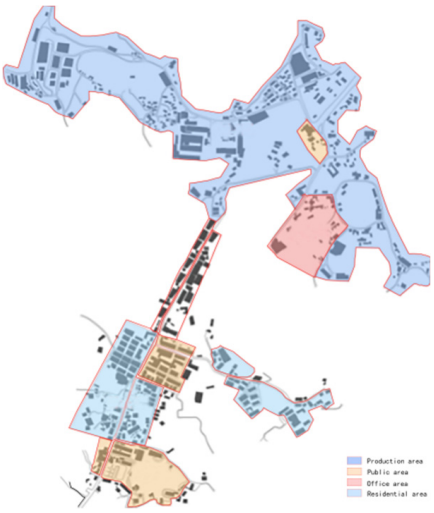
Functional Form Characteristics	The Name of Industrial Heritage	Functional Form Diagram
Separated type	061-531 Factory	
	Qianxi Machinery Factory	

Table 4. *Cont.*

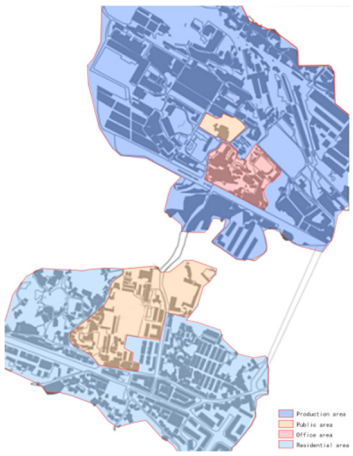
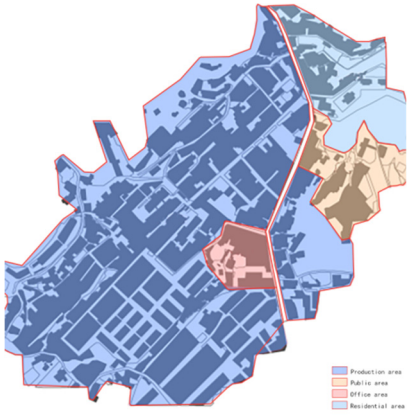
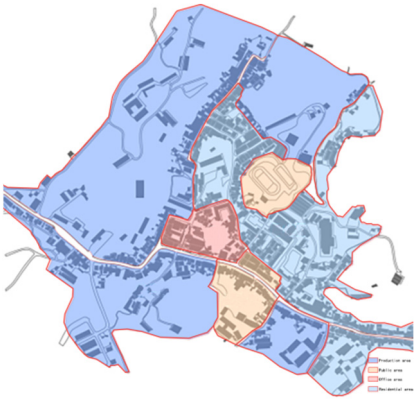
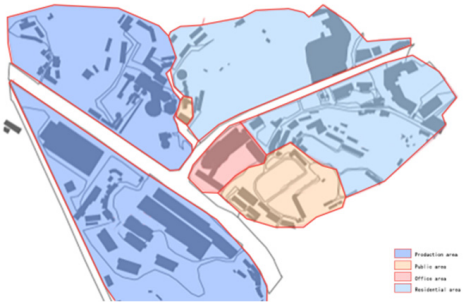
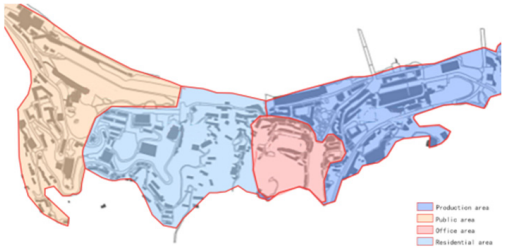
Functional Form Characteristics	The Name of Industrial Heritage	Functional Form Diagram
Separated type	Zunyi Titanium Factory	
Centralized type	Zunyi Alkali Factory	
	Aviation Site	
	061 Headquarters	

Table 4. *Cont.*

Functional Form Characteristics	The Name of Industrial Heritage	Functional Form Diagram
Serial-linked type	Liuzhi Mine	
	Wujiang Plant	
	061-3651 Factory	

3.2. Spatial Morphological Structure of Guizhou Industrial Heritage

3.2.1. Integration Analysis

According to Figure 4, the locations with higher integration levels of sampled factories are primarily concentrated along main roads. Production areas within the factories are generally distributed along these main roads, while residential areas are situated along secondary roads. Thus, accessibility gradually decreases from positions along main roads to those along secondary roads.

As presented in Table 5, the average values for global and local integration are 0.36913 and 1.000753, respectively, which indicates a generally inadequate level of spatial accessibility among the sampled factories. This finding suggests that the Guizhou factory was primarily designed to bolster military preparedness, as demonstrated by its remote geographical location and the economic difficulties associated with infrastructure development, particularly in terms of road access.

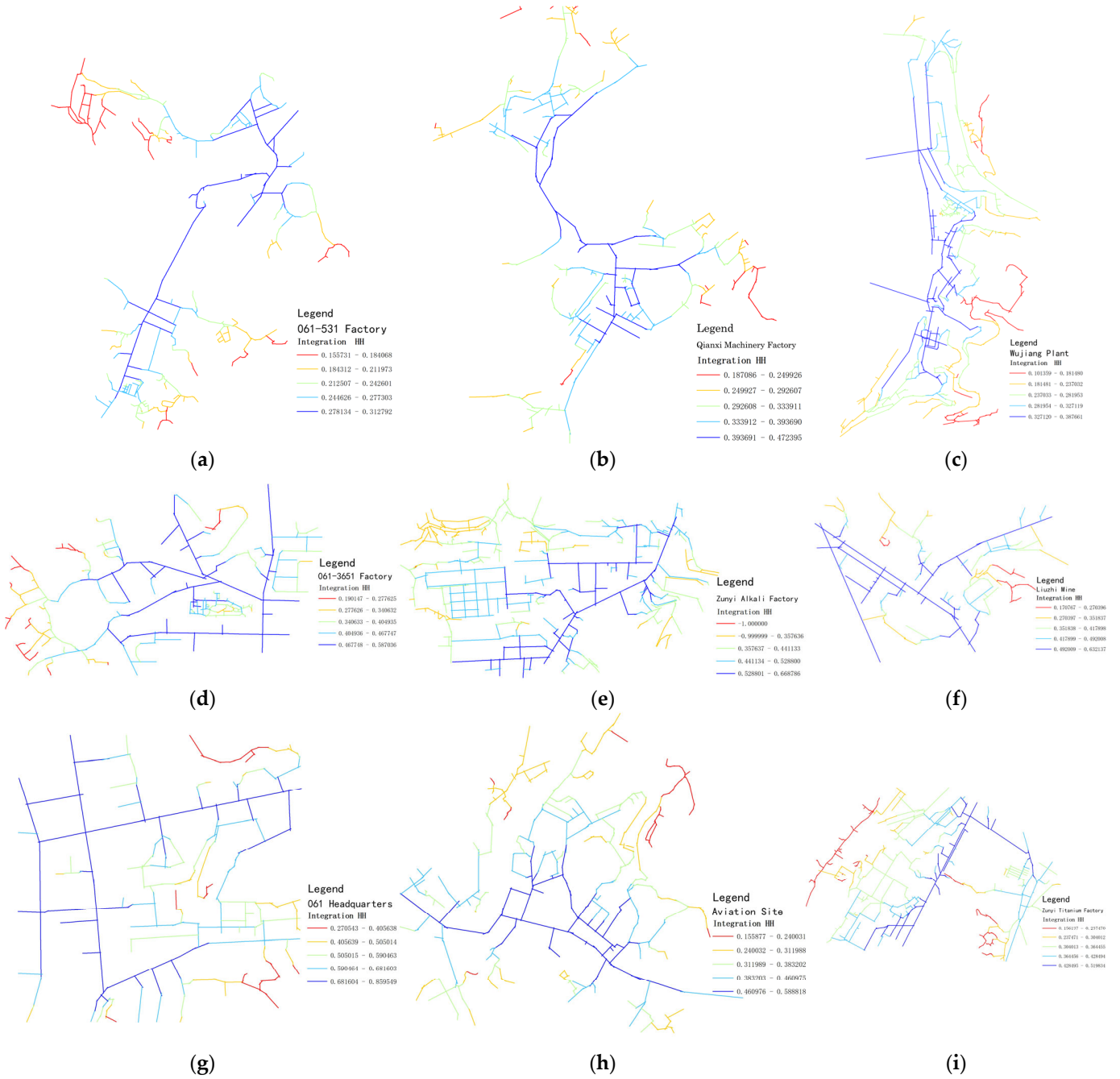


Figure 4. Integration Diagram of Industrial Heritage Sites from Guizhou (Global Integration). (**a**) 061–531 Factory Integration Analysis; (**b**) Qianxi Machinery Factory Integration Analysis; (**c**) Wujiang Plant Integration Analysis; (**d**) 061–3651 Factory Integration Analysis; (**e**) Zunyi Alkali Factory Integration Analysis; (**f**) Liuzhi Mine Integration Analysis; (**g**) 061 Headquarters Integration Analysis; (**h**) Aviation Site Integration Analysis; (**i**) Zunyi Titanium Factory Integration Analysis.

Table 5. Statistical Analysis of Spatial Syntactic Axis Integration of Industrial Heritage from Guizhou.

The Name of Industrial Heritage	Global Integration	Local Integration
061-531 Factory	0.22521	0.98392
061-3651 Factory	0.37753	1.00949
061 Headquarters	0.55971	1.06064

Table 5. *Cont.*

The Name of Industrial Heritage	Global Integration	Local Integration
Aviation Site	0.34955	0.97534
Qianxi Machinery Factory	0.31576	0.98376
Zunyi Alkali Factory	0.42794	1.06473
Zunyi Titanium Factory	0.32191	1.02863
Liuzhi Mine	0.39499	0.98595
Wujiang Plant	0.34955	0.97534
Mean	0.36913	1.00753

3.2.2. The Comprehensibility Index

As shown in Figure 5 and Table 6, the comprehensibility index value is highest at 061 Headquarters (0.4873), which is less than 0.5, indicating that the overall spatial comprehensibility of Guizhou's industrial heritage is low. The spatial texture density is also low, and the overall and partial correlations are not strong, suggesting that the overall perception of Guizhou's industrial heritage makes it difficult to form a complete impression through a few main roads or a single area. The mountainous and hilly topography of Guizhou contributes to a complex and diverse industrial heritage landscape. The presence of numerous natural mountains both within and in proximity to the factories leads to inadequate overall and partial spatial planning and integration of layouts. Thus, this forms a diverse and complex spatial network integrating natural and social elements.

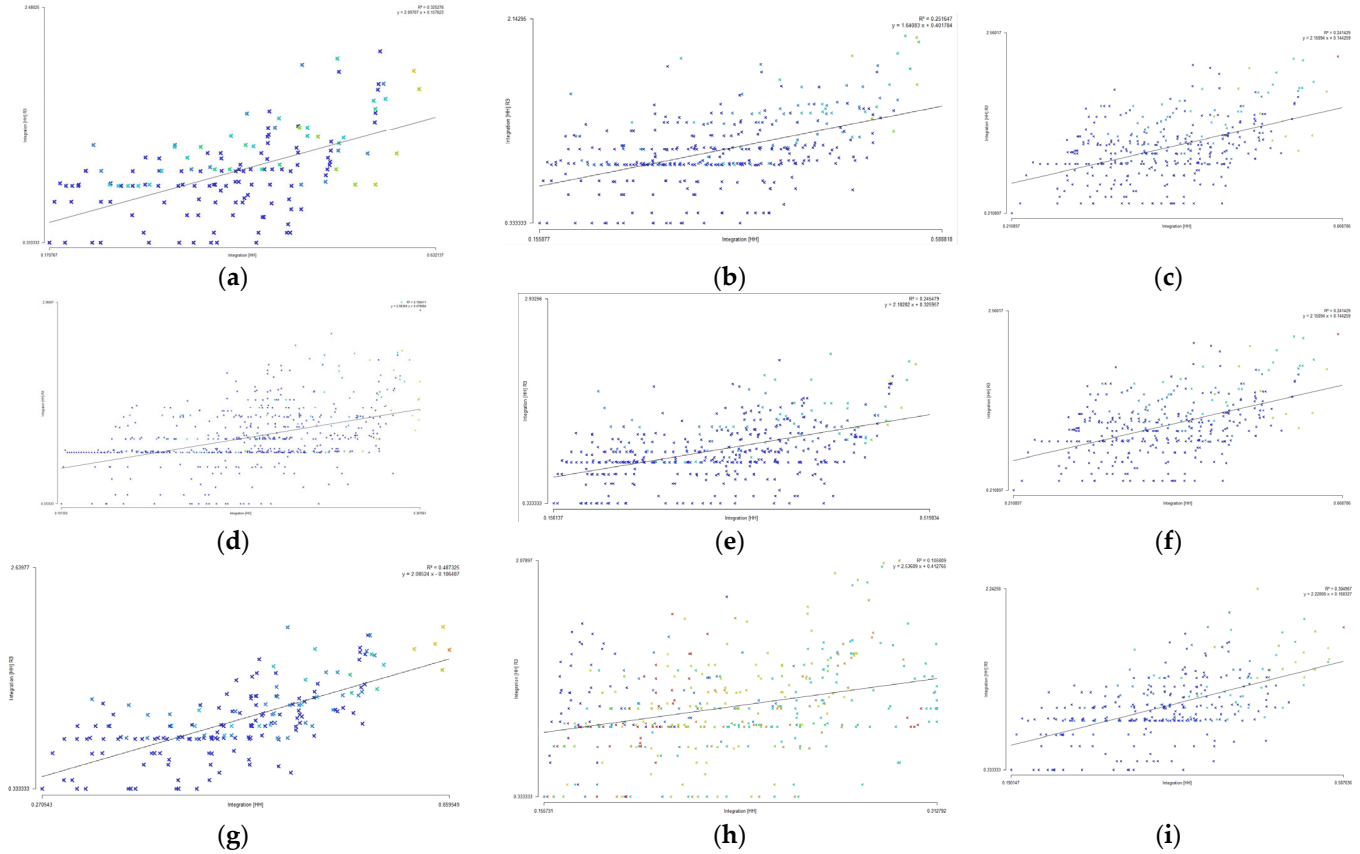


Figure 5. Comprehensibility Map of Industrial Heritage Sites from Guizhou. (**a**) Liuzhi Mine comprehensibility index; (**b**) Aviation Site comprehensibility index; (**c**) Qianxi Machinery Factory comprehensibility index; (**d**) Wujiang Plant comprehensibility index; (**e**) Zunyi Titanium Factory comprehensibility index; (**f**) Zunyi Alkali Factory comprehensibility index; (**g**) 061 Headquarters comprehensibility index; (**h**) 061-531 Factory comprehensibility index; (**i**) 061-3651 Factory comprehensibility index.

Table 6. Statistical Analysis of Spatial Syntactic Axis Comprehensibility for Industrial Heritage Sites from Guizhou.

The Name of Industrial Heritage	Fitting Function	Comprehensibility
061-531 Factory	Y = 2.5361x + 0.4128	0.1058
061-3651 Factory	Y = 2.2281x + 0.1683	0.3049
061 Headquarters	Y = 2.0852x − 0.1065	0.4873
Aviation Site	Y = 1.6508x + 0.4017	0.2516
Qianxi Machinery Factory	Y = 2.3470x + 0.2427	0.1889
Zunyi Alkali Factory	Y = 2.1509x + 0.1442	0.2414
Zunyi Titanium Factory	Y = 2.1828x + 0.3259	0.2454
Liuzhi Mine	Y = 2.0971x + 0.1576	0.3253
Wujiang Plant	Y = 2.0835x + 0.4781	0.1994
Mean	—	0.2611

3.2.3. Connectivity and Control Value Analysis

As shown in Table 7, there is minimal variation in the average connectivity and control values across the factory areas in Guizhou. The average connectivity values range between [2.0–2.3], with the highest average connectivity found at Zunyi Alkali Factory (2.21) and the lowest at Liuzhi Mine (2.15). The industrial factory areas generally have average spatial permeability, ensuring the connectivity of various streets and the evacuation of personnel, which are the basic requirements for the construction of the factory areas. Each factory area has an average control value of 1, yet there is significant variation between the minimum and maximum values. This suggests that overall, the internal spatial control of the factory areas towards external spaces is relatively effective, with varying degrees of influence networks integrating natural and social elements.

Table 7. Statistical Analysis of Connectivity Value and Control Values for Industrial Heritage Spatial Syntactic.

The Name of Industrial Heritage	Connectivity Value			Control Value		
	Mean Value	Minimum Value	Maximum Value	Mean Value	Minimum Value	Maximum Value
061-531 Factory	2.15	1.00	6.00	1.00	0.25	2.83
061-3651 Factory	2.15	1.00	6.00	1.00	0.25	2.83
061 Headquarters	2.16	1.00	8.00	1.00	0.13	4.20
Aviation Site	2.19	1.00	10.00	1.00	0.17	3.87
Qianxi Machinery Factory	2.11	1.00	6.00	1.00	0.20	2.75
Zunyi Alkali Factory	2.07	1.00	6.00	1.00	0.17	4.17
Zunyi Titanium Factory	2.21	1.00	9.00	1.00	0.14	3.67
Liuzhi Mine	2.15	1.00	14.00	1.00	0.07	7.00
Wujiang Plant	2.08	1.00	9.00	1.00	0.11	4.31
Mean	2.19	1.00	8.00	1.00	0.14	4.00

3.2.4. Choice Centrality and Depth Value Analysis

According to Table 8, the average depth value (19.91) and average choice value (7660.21) of the nine industrial heritage sites are relatively low, indicating that the overall accessibility and convenience of these industrial heritage sites are average. There is significant variation in both depth values and centrality values. For instance, 061-531 Factory and Wujiang Plant exhibit the highest depth values and centrality values, with depth values of 29.69 and 29.21, respectively, and centrality values of 12,796.20 and 16,869.40, respectively. The overall mean depth value and centrality value are 25.47 and 11,730.43, respectively. These higher values indicate that, overall, the continuity of the planar spatial roads within the industrial heritage is relatively low, with weaker accessibility and lower spatial portability.

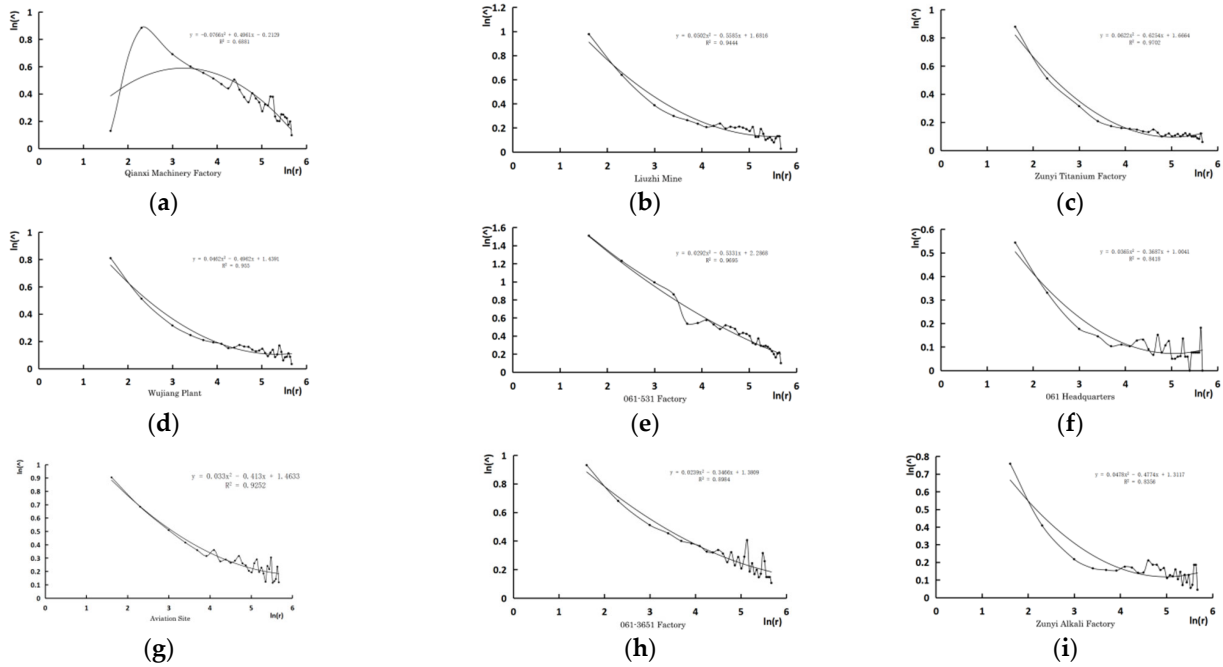
Table 8. Statistical Analysis of Depth Value andChoice Centrality for Industrial Heritage Spatial Syntactic.

The Name of Industrial Heritage	Depth Value			Choice Centrality		
	Mean Value	Minimum Value	Maximum Value	Mean Value	Minimum Value	Maximum Value
061-531 Factory	29.69	20.96	41.08	12,796.20	0.00	117,808.00
061-3651 Factory	17.31	10.97	31.78	5528.94	0.00	57,196.00
061 Headquarters	10.51	6.83	19.52	1769.23	0.00	17,596.00
Aviation Site	19.66	11.21	39.56	7072.13	0.00	94706.00
Qianxi Machinery Factory	20.75	13.66	32.97	7325.74	0.00	82391.00
Zunyi Alkali Factory	15.52	1.00	27.92	5445.53	0.00	77,761.00
Zunyi Titanium Factory	22.22	13.14	41.41	9930.38	0.00	157,779.00
Liuzhi Mine	14.36	8.66	29.36	2204.34	0.00	19,268.00
Wujiang Plant	29.21	18.18	66.72	16,869.40	0.00	221,409.00
Mean	19.91	11.62	36.70	7660.21	0.00	93,990.44

3.3. Spatial Morphological Cluster Study of Industrial Heritage in Guizhou

3.3.1. Study on Overall Spatial Morphological Clusters of Industrial Heritage in Guizhou

Figure 6 shows that the overall logarithmic fitting curves of various factory areas exhibit three trends: random, uniform, and clustering. The spatial fitting curves of the Titanium Factory and 061-531 Factory show a slow decline followed by a rapid decrease, forming a concave shape upwards at a specific point, indicating a random distribution pattern. The spatial fitting curves of the 061 Headquarters, Wujiang Plant, Alkali Factory, 061-3651 Factory, Liuzhi Mine, and Aviation Site show a pattern of periodic rises and falls, suggesting a uniform spatial texture distribution pattern in the factory areas. The spatial fitting curve of Qianxi Machinery Factory shows a repeated pattern of slight ups and downs, indicating a clustered spatial texture distribution pattern in this factory area. Overall, the spatial distribution of industrial heritage follows certain inherent rules, with uniform distribution as its main characteristic.



(**a**) (**b**) (**c**) (**d**) (**e**) (**f**) (**g**) (**h**) (**i**)

Figure 6. Scatter Plot Fitting Curves of Overall Interstitial Index vs. Sliding Window Size for Various Factory Areas. (**a**) Qianxi Machinery Factory; (**b**) Liuzhi Mine; (**c**) Zunyi Titanium Factory; (**d**) Wujiang Plant; (**e**) 061-531 Factory; (**f**) 061 Headquarters; (**g**) Aviation Site; (**h**) 061-3651 Factory; (**i**) Zunyi Alkali Factory.

3.3.2. Study on Spatial Morphological Clusters of Industrial Heritage Buildings in Guizhou

Figure 7 illustrates two overall trends in the double logarithmic fitting curves of building interstitial indices for various factory areas: Firstly, for buildings in Unit 061 Headquarters, Titanium Factory, Alkali Factory,061-3651 Factory, Liuzhi Mine, and Aviation Site, the interstitial curves gradually decrease with increasing sliding window size, reaching a turning point where the curve rapidly decreases in a wave-like manner, forming an upward concave shape. Such factory areas exhibit a uniform spatial morphology. Secondly, for buildings in Qianxi Machinery Factory, Wujiang Plant, and 061-531 Factory, the fitting curves initially show a linear decline until reaching a critical scale, where they sharply decrease. After reaching another critical scale, this downward trend peaks and then shows a subsequent upward trend, with minor fluctuations repeating thereafter. The spatial distribution patterns of buildings in each factory area follow inherent rules, with uniform spatial morphology clusters predominating.

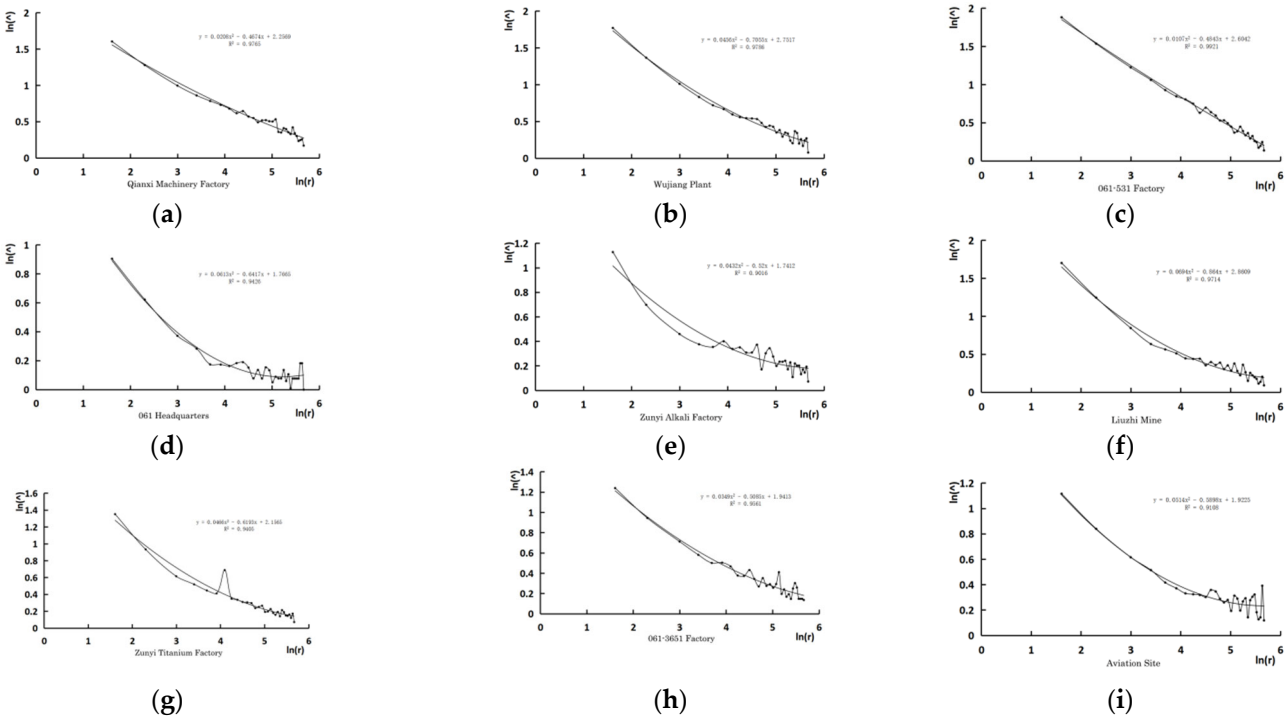


Figure 7. Scatter Plot Fitting Curves of Building Interstitial Index vs. Sliding Window Size for Various Factory Areas. (**a**) Qianxi Machinery Factory; (**b**)Wujiang Plant; (**c**) 061-531 Factory; (**d**) 061 Headquarters; (**e**) Zunyi Alkali Factory; (**f**) Liuzhi Mine; (**g**) Zunyi Titanium Factory; (**h**) 061-3651 Factory; (**i**) Aviation Site.

3.3.3. Study on Spatial Morphological Clusters of Road Networks in Guizhou Industrial Heritage

Figure 8 illustrates three overall trends in the double logarithmic fitting curves of road network interstitial indices for various factory areas: Firstly, for 061-531 Factory and the Titanium Factory, the interstitial curves decrease gradually with increasing sliding window size, indicating a random spatial morphology for these factory area road networks. Secondly, for Qianxi Machinery Factory, 061 Headquarters, Zunyi Alkali Factory, Liuzhi Mine, 061-3651 Factory, and Aviation Site, the fitting curves initially decline until reaching a critical scale, where they exhibit a minor upward trend. Upon reaching another critical scale, this upward trend peaks and then declines again, showing minor fluctuations thereafter. This pattern indicates a uniform spatial distribution form for road networks in these factory areas. Thirdly, for Wujiang Plant, the interstitial curve increases gradually with increasing sliding window size, reaching a turning point where the curve rapidly decreases in a

wave-like manner. This suggests a clustered spatial morphology for the road network in this factory area.

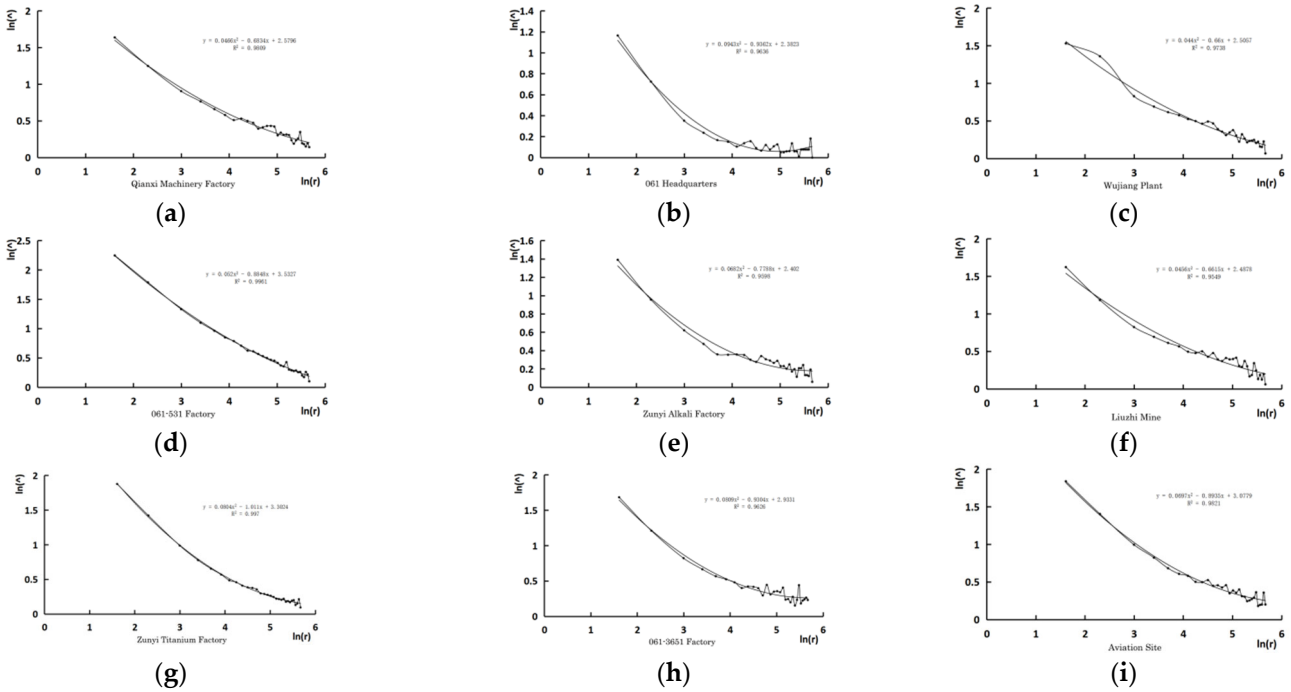


Figure 8. Scatter Plot Fitting Curves of Road Network Interstitial Index vs. Sliding Window Size for Various Factory Areas. (**a**) Qianxi Machinery Factory; (**b**) 061 Headquarters; (**c**) Wujiang Plant; (**d**) 061-531 Factory; (**e**) Zunyi Alkali Factory; (**f**) Liuzhi Mine; (**g**) Zunyi Titanium Factory; (**h**) 061-3651 Factory; (**i**) Aviation Site.

The spatial distribution patterns of road networks in each factory area exhibit inherent regularities, with a predominance of uniform spatial morphology clusters.

3.4. Spatial Morphological Intensity Study of Industrial Heritage in Guizhou

3.4.1. Study on Overall Spatial Morphological Intensity of Industrial Heritage in Guizhou

The fractal dimension reflects the effectiveness of occupying space by complex forms, serving as a measure of the irregularity of complex forms. Table 9 shows that the trend curves of fractal dimensions of the overall plane (whole) of sampled factory areas vary significantly, with considerable overall differences. The plane texture fractal dimensions of 061 Headquarters, Zunyi Alkali Factory, and Zunyi Titanium Factory (1.6647~1.6869) are the highest, indicating the highest degree of spatial complexity in these factory areas. The distribution system is most concentrated, the spatial morphology structure is complete and complex, and the irregular characteristics of spatial texture are prominent. Conversely, the plane texture fractal dimensions of Aviation Site, 061-531 Factory, and Qianxi Machinery Factory (1.3170~1.5028) are the lowest, indicating lower complexity of texture, fragmented texture, and less prominent irregular characteristics. The average fractal dimension across all factory areas is 1.5736, which falls into the upper-middle-range within the range of 1 to 2, indicating significant overall spatial morphological characteristics. The spatial morphology structure is highly complex, the plane space is rich, and the irregular characteristics of spatial texture are prominent.

Table 9. Overall Fractal Dimensions of Various Factory Areas.

The Name of Industrial Heritage	The Fitting Function Relationship	The Coefficient of Determination for the Fitting/R2	Fractal Dimension
061-531 Factory	y = −1.5272x + 11.966	0.9995	1.5272
061 Headquarters	y = −1.6647x + 11.33	0.9970	1.6647
Qianxi Machinery Factory	y = −1.5028x + 11.428	0.9950	1.5028
Zunyi Alkali Factory	y = −1.6747x + 12.537	0.9980	1.6747
Liuzhi Mine	y = −1.5794x + 11.738	0.9983	1.5794
Zunyi Titanium Factory	y = −1.6869x + 13.640	0.9916	1.6869
Wujiang Plant	y = −1.6276x + 12.415	0.9989	1.6276
Aviation Site	y = −1.317x + 10.0690	0.9966	1.3170
061-3651 Factory	y = −1.5817x + 11.314	0.9962	1.5817
Mean		0.9968	1.5736

3.4.2. Study on the Morphological Intensity of Industrial Heritage Buildings in Guizhou

Table 10 shows differences in the fractal dimensions of sampled factory buildings. The fractal dimensions of the planar textures of 061 Headquarters, Zunyi Alkali Factory, and Zunyi Titanium Factory (1.5775 to 1.6084) are the highest, indicating the highest degree of spatial complexity in the factory areas. The systems are most concentrated, the spatial form structures are complete and complex, and the irregular characteristics of the architectural spatial textures are prominent. The fractal dimensions of the planar textures of 061-531 Factory, Qianxi Machinery Factory, Liuzhi Mine, and Wujiang Plant (1.3170 to 1.5028) are the lowest, indicating lower complexity in texture, fragmentation, and less significant irregular characteristics. The average fractal dimension of the buildings in each factory area is 1.5052, falling within the range of 1 to 2, indicating a moderate level. Therefore, it can be seen that the architectural spaces of the factory areas exhibit a trend of high complexity and concentrated distribution.

Table 10. Fractal Dimensions of Buildings in Each Factory Area.

The Name of Industrial Heritage	The Fitting Function Relationship	The Coefficient of Determination for the Fitting/R2	Fractal Dimension
061-531 Factory	y = −1.4425x + 11.425	0.9989	1.4425
061 Headquarters	y = −1.5775x + 10.803	0.9929	1.5775
Qianxi Machinery Factory	y = −1.4094x + 10.771	0.9979	1.4094
Zunyi Alkali Factory	y = −1.6084x + 12.036	0.9932	1.6084
Liuzhi Mine	y = −1.4242x + 10.764	0.9967	1.4242
Zunyi Titanium Factory	y = −1.5854x + 12.933	0.9974	1.5854
Wujiang Plant	y = −1.4292x + 11.061	0.9981	1.4292
Aviation Site	y = −1.5683x + 11.643	0.9990	1.5683
061-3651 Factory	y = −1.5022x + 10.858	0.9961	1.5022
Mean		0.9967	1.5052

3.4.3. Study on the Morphological Intensity of Road Space in Guizhou Industrial Heritage

Table 11 shows differences in the fractal dimensions of sampled factory area road networks. The fractal dimensions of the planar textures of road networks for 061 Headquarters and Zunyi Alkali Factory (1.5110 to 1.5199) are the highest, indicating the highest degree of spatial complexity in the factory areas. The systems are most concentrated, the spatial form structures are complete and complex, and the irregular characteristics of spatial textures are prominent. The fractal dimensions of the planar textures of road networks for Liuzhi Mine, Zunyi Titanium Factory, and Wujiang Plant (1.4394 to 1.4707) are moderate, indicating higher complexity in the planar textures of the road networks, concentrated system distribution, and overall regularity in the texture of the factory areas. The fractal dimensions of the planar textures of road networks for the Aviation Site, 061-531 Factory, Qianxi Machinery Factory, and 061-3651 Factory (1.3377 to 1.3901) are the lowest, indicating

lower complexity in the planar textures of the road networks, fragmented texture, and less significant irregular characteristics. The average fractal dimension of the road networks in each factory area is 1.4299, falling slightly below the moderate level within the range of 1 to 2. Therefore, it can be seen that the road networks in the factory areas exhibit a trend of lower complexity and dispersed distribution in spatial form.

Table 11. Fractal Dimensions of Road Networks in Each Factory Area.

The Name of Industrial Heritage	The Fitting Function Relationship	The Coefficient of Determination for the Fitting/R2	Fractal Dimension
061-531 Factory	y = −1.3377x + 10.925	0.9990	1.3377
061 Headquarters	y = −1.511x + 10.534	0.9958	1.5110
Qianxi Machinery Factory	y = −1.3663x + 10.683	0.9896	1.3663
Zunyi Alkali Factory	y = −1.5199x + 11.613	0.9982	1.5199
Liuzhi Mine	y = −1.4452x + 10.838	0.9976	1.4452
Zunyi Titanium Factory	y = −1.4394x + 12.116	0.9973	1.4394
Wujiang Plant	y = −1.4707x + 11.357	0.9983	1.4707
Aviation Site	y = −1.3839x + 10.572	0.9986	1.3890
061-3651 Factory	y = −1.3901x + 10.270	0.9945	1.3901
Mean		0.9965	1.4299

4. Discussion

4.1. Spatial Characteristics of Guizhou's Industrial Heritage

As a karst area, the construction cost of Guizhou is relatively high, and the background of industrial development is that China has transferred the industry from the coastal and plain areas to the mountainous areas for the sake of war preparedness. Therefore, industrial construction is greatly affected by the thinking of war readiness, the layout is more defensive, and the industrial heritage with different functions presents significant regional characteristics in terms of spatial characteristics. The findings of this study indicate that the spatial distribution of Guizhou's industrial heritage can be classified into four distinct categories: concealed locations, comprehensive locations, convenient locations, and resource-based locations. The primary factors contributing to these locational variations are the strategic imperatives associated with preparedness, as well as the limitations imposed on industrial production by the region's terrain and environmental conditions. Military-industrial sites, including the 061-531 Factory, the 061-3651 Factory, and the 061 headquarters building, are classified as concealed locations. These sites necessitate geographical concealment and complex terrain to facilitate their operations in the face of potential external threats. These findings align with those of Li Tingting [38], who studied military-industrial enterprises in the northern Sichuan region of the Three-Line Construction Industrial Heritage. Military-industrial enterprises tend to be situated near mountains and rivers to meet the requirements of secure production, while chemical enterprises favor dispersed locations along riverbanks based on resource conditions. Mechanical enterprises, meanwhile, prioritize proximity to urban transportation arteries and labor considerations. However, this study also reveals that the type of location does not have a direct correlation with the spatial distribution patterns of industrial heritage. The primary factors contributing to the variations in layout are the intricate karst topography and the functional requirements of production. Li Tingting has identified four spatial patterns exhibited by industrial heritage sites in southern China: centralized, dispersed, radial, and serial-parallel. This observation supports the notion that the overall design of industrial areas in mountainous regions predominantly adheres to the terrain, characterized by horizontal layouts that follow the same contour line. Construction practices utilize flat land and gentle slopes situated between valleys while minimizing the use of arable land and reducing the need for excavation. This study concurs with this perspective; however, it also finds that, when analyzing functional zoning, the functional zones of industrial heritage correspond with

their spatial layout. The functional zones are relatively straightforward and do not create complex or composite spaces.

4.2. Spatial Morphological Structural Characteristics of Guizhou Industrial Heritage

The changes in spatial morphological structure significantly influence the evolution of spatial systems, comprehensively reflecting the process of spatial transformation. They represent the increase in internal elements, the expansion of scope, and the optimization and upgrading of internal structure and functions within the spatial system [28–30]. The global integration value and the average local integration value of Guizhou's industrial heritage are (0.36913 and 1.000753), both of which are relatively low. This indicates poor spatial accessibility of the industrial heritage. The average connectivity of the various factory areas falls within the range of [2.0–2.3], suggesting that the overall spatial permeability of the industrial sites is average. It only ensures the basic requirements of connecting streets and evacuating people, which are fundamental needs for the construction of the factory areas. This finding aligns with the research by Ge Hongyi on Anshun Tünpu settlements [36], indicating that buildings of different types brought about by defense need to share a similar logic in spatial layout. The comprehensibility of internal spaces within factory areas is relatively low, consistent with the findings of Liu Lin regarding traditional towns in central Guizhou [39]. To some extent, this reflects the fragmentation of land development caused by the karst landscape. However, the comprehensibility of Liu Lin's Qianzhong Ancient Town is 0.49, which is higher than that of the industrial heritage sites. This indicates that spatial planning for small-scale residential buildings can improve the overall-to-local connectivity, compensating for the limitations in spatial organization. In comparing the control over internal spaces with external spaces within factory areas, industrial heritage exhibits higher control mechanisms compared to the relatively lower control structures observed in Anshun Tünpu and traditional towns in central Guizhou [36]. This difference may be attributed to the site selection and layout considerations of the industrial heritage, which centered around defense preparedness. The remote geographical locations of these factory areas, often situated in mountainous terrain and ravines, heavily influenced by topography and terrain, combined with economic difficulties of the time, resulted in challenges in developing transportation routes. Under the premise of emphasizing defensive and concealment strategies, the transportation routes within factory areas typically consist of a main traffic artery and various subsidiary routes; the demand for the completeness and improvement of the road system is not as high as that of settlements primarily focused on living functions. Most of the dimensional dimensions of the industrial plants in Guizhou are mainly complex, and a small part of the space is simplified, which is different from the high-complexity spatial structure of the traditional settlements in the karst area of Guizhou Province [40] but basically consistent with the spatial characteristics of the Tunpu settlements [30], which confirms that the spatial layout of the industrial plant area and the Tunpu settlement in the context of the preparation for the war is not only affected by the natural topography of the region. The intentional design of the military deployment also played a key role in the construction of the plant. According to the research on the spatial morphological intensity of industrial heritage, the spatial morphological clusters of industrial plants are mainly homogeneous, followed by random type, which is basically similar to the spatial morphological structure of karst traditional ancient towns and karst Buyi traditional villages, which confirms that the karst topography and landform of Guizhou restricts the development of large-scale centralized spatial layout of the three-line construction, but carries out a uniform and decentralized layout according to the terrain, and embodies the military strategy of "backing, concealment and dispersion" of the third-line construction, and the uniform and decentralized layout is conducive to dispersing potential risks. Increases survivability and military defense effectiveness.

5. Conclusions

Through an analysis of the spatial, morphological, and structural characteristics of nine typical industrial heritage sites in Guizhou, it is found that the site selection principles of Guizhou industrial heritage fully reflect the strategic thinking of 'relying on mountains, dispersion, and concealment'. Factors such as terrain, transportation convenience, and natural resource conditions are primary influencers. The site selection is divided into four types: concealed site selection, comprehensive site selection, convenient site selection, and resource-based site selection. The strategic demands under the background of preparation for war and the constraints of the terrain and environment on industrial production are the main reasons for the differences in site selection. The layout forms of industrial heritage include four types: centralized, radial, linear, and dispersed. There is no direct correlation between the type of site selection and the layout of industrial heritage. The complex karst terrain and the functional demands of production are the main reasons for the differences in layout forms. In addition, the functional zoning of industrial heritage corresponds with the layout forms, with simple, functional zoning and the absence of complex spatial structures. Based on quantitative research methods such as gap degree, fractal dimension, and space syntax theory, the spatial texture and structural characteristics of Guizhou's industrial heritage have been studied. The results show that the overall connectivity of industrial heritage is low, global integration is low, control value differences are large, average depth is low, intelligibility is poor, and choice is low. This indicates that the internal spatial connectivity of the industrial heritage is generally weak, accessibility is poor, relevance is strong, convenience is average, cohesion is low, and trafficability is mediocre. Different factory areas within the industrial heritage exhibit diversity in spatial morphology, architectural spatial distribution, and road network spatial distribution. The predominant spatial distribution is uniform, reflecting a preference for spatial uniformity and regularity in planning and design to enhance operational efficiency. Most parts of Guizhou factory areas demonstrate complexity in dimensional shape, with some areas showing simplified spatial characteristics. The average fractal dimensions of the overall site plan and building plan tend towards moderate or slightly above, indicating high spatial complexity and irregular texture characteristics. In contrast, the average fractal dimension of the road network plan tends towards moderate to slightly below, reflecting a relatively simple design and dispersed distribution. These findings illustrate distinctive characteristics of factory areas in terms of overall spatial morphology, architectural layout, and road network design, highlighting high spatial complexity and irregularity. Preserving the spatial pattern characteristics of industrial heritage and showcasing their intrinsic historical and cultural elements are crucial for activating heritage resources and ensuring sustainable development [33]. Therefore, this study serves as a valuable reference for the analysis of the spatial characteristics and influencing factors associated with other forms of tangible cultural heritage. It establishes a foundation for the development of relevant strategies aimed at the protection and utilization of industrial heritage, thereby holding significant implications for the systematic preservation and revitalization of such heritage. Furthermore, the methodologies employed in this research predominantly emphasize the characteristics of spatial form, with the influencing factors being derived from qualitative analyses conducted by the researchers. A notable limitation of this study is the absence of a quantitative analysis of these influencing factors, as well as the integration of social development needs in the formulation of corresponding planning measures and policies. Addressing these aspects will be a primary focus of future research.

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References

1. Blake, J. On defining the cultural heritage. *Int. Comp. Law Q.* **2000**, *49*, 61–85. [CrossRef]
2. Zhang, J.; Sun, H.; Xu, S.; Aoki, N. Analysis of the Spatial and Temporal Distribution and Reuse of Urban Industrial Heritage: The Case of Tianjin, China. *Land* **2022**, *11*, 2273. [CrossRef]
3. Chung, H.; Lee, J. Modern Industrial Heritage as Cultural Mediation in Urban Regeneration: A Case Study of Gunsan, Korea, and Taipei, Taiwan. *Land* **2023**, *12*, 792. [CrossRef]
4. Medeiros, L. The reused factory: The contribution of architectural archaeology to the knowledge and enhancement of industrial heritage. *E-RPH* **2022**, *27*, 28–51. [CrossRef]
5. Chen, Z.; Huang, J.; Dai, H.; Liu, J. Development route analysis of intangible cultural heritage industry of China based on data mining. *J. Phys. Conf. Ser.* **2021**, *1848*, 012040. [CrossRef]
6. Zhang, X.; Yang, Y.; Liu, B. The Spatiotemporal Distribution Characteristics and Spatial Integration Protection of China's Industrial Heritage. *Econ. Geogr.* **2023**, *43*, 103–114. (In Chinese) [CrossRef]
7. Zhang, Q.; Zou, C. The Spatial Distribution Characteristics and Systematic Revitalization Strategies of National Industrial Heritage in China. *Huazhong Archit.* **2023**, *41*, 85–89. (In Chinese) [CrossRef]
8. Alviz-Meza, A.; Vasquez-Coronado, M.H.; Delgado-Caramutti, J.G.; Blanco-Victorio, D.J. Bibliometric analysis of fourth industrial revolution applied to heritage studies based on web of science and scopus databases from 2016 to 2021. *Herit. Sci.* **2022**, *10*, 189. [CrossRef]
9. Martinović, A.; Ifko, S. Industrial heritage as a catalyst for urban regeneration in post-conflict cities Case study: Mostar, Bosnia and Herzegovina. *Cities* **2018**, *74*, 259–268. [CrossRef]
10. Yang, L. Study on the Development Model of the Combination of "Third-Tier" Industrial Heritage and Rural Tourism under the Concept of Urban Image. *Sci. Program.* **2022**, *2022*, 2730532. [CrossRef]
11. Scaffidi, F. Average social and territorial innovation impacts of industrial heritage regeneration. *Cities* **2024**, *148*, 104907. [CrossRef]
12. Yao, L.; Gao, C.; Zhuang, Y.; Yang, H.; Wang, X. Exploring the Spatiotemporal Dynamics and Simulating Heritage Corridors for Sustainable Development of Industrial Heritage in Foshan City, China. *Sustainability* **2024**, *16*, 5605. [CrossRef]
13. Zhang, J.; Cenci, J.; Becue, V. A Preliminary Study on Industrial Landscape Planning and Spatial Layout in Belgium. *Heritage* **2021**, *4*, 1375–1387. [CrossRef]
14. Babutsalı Alpler, Z.; Şahin, N.P.; Dağlı, U.U. A critical discussion of industrial heritage buildings adaptive re-use as film spaces, case study: Industrial heritage buildings at Istanbul. *J. Archit. Conserv.* **2020**, *26*, 215–234. [CrossRef]
15. Yang, Q. The Social Production of Industrial Heritage Spaces in the Background of Cultural Governance: A Comparative Study Based on Cases from Taipei and Hong Kong. *Buildings* **2023**, *13*, 1579. [CrossRef]
16. Çayır, C. Sanayi Mirasının Korunarak Yeniden Işlevlendirilmesi Eskişehir Fabrikalar Bölgesi çift kurt Kiremit ve Tuğla Fabrikası Örneği. Master's Thesis, Mimar Sinan Fine Arts University, Istanbul, Turkey. Available online: https://search.proquest.com/openview/0d3196049f596143fb6b37b9ebf609c3/1?pq-origsite=gscholar&cbl=2026366&diss=y (accessed on 1 May 2011).
17. Vargas-Sánchez, A. Industrial heritage and tourism: A review of the literature. In *The Palgrave Handbook of Contemporary Heritage Research*; Springer: Berlin/Heidelberg, Germany, 2015; pp. 219–233. [CrossRef]
18. Gharaati, F.; Mahdavinejad, M.; Nadolny, A.; Bazazzadeh, H. Sustainable Assessment of Built Heritage Adaptive Reuse Practice: Iranian Industrial Heritage in the Light of International Charters'. *Hist. Environ. Policy* **2023**, *14*, 498–532. [CrossRef]
19. Han, S.H.; Zhang, H. Progress and Prospects in Industrial Heritage Reconstruction and Reuse Research during the Past Five Years: Review and Outlook. *Land* **2022**, *11*, 2119. [CrossRef]
20. Yao, C. Adaptive reuse of industrial heritage with cultural-creative industry: A study of 798 art district. *BCPBM* **2021**, *13*, 341–365. [CrossRef]
21. Swensen, G.; Stenbro, R. Urban planning and industrial heritage—A Norwegian case study. *J. Cult. Herit. Manag. Sustain. Dev.* **2013**, *3*, 175–190. [CrossRef]
22. Zhang, J.; Zhuo, L.; Sun, H.; Wang, Y.; Wei, H.; Xu, S.; Aoki, N. Construction of the Chinese Route of Industrial Heritage Based on Spatial and Temporal Distribution Analysis. *Buildings* **2024**, *14*, 1065. [CrossRef]
23. Fan, X.; Sun, L. Geographic Distribution Characteristics and Influencing Factors for Industrial Heritage Sites in Italy Based on GIS. *Sustainability* **2024**, *16*, 2085. [CrossRef]
24. Hueso-Kortekaas, K.; Carrasco-Vayá, J.-F. The Patrimonialization of Traditional Salinas in Europe, a Successful Transformation from a Productive to a Services-Based Activity. *Land* **2024**, *13*, 772. [CrossRef]
25. Zhou, J. Research on the protection and reuse of industrial architectural heritage in Guizhou. *Ind. Constr.* **2015**, *45*, 48–51. (In Chinese) [CrossRef]
26. Luo, Y.P.; Li, Y.P. The History, Experience, and Lessons of the Third Front Construction in Guizhou. *J. Southwest Univ. Sci. Technol. (Philos. Soc. Sci.)* **2022**, *39*, 11–17. (In Chinese) [CrossRef]

27. Zhou, J.; Liu, B. Research on the Integration of Three-Line Industrial Heritage Protection and Small Town Development—A Case Study of Guizhou Province. *Reform Strategy* **2016**, *32*, 104–107. [CrossRef]
28. Xu, R.; Yang, G.; Qu, Z.; Chen, Y.; Liu, J.; Shang, L.; Liu, S.; Ge, Y.; Chang, J. City components–area relationship and diversity pattern: Towards a better understanding of urban structure. *Sustain. Cities Soc.* **2022**, *60*, 102272. [CrossRef]
29. Lin, Z.; Liang, Y.; Liu, X. Study on spatial form evolution of traditional villages in Jiuguan under the influence of historic transportation network. *Herit. Sci.* **2023**, *12*, 29. [CrossRef]
30. Liu, L. Research on the Spatial Genetic Characteristics of Traditional Ancient Towns in Central Guizhou. Master's Thesis, Guizhou University, Guiyang, China, 2021. (In Chinese)
31. Wu, C.D.; Cheng, C.C.; Chang, C.C.; Lin, C.; Chang, K.C.; Chuang, Y.C. Gap shape classification using landscape indices and multivariate statistics. *Sci. Rep.* **2016**, *6*, 38217. [CrossRef]
32. Liu, S.; Chen, Y.; Yang, R.; Li, D.; Qiu, Y.; Lu, K.; Cao, X.; Chen, Q. Spatiotemporal Dynamics of Constructed Wetland Landscape Patterns during Rapid Urbanization in Chengdu, China. *Land* **2024**, *13*, 806. [CrossRef]
33. Chang, C.S.; Meidani, M.; Deng, Y. Role of morphologic indices on the variation of limiting void ratios for uniform sands. *Géotech. Lett.* **2018**, *8*, 248–255. [CrossRef]
34. Youssef, K.A.; Youssef, A.M.A. Promoting spatial cognition in hospital buildings using space syntax analyses. *J. Eng. Appl. Sci.* **2022**, *69*, 101. [CrossRef]
35. Chen, X.; Liu, X. Quantitative Analysis of Urban Spatial Morphology Based on GIS Regionalization and Spatial Syntax. *J. Indian Soc. Remote Sens.* **2022**, *51*, 1855–1864. [CrossRef]
36. Fang, Y. Research on the Spatial Social Networks and Architectural Network Genetic Characteristics of Tunpu Settlements in Guizhou and Their Maintenance Mechanism. Guizhou University, Guiyang, China, 2022. Available online: https://kns.cnki.net/kcms2/article/abstract?v=UjEBX92ALNEsTcg-5dMbv3YboA1yaBdhKaDT4WVk-xS1Y9qCdeeEDBAAEe9M5bcAnnX5Ry2jaYmagV-00s3rFlNnjdmpLpFWss9arlnVDBqCtYTIyknx50trNHTrJlIAGzmutBLTMCzfw1VT19cpWo9iyXFQcodHVXzK7-LxZVbAuspkhg92GxQXGpikzGG00K8pRU52hKI=&uniplatform=NZKPT&language=CHS (accessed on 16 January 2023). (In Chinese)
37. Drobnjaković, M.; Panić, M. Introduction of the Approach for Reviving the Sub-Municipal Level as a Spatial Aspect of Decentralization in Serbia. *Land* **2024**, *13*, 752. [CrossRef]
38. Liu, D.J.; Xie, S.Y.; Chen, J.Z.; Pei, X.X. Research on the evolution mode of spatial structure of regional tourist attraction system based on fractal theory: A case study of Wuhan City. *Econ. Geogr.* **2013**, *33*, 155–160. (In Chinese) [CrossRef]
39. Ge, H. Spatial Characteristics and Evolution of Tunpu Settlements in Anshun. *Guizhou Univ.* **2022**. (In Chinese) [CrossRef]
40. Pang, M. Spatial Texture Identification and Differentiation of Traditional Villages in Karst Area of Guizhou. Master's Thesis, Guizhou University, Guiyang, China, 2022. Available online: https://kns.cnki.net/kcms2/article/abstract?v=sMQVub3UVPjJniPUsl3NFTMpMds8vb3CGmE_axKEmqWkPkI283p497ws1iMRNzr9pMXEhccX3PRAp1HTpeZrTW1ZfTJXNA9VJeS-HFaOtEnJkyBjqPinNXgeZ9vH0RnHTisazDjOkMqBVlZ3NCjpF9nf1A7yyyHS8QxQwwv84UKs0YyZT5uHTq9zl5a2nq6GdNopAdPUZ58=&uniplatform=NZKPT&language=CHS (accessed on 16 January 2023). (In Chinese)

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