The Research on Landscape Design Strategy of Xuzhou Mining Wastelands from the Perspective of Naturalism Aesthetics

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Abstract

With the continuous development of urban mineral resources, the ecology of mining areas has been seriously damaged, and the landscape design of mining wastelands has gradually received attention. To address this issue, the sample of this study is the landscape regeneration design of Xuzhou Anran Mountain abandoned quarry, this study aims to enhance the natural aesthetic value and beautiful ecological environment of the site through the sample. This study adopts a mixed research method: a combination of qualitative and quantitative methods, with qualitative research as the main focus, combined with questionnaires, interview records, data statistics, field research, case studies and other methods, to comprehensively analyze the development history, distribution and characteristics of the landscape of the mining wastelands in Xuzhou, and to summarize the aesthetic performance and design strategies of the naturist landscape. The goal of the study is to explore the performance of naturalistic aesthetic language in the landscape regeneration design of mining wastelands in Xuzhou. In order to balance the harmonious relationship between the natural landscape, ecological environment and tourists of mining wastelands. The results of the study show that (1) the development of the landscape of mining wastelands, experienced the germination, transformation and development period. (2) The distribution of mining wastelands in Xuzhou presents a “point-like” distribution. It is characterized by serious damage to natural ecology and scattered humanistic landscape. (3) The design strategy of the research theme is summarized by prioritizing the restoration of natural ecology, incorporating the language of natural aesthetics, and interacting with dynamic aesthetic elements. (4) Based on the profile and advantages of the sample site, this study proposes design inspiration, design concepts and objectives, analyzes the value of natural aesthetics of the quarry, and carries out a deeper dissection and validation of the sample under the guidance of naturalistic aesthetic theory. The results of the study help to promote the development of the region's economy and ecological environment, and provide a theoretical basis and practical guidance for the design of natural aesthetics in abandoned landscapes in Xuzhou and other regions.

Keywords: Landscape Design Strategy; Xuzhou Mining Wastelands; Naturalism Aesthetics

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Introduction

The landscape design of mining wastelands aims to achieve resource protection and reuse by converting brownfield sites into aesthetically pleasing and environmentally sustainable public spaces. Since the Industrial Revolution, Western countries, particularly Germany, Britain, France, the United States, and Australia, were pioneers in introducing policies, laws, and regulations for wastelands management. These nations initiated and supported the development of mining wastelands landscape regeneration, establishing pragmatic institutional frameworks. With China's rapid economic growth and urban expansion, increasing attention has been paid to the ecological environment, particularly the damage caused by mining activities (Zhang Shiwen, 2020). The Chinese government, in particular, has placed significant emphasis on the environmental restoration and management of mining wastelands, issuing relevant policy documents such as the 2004 Notice on Declaring National Mining Parks. This marked the beginning of systematic landscape reconstruction in China's mining wastelands, making landscape regeneration a topic of increasing discussion (Li Chan, 2022).

In the 21st century, Chinese scholars have increasingly focused on the research of landscape design for mining wastelands. Before the 1980s, there was limited literature on China's mining restoration design theory, with most efforts focused on basic restoration. Influenced by both domestic and international policies and successful case studies, Wang Xizhi in 2008 proposed integrating industrial, mining, and agricultural cultures to create a mining industrial cultural heritage. Associate Professor Fang Songlin proposed specific measures for the cultural landscape design of mining wastelands, including subsidence areas, gangue mountains, open pits, and underground mines. Subsequently, scholars like Wang Xiangrong, Liu Fengmin, and Zhang Likai proposed various landscape regeneration design strategies for mining wastelands and conducted diverse explorations in this field, paving a new path for landscape restoration in contemporary China (Jia Lusha, 2021). Professor Yu Kongjian's works, Foot Culture and the Beauty of Weeds and Regional Ecological Security Patterns, emphasize that the core of landscape design for mining wastelands lies in embracing ecological principles. These scholars' influence can be seen in the transformation of successful cases such as Zhongshan Qijiang Park in Guangdong Province and Xuzhou Pan'an Lake Park (Hongtao Xing, 2024).Most existing literature focuses on the ecological and cultural studies of mining wastelands, highlighting the need for more attention to their natural landscape design. With the rapid development of landscape restoration in mining wastelands, many mining parks have adopted Western rule-based landscape styles, often neglecting to integrate naturalistic design concepts from Chinese classical gardens. Therefore, in the exploration of landscape design for mining wastelands, naturalistic aesthetics should serve as the guiding principle to create aesthetically pleasing and ecologically harmonious landscapes.

Xuzhou city, as a typical mineral resource city, has been mining coal, mining and quarrying for a long time, facing the double crisis of resource depletion and serious damage to the ecological environment.In 2013, Xuzhou city, in accordance with the requirements of the national eco-civilization construction, showed the world the image of “green and livable Xuzhou”, which was used as an opportunity to improve and enhance the ecological environment and achieve the goal of landscape regeneration and utilization of mining wastelands (Cao Jingjing, 2015). In terms of theoretical research, it is mainly covered by Mr. Li Yong's “Park green space construction in Xuzhou city”, “Xuzhou mining wastelands

management mode under the process of urbanization", and "Summary of ecological restoration modes of quarrying wastelands in Xuzhou city and evaluation of effect" (Yin Niyang, 2017). There have been discussions on the ecological restoration of Xuzhou gardens, low-impact development of the landscape, and the style of Xuzhou gardens. However, there is no corresponding systematic theoretical research on the combination of naturalism and mining wastelands park landscape design.

In summary, the ecological protection and restoration of mine wasteland has become the focus of global attention, and its landscape regeneration has been increasingly valued as a strategy for the dual optimization of resources and environment. With their pioneering experience after the industrial revolution, developed countries in the West have provided valuable references for global abandoned land management in both theory and practice. However, the natural landscape design of remote mining wasteland still lacks sufficient exploration. In recent years, with the increasing awareness of ecological protection in China, the management of mining wastelands has risen to be the focus of national policy and academic research, and since 2004, Chinese scholars have put forward a variety of design strategies centering on ecological restoration, cultural landscape integration, etc. The design of the remote mining wastelands in Xuzhou City, as a representative of a resource-based city, has been a major challenge. Xuzhou, as a representative of resource-oriented cities, has made practical progress in ecological restoration, but the research on the combination of naturalistic aesthetics and the design of parks in wastelands is still insufficient. Therefore, in-depth exploration of the application of naturalistic design concepts in the landscape regeneration of mining wastelands not only helps to improve the relevant theoretical system, but also has great value in promoting the practice of wastelands management in Xuzhou and the whole country.

Research Objectives

1.To analyze the development history, distribution status, and characteristics of the Xuzhou mining wastelands landscape.

2.To explore the expression of naturalistic aesthetic language in the landscape regeneration design of these areas.

Research Methodology

This study used a combination of qualitative and quantitative research methods. The specific research methods are as follows:

1. Data sources

The data mainly come from domestic and foreign related literature, on-site research on mining wastelands in Xuzhou, and expert interviews. Literature covers naturalistic landscape design theory, ecological restoration cases of mining wastelands, and research results on the history and current situation of Xuzhou; field research obtains the geographic distribution, natural ecological characteristics and humanistic landscape characteristics of mining wastelands; interviews focus on the professional opinions of landscape designers, ecologists and local managers in the field.

2. Research object and sampling

This study selects representative mining wastelands in Xuzhou as the research object, including quarries, coal mines and other related sites. A stratified random sampling method was used to select typical sites with different ecological status and humanistic values from the

mining wastelands in Xuzhou. The study population consists of the following groups: experts in landscape design in Xuzhou, researchers on the landscape of recreational areas in Xuzhou, local residents around the mining areas, and people related to the mining industry.

3.Data Collection

Literature analysis: systematic review of theoretical research results related to mining wastelands, focusing on the application of naturalistic design concepts in wastelands landscape design; field research: recording the natural environmental characteristics and humanistic landscape elements of mining wastelands through on-site investigation and mapping; interviews and questionnaires: semi-structured interviews with experts to understand their opinions on naturalistic landscape design; questionnaire surveys to collect the Aesthetic evaluation and functional needs of community residents and tourists on the transformation of abandoned land.

4.Data Analysis

Qualitative analysis: content analysis was used to summarize the naturalistic landscape design preferences and key strategies in the interview and questionnaire data; quantitative analysis: the data were analyzed using the statistical tool Questionnaire Star to explore the correlation between residents' and tourists' aesthetic preferences and functional expectations for the landscape of mining wastelands.

5.Research framework

Based on the above research methodology, firstly, we summarize the existing mining wastelands landscape design theories and practice results; secondly, through questionnaire surveys, expert interviews, field research and case studies, we collect information about the current situation, characteristics and tourists' needs of mining wastelands, and use content analysis and statistical methods to refine the key design strategies. Finally, we propose a sample case combining naturalistic theoretical guidance and practice to realize the balance of natural aesthetics, ecological restoration and humanistic care.

Research tool

The research tools employed to study the Xuzhou mining wastelands landscape from the perspective of naturalism aesthetics include observation forms, questionnaires, and interviews. （1）**Observation Form:** Between June and August 2023, on-site observations were conducted in the main urban areas of Xuzhou's mining wastelands to understand the development history, distribution, and characteristics of these landscapes. The results of these observations were descriptively analyzed.（2）**Questionnaire:** From November 2023 to March 2024, the researcher selected four groups of sample informants, including landscape design experts in Xuzhou, researchers of the landscape of Xuzhou recreational areas, local residents around the mining area, and individuals associated with the mining industry. Twenty questionnaires were distributed to each group, totaling 80, all of which were collected, achieving a 100% response rate. These samples were chosen to reflect the overall characteristics and needs from multiple perspectives and levels. The questionnaire aimed to gauge respondents' awareness of the concept of abandoned mining land, the current state of abandoned quarries, their understanding of landscape regeneration, and their assessment of the aesthetic value of landscape regeneration.(3) **Interview Form:** In May 2024, four groups of experts were contacted, and individual experts were interviewed based on a pre-formulated

survey outline. The experts shared their views on the landscape design of mining wastelands, unanimously agreeing that aesthetics should be guided by naturalism. Finally, practical design recommendations were proposed in consideration of the sample site characteristics and aesthetic needs.

Research Results

1. Development history, distribution status and characteristics of Xuzhou mining wasteland landscape

1. 1 Mining wastelands landscape development history

(1) Budding period

The budding period refers to the phase during which mining activities caused significant ecological destruction, with minimal efforts toward ecological restoration. Between 1950 and 1979, in response to the demands of national construction, Xuzhou engaged in large-scale coal mining and quarrying activities. By the 1970s, the prolonged development of Xuzhou's mining and smelting industries had resulted in extensive land occupation and mountain destruction. This led to severe land subsidence, water pollution, and the destruction of vegetation. The government became aware of the environmental harm affecting the population and began considering measures to improve the degraded landscape. However, the land reclamation rate for wastelands remained below 1%.

(2) Transitional period

The transitional period marks the time when some of the abandoned land began to undergo redevelopment as mining activity decreased. Between 1980 and 1999, the Xuzhou government began to focus on the restoration and protection of mining wastelands. In the early 1980s, China's Ministry of Coal Industry drew on foreign land reclamation experiences, leading to the initiation of land reclamation and ecological reconstruction in mining areas. In response to the national call, Xuzhou actively engaged in mining wasteland reclamation efforts, such as the practice of planting saplings in the stone cracks of abandoned mines in Hanwang Town, Tongshan District.

(3) Development period

The developmental period marks the phase during which both the government and society increasingly emphasized the ecological restoration and reuse of mining wastelands. The focused efforts to restore and reuse Xuzhou's mining wasteland landscapes began in earnest in the 21st century. Notably, in 2005, the United Nations Environment Programme launched the "Urban Environmental Agreement - Green City Declaration," and in 2007, China incorporated ecological civilization construction into the government report, setting it as a new requirement for building a moderately prosperous society. In the same year, Xuzhou City developed the "Mountain Forest Protection and Utilization Plan," which provided institutional guarantees for the ecological restoration of abandoned mining areas.

To ensure the smooth progress of ecological restoration, Xuzhou City increased its capital investment in 2008, implementing a series of projects such as "Wetland Restoration" and "Quarry Management." In 2008, Xuzhou City further increased its financial investment, continuing ecological management and landscape restoration efforts, aiming to transform its landscape resources into a mining wastelands park (Li Yong, 2016). Since 2010, Xuzhou has vigorously promoted the "Second March into the Barren Mountains" initiative, aiming to reforest barren landscapes. By 2015, Xuzhou had completed the afforestation of 6,866 hectares

of barren mountains, raising the woodland coverage rate to 32.5%. Notable examples include the Zhushan Quarry Ruins Park and Wolniu Mountain Park (Hongtao Xing, 2024).

1.2 The distribution status of mining wastelands in Xuzhou

The researchers conducted field surveys and literature reviews on two types of mining wastelands, categorizing them into coal mining subsidence type and mountain quarrying type landscapes.

(1) Coal mining collapse type mining wastelands distribution

Coal mining subsidence wastelands are primarily located in the Jiuli, Jiawang, Liguo, Zhahe, and Liguo iron ore mine areas within Xuzhou's urban planning zone. The subsidence and land degradation affect 97.83 km² in Jiawang, 94.88 km² in Jiuli, 11.66 km² in Zhahe, and 3.40 km² in Liguo (Fig. 1). Xuzhou's coal mine subsidence areas are characterized by a high subsidence rate, extensive land degradation, and significant surface water accumulation (Huang Jingjun, 2002). These subsiding areas severely impact local production and daily life, posing significant safety hazards.

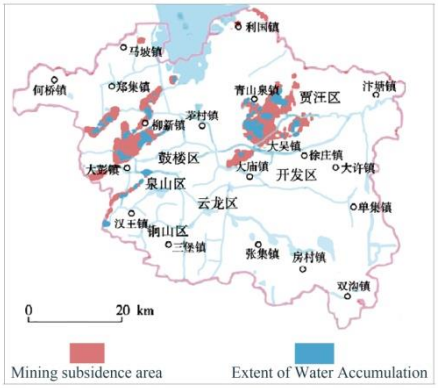


Figure 1 Distribution map of coal mining subsidence in Xuzhou urban planning area
Source: https://www.163.com/dy/article/ER87BBK105509P99.html (2023)

(2) Distribution of mining wastelands of quarrying type

Quarrying-type mining wastelands are mainly distributed along both sides of the Xuzhou Ring Road and within the visual range of the city's three main thoroughfares. The area of quarrying-induced wastelands in Xuzhou's main urban area totals 25.73 km² (Fig. 2). Specifically, 5.74 km² of land was degraded within the urban development boundary, 2.72 km² within the Luliang Mountain Scenic Area, 1.26 km² within the Big Dawng Mountain Scenic Area, and 4.35 km² within the visible areas along both sides of the Beijing-Fu Highway and the Beijing-Shanghai High-Speed Railway (Jiang Bo & An Shoulin, 2019). The quarrying-induced wastelands not only degrade the ecological environment but also pose significant threats to regional economic and social development.

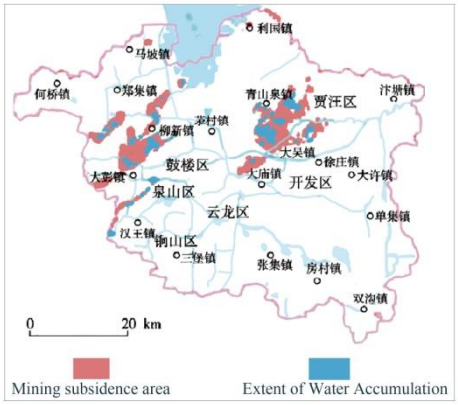


Figure 2 Map showing distribution of minim wastelands in Xuzhou planning area
Source: https://www.163.com/dy/article/ER87BBK105509P99.html (2023)

1.3 Characteristics of mining wastelands in Xuzhou

(1) Natural ecological characteristics

Due to years of underground mining, Xuzhou has developed extensive mining voids, resulting in surface subsidence, cracks, building collapses, reduced land cultivation capacity, and the forced relocation of villages. Coal mining wastewater is contaminated with high levels of parasites, pathogens, and harmful substances, severely polluting surface water, groundwater, farmland, and air. This pollution degrades the ecological environment, results in land wastage, and threatens the survival of nearby organisms. Meanwhile, open quarries in Xuzhou's main urban area, characterized by steeply sloped exposed rock faces (60-70°), have become sources of visual pollution. The original landforms and mountain vegetation have been severely damaged, leaving only weeds and shrubs, which contribute to a degraded ecological environment.

(2) Human landscape characteristics

Post-mining landscape elements, such as cave-ins, structures, abandoned rock and slate, timber, puddles, and processing and transportation facilities, remain at the site. These elements are characterized by fragmentation and dispersion. The visual appeal of the natural landscape has been significantly diminished, resulting in a loss of its original ecological character and transformation into a desolate area. Additionally, although the site's structures and industrial facilities are in disrepair, their unique shape, volume, and style contribute distinctive character to the site. If these elements are reused and transformed into landscapes characterized by "earth art," they could more effectively illustrate the passage of time.

2.The performance of naturalistic aesthetic language in the landscape regeneration design of Xuzhou mining wastelands

2.1 Naturalistic Aesthetic Design Strategies for Xuzhou Mining Wastelands

Naturalistic aesthetic language emphasizes harmonious symbiosis with the natural environment, focusing on ecological restoration and sustainable development. Therefore, in the landscape regeneration of mining wastelands, existing conditions should be utilized to explore the inherent aesthetic value of these sites. Strategies such as prioritizing natural ecological restoration, integrating the site’s natural aesthetic language, and enhancing the interaction of dynamic aesthetic elements are recommended to endow the site with new meanings based on

local conditions.

(1) Advocating Ecological Restoration as a Priority Ecological restoration is the core of mining wastelands management, mainly including the comprehensive restoration of mountains, water bodies, and vegetation. For mountain management, techniques such as partial backfill and planting are used to stabilize the surface, promote plant growth, and achieve ecological restoration. At the same time, the site is greened by structuring plant communities and effectively controlling environmental pollution. For water treatment, low-impact development techniques should be selected based on local conditions to minimize secondary environmental damage and realize the effective use and recycling of resources (Zhong Jianhong, 2007).

(2) Incorporate the natural aesthetic language of the site

In the landscape design of mining wastelands, intervening aesthetic ideas can renew the value of the site and provide aesthetic and functional utility. Respecting natural aesthetics involves more than just allowing nature to recover; it also encompasses ecological restoration and natural remodeling tailored to aesthetic requirements. Through unique lines and textures, abandoned spaces are given new life and aesthetic value (Zhao, Fangying & Xu, 2006). The aesthetic performance of lines is mainly embodied in smooth and soft curves, which can not only effectively soften the hard edges of the wastelands but also visually create a harmonious and natural atmosphere, for example, the Cingshan Mine Pit Park in Shanghai, China (see Figure 2). Conversely, the aesthetic perception of texture is achieved through the skillful fusion of natural and human-made textures, enabling visitors to experience comfort and harmony with the site both in touch and sight, such as at the renowned Akashi Kaikyo Park in Japan and the Tangshan Mine Pit Park in Nanjing, China.

(3) Enhance the interaction of dynamic aesthetic elements

Dynamic aesthetic elements are integrated into the landscape of mining wastelands, thereby injecting new vitality into the site. The interactivity of the site is enhanced, enabling visitors to actively explore the aesthetic value of the art contained within, rather than merely passively appreciating the landscape. Natural ecological processes possess unique aesthetics, and by selecting plants with varying flowering periods and colors, a landscape effect is created that encompasses four distinct seasons, each with its own unique aesthetic appeal. Furthermore, animals, water flow, light, and shadow are incorporated, ensuring that the landscape is not only visually diverse but also harmonious in terms of ecological function and humanistic experience. By utilizing dynamic aesthetics to transform the landscape, the dynamic elements are integrated into the creation of art, thereby showcasing the beauty of vitality.

2.2. Sample - Landscape Regeneration Design for Xuzhou Mining wastelands AnRan Mountain Quarry

2.2.1 Site Overview

(1) Location analysis

Anran Mountain is situated to the east of Damiao Town, within the Xuzhou Economic Development Zone, Jiangsu Province, China. This area serves as a significant gateway to the eastern region of Xuzhou. The abandoned quarry at Anran Mountain is situated 4 kilometers away from Xuzhou East Railway Station, on the north side of the G206 National Highway, and is one of the renowned mountain ranges located on the outskirts of the city. It borders Qinglong Mountain to the west, Anran Village to the south, Laotuoren Village to the

north, and Pack Blue Mountain to the east. The total area of the plot is approximately 24.6 hectares, with a water area of 6 hectares (Figure 5). The surrounding terrain is diverse and possesses obvious natural advantages, while the overall environment is beautiful and holds outstanding natural aesthetic value.

(2) Analysis of the current situation of the site

AnRan Mountain Quarry, located at longitude 117°22′03″E and latitude 34°17′41″N, experiences a southern temperate monsoon climate, with an annual temperature of 14℃ and an average annual precipitation ranging from 800 to 930mm. The outline of the site bears resemblance to a "key shape". Mining activities and other factors have resulted in significant elevation changes and steep slopes within the mountain, with a maximum height difference of up to 29 meters. The site is characterized by abundant debris, low vegetation coverage, underground hollows, and heavily polluted water sources. Additionally, the presence of broken rock bodies not only causes visual pollution and geological hazards but also impacts the lives of surrounding residents. The site comprises an Ran Mountain, a lake, hills, hilly woodlands, and quarries. It features existing rock wall sections, quarry pits, broken ground surfaces, and visible traces of crags, pits, and earth walls (refer to Fig. 3).

Figure 3 Xuzhou Anranshan Quarry Area Location
Source: Zhihu, Jiangsu important news network

2.2.2 Strengths and Opportunities Analysis of the Site

(1) Strengths Advantages

The tourism location advantage of the Anran Mountain Mining Site is evident. The site boasts convenient transportation and is situated just 5 kilometers away from the Xuzhou High-Speed Railway International Business District and the scenic Jinlong Lake Area. It experiences a temperate climate with four distinct seasons and features typical geological and geomorphological phenomena. The site, located in the suburbs and serving as a transitional zone between the city and the countryside, is just a 1-hour drive from the city center. It offers city dwellers an ideal escape from the hustle and bustle, providing a close-to-nature experience while fulfilling its role as an urban green lung and activating the ecological functions of this transitional zone.

(2) Opportunities

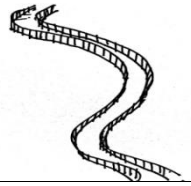
Xuzhou is expediting the reform of its ecological civilization system and has initiated the formulation of the Special Plan for the Reclamation and Utilization of Industrial and Mining Wastelands in Xuzhou since 2012. This initiative presents a new development trajectory for the landscape restoration of mining wastelands in the region. The swift progress of the Xuzhou Economic Development Zone will undoubtedly draw more domestic and foreign tourists to the area, thereby positioning the landscape of the Anran Mountain quarry site as a significant urban showcase, exhibiting the new urban aesthetic of Xuzhou.

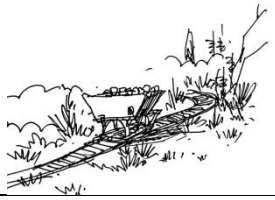
2.2.3 Sources of inspiration for site design

(1) Xuzhou Anran Mountain Quarry faces ecological problems. The design is inspired by ecological restoration and sustainable development, aiming to transform it into a green public space. The design considers the complex ecological environment, including natural elements such as gravel, stone walls, mountains, water bodies and plants. It draws inspiration from natural forms, textures and colors, and uses natural elements for landscape design to coordinate the site with the surrounding environment and bring visual and harmonious Tactile comfort. (Table 1).

(2) Understand the needs through communication with residents, and fully consider leisure, entertainment and public service facilities in the design, such as setting up trails, plant viewing areas, etc., to meet people's daily activities and communication needs. The overall design realizes the landscape regeneration of the abandoned quarry and creates a green and sustainable public space through ecological restoration, extraction of natural elements and response to residents' needs.

Table 1 the design inspiration

Characteristics	**Design methodology**	**Creative part**
Characteristics of nature 	The ecological integration of natural elements is mainly reflected through graphics, colors and shapes. These elements are mainly derived from nature, mainly animals and plants, and reflect spiritual sustenance. Such as: lotus, etc. Refining and metaphorical techniques express some abstract thoughts and feelings, such as water, clouds, etc., showing the beautiful relationship between man and nature.	Lotus flower  Water pattern 
Terrain Characteristics 	According to the topographic characteristics of the quarry, lines are extracted and abstract expressions are applied to any corner of the road or environment. Modern design techniques are used to create a new.	Curved boardwalk 
Landscape Characteristics	Highlight the unique landscape elements of the quarry, such as the	Stone transport truck

Characteristics	Design methodology	Creative part
	abandoned stones of Anran Mountain, processing and stone transportation, etc., refine the element symbols, and give the site unique landscape characteristics	

Source: Author (2024)

2.2.4 Design positioning

Based on the texture of the site and making full use of the existing topography and other current conditions on the site, the Anran Mountain Quarry, an abandoned mining site in Xuzhou, is transformed into an eco-friendly and vibrant landscape park. The design concept takes naturalistic ecological restoration as the core, combines the natural and human resources of the site, and defines the place as a comprehensive mountain park that integrates ecological services, cultural display, viewing and recreation, and fitness.

2.2.5 Analysis of the natural aesthetic value of the quarry site

(1) Natural aesthetic value of the site

According to the analysis of the natural conditions of the preliminary site research, it is known that the site has a certain natural aesthetic value. Although the mining activities have caused some damage to the geological structure and vegetation of the Pack Blue Hill Quarry, the overall landscape of the site is preserved basically intact, with no significant geologic hazards, such as landslides or collapses, and less debris and residue. The site has better preserved the original landscape of the quarry wastelands, showing a unique natural texture, which constitutes an important basis for the natural aesthetic value. In addition, the ecological environment around the site is good, and restoring its ecological conditions will help integrate with the surrounding ecological environment and enhance the ecological benefits. Discovering the natural aesthetic value of the Pack Blue Hill Quarry is of positive significance to the promotion of local ecological protection and development.

(2) Artistic and aesthetic value of the site

Due to the large scale of the existing pit, the Pack Blue Mountain Quarry has formed a rich spatial combination with the topography and cliffs within the site, which together with the remaining wilderness landscape constitutes a very high artistic aesthetic value. At the same time, the mining site is surrounded by convenient transportation, rich and diverse tourism resources, and is geographically close to the town and the high-speed rail business district, which possesses a certain base of tourist sightseeing crowds. Therefore, by exploring and utilizing the artistic and aesthetic value of the site, it can be shaped into a brand-new and differentiated form of park, showing the unique charm of the mine and attracting public attention.

2.2.6 Landscape design strategy under the guidance of naturalistic aesthetics

Due to the poor quality of the ecological environment of Xuzhou Anran Mountain Quarry, the construction of the mine park is carried out to respect the environment and texture of the site, protect the landscape substrate of the site, and ensure the integrity and continuity of the mountains and water bodies in the site through the restoration of the mountain landscapes and the integration of the water system.

(1) Mountain design

Ecological restoration of the original mountain after mining on the site. By partially backfilling and controlling the height of the contour wall, the aim is to intentionally restore the morphology of the mountain. This approach not only significantly reduces the amount of earthwork, but also allows the terrace-type structure to be closely integrated with the original mountain, preventing soil erosion and landslides. At the same time, the contour restoration wall itself creates an atmospheric and beautiful landscape texture that blends perfectly with the mountain (Figure 4). This design focuses on both functionality and aesthetic value, enhancing the natural harmony of the overall landscape.

Protect the existing mountains and their vegetation and create a continuous and diverse habitat environment for flora and fauna. After the greening of the mountains within the site, only low-intensity sightseeing and recreational programs such as walking trails and landscape towers will be installed. The walking trails are designed to be elevated to minimize damage to the vegetation and soil of the mountain and to reduce the impact on animal migration. In addition, the depth of the pit and the height of the rock walls are utilized to create a multi-level visual experience. Viewing platforms are designed on the mountain to provide panoramic views and enhance the sensory experience for visitors.

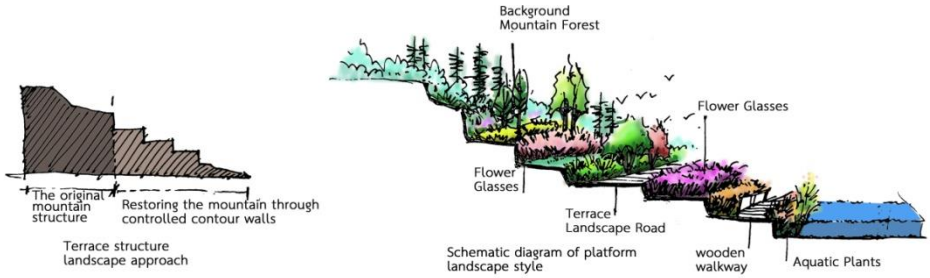


Figure 4 Terrace structure landscape approach and Schematic diagram of platform landscape style
Source: Author (2024)

(2) Water body design

Establish a perfect low-impact development system in the abandoned quarry site. Arrange rainwater collection ponds in the low-lying areas on the east and west

Establish a perfect low-impact development system in the abandoned quarry site. Arrange rainwater collection ponds in the low-lying areas on the east and west sides of the base to collect and purify rainwater runoff from the mountain and the site with the advantage of natural terrain. Design an ecological rainwater diversion system on the site to collect and purify the rainwater, which will then be channeled into the wetland system. Create a small wetland landscape garden, aiming to promote the concept of wetland conservation and sponge city management and its practical application knowledge.

Create a landscape water system with a focus on viewpoints, covering waterfalls, wetlands and lakes. In addition, on the south side of An Ran Mountain in the lake zone, design rain gardens and rainwater wetlands (Fig. 5) with a water surface area of about 6 hectares. On the north side of An Ran Mountain, design berm ecological planting tanks. Through the reflection of the water surface and the surrounding vegetation, the dynamic aesthetics of the landscape will be increased. Streams and waterfalls are designed in conjunction with the

topography (Fig. 6), utilizing the natural drop to form a water landscape, enhancing the vitality and attractiveness of the site, and improving the overall landscape quality and ornamental value.

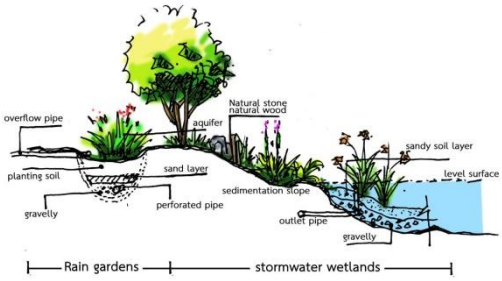


Figure 5 Rain gardens and stormwater wetlands
Source: Author (2024)

Figure 6 Designed waterfalls on the rocky cliffs of the mining face
Source: Author (2024)

(3) Plant Design

Plant restoration landscaping can integrate natural and artistic aesthetic values to create a novel natural garden, which not only meets the needs of tourists, but also promotes ecological recovery. Firstly, for the characteristics of poor soil and drought in Xuzhou mine wastelands, drought-resistant and barren plant species, such as creepers and spring flowers, are planted on the cliff wall through the technique of "planting holes", which gradually cover the exposed rocks and form a green ecological barrier. Secondly, the implementation of horizontal re-greening habitat garden. Firstly, the gravel tailings will be cleaned up on the site, and then the direct mulching of 30-60m (soil improvement) will be adopted, paying attention to the preservation of the site's original arborvitae. Choose colorful foliage, aromatic, ornamental grasses and other plants to form a rich vegetation level. Thirdly, utilizing the rocks of the site's stone material, it will be piled up as a rock garden, and the vegetation suitable for growing in the environment here will be selected (Table 2). That is to say, the disadvantage can be transformed into an advantage, effectively prevent soil erosion, enhance soil fertility, and gradually restore the stability of the ecosystem, and at the same time, it also solves the restoration safety problem of the mine pit slope and the problem of rainwater runoff. Natural stone stacking also creates a sense of wild nature. Fourth, in reflecting the aesthetic aesthetics of plants, focusing on the natural grouping of plant design, integrating the terrain and softening the hard landscape. Skillful use of plant form, color and seasonal changes create a multi-layered visual landscape.

Table 2 Vegetation selection for rock gardens

Plant species	**plant name**
arbors	Chinese pine, lacebark pine, Robinia pseudoacacia, elm, wingceltis
shrub	Sabina procumbens, fructus forsythia, winter jasmine, cornus alba
ratoon flowers	Hosta plantaginea, Chinese peony, hollyhock, roof iris, annual phlox, orange day-lily, vervain
flower bulbs	Tulbaghia violacea, Lilium tenuifolium, Oxalis corniculate, tulip
Herb	Chinese Pennisetum, pampasgrass, rusty woodsia, stipa capillata
Ground cover plants	ophiopogon japonicus, bison grass, Sedum aizoon

Source: Author (2024)

(4) Waste material reuse design

Reasonable reuse of waste materials in the site not only protects the ecological environment and saves resources, but also injects artistic aesthetics into the landscape (Fig.7). Abstract and artistic processing of the remnants gives them aesthetic value. Combining the design of waste materials and natural elements within the site, it activates the vitality of the site, enhances the characteristics of public facilities and identification systems, and creates a unique landscape of the mining wastelands at a low cost. It not only meets people's aesthetic needs, but also breathes new life into the wastelands, highlighting its uniqueness and artistic value.

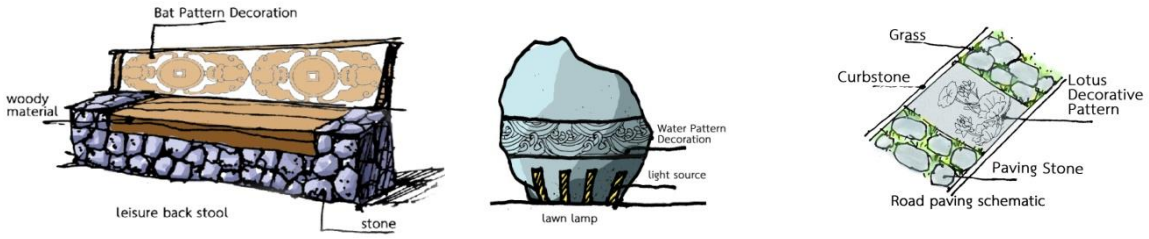


Figure 7 Landscape lights, benches and road paving are all designed using site waste materials + natural patterns

Source: Author (2024)

Discussion and Conclusions

1. Discussion

1.1 Stages of mining wastelands landscape development

This study points out that the development of mining wastelands landscapes in China has gone through an embryonic, transitional and developmental period, a finding that is consistent with Li Pei scholars' literature study on the protection and utilization of mining heritage (Li Pei, 2016), further validating the temporal evolution of the governance of mining wastelands. At the same time, this study particularly emphasizes the design concept of prioritizing ecological restoration in the transition period, further refining the special manifestation of this process on Chinese mining wastelands, and providing more detailed temporal clues and geographical characteristics for the study of wasteland heritage sites.

1.2 “Point-like” distribution characteristics and ecological restoration strategy

It is found that the distribution of Xuzhou mining wastelands is characterized by “point-like” distribution, accompanied by serious damage to the natural ecology and dispersed humanistic landscape, which is consistent with Zhong Jianhong's study on the restoration of Xuzhou quarrying wastelands (Zhong Jianhong, 2007). On this basis, this study further proposes a design concept based on the priority of natural ecological restoration, which provides a specific ecological restoration and landscape design strategy for the “point-like” distribution of wastelands, reflecting the creative use of the site-specific conditions, and providing new perspectives and practical examples for similar studies.

1.3 Integration of natural aesthetics and dynamic aesthetic elements

By analyzing the aesthetic value of naturalism, this study proposes that the interaction of dynamic aesthetic elements (e.g., waterfalls and rain garden design) is one of the core strategies for constructing the language of natural aesthetics. This result echoes the theory of “the beauty of weeds” proposed by Yu Kongjian (Yu, 2003), and is verified in more detail in actual cases, such as designing terrace landscapes based on contour lines and selecting native plants that change in the four seasons, demonstrating how to realize the integration of natural aesthetics in specific mining wastelands scenarios, and providing an opportunity for The design of the terrace landscape according to the contour line and the selection of native plants in four seasons, etc. demonstrates how to realize the integration of natural aesthetics in specific mining wastelands scenarios, and provides new ideas for the expression of natural aesthetics in mining wastelands.

1.4 Waste Reuse and Ecological Design Innovation

This study demonstrates through examples how the artistic transformation and functional regeneration of waste can be realized in mining wastelands projects, such as the use of waste ores to design seating benches, landscape lamps, and paving, etc. These practices not only reduce the waste of resources, but also endow the site with a unique historical memory and cultural identity, and provide design inspiration for sustainable regeneration. This innovative design idea continues the ecological design concept proposed by Prof. Wang Xiangrong (Wang Xiangrong, 2002), and combines the actual situation of local resources in China to propose appropriate design strategies.

2. Discussion

This paper summarizes relevant theories and practical experiences at home and abroad, and proposes a naturalistic aesthetic design strategy for the landscape of mining wastelands in Xuzhou, taking into account the development history, distribution and characteristics of the landscape of mining wastelands in Xuzhou. It is found that (1) the development history of the landscape of Xuzhou mining wastelands, accompanied by resource extraction, ecological destruction and subsequent attempts at governance and regeneration, provides temporal clues for understanding the historical context of mining wastelands. (2) The overall distribution of Xuzhou mining wastelands is "point-like", and the wastelands are characterized by recognizable humanistic landscapes and natural ecology. The natural ecology of these areas is severely damaged and the humanistic landscape elements are scattered, so effective landscape regeneration strategies are urgently needed to restore ecological balance and enhance aesthetic value. (3) The design strategy is summarized in three aspects: prioritizing natural ecology restoration, integrating natural aesthetic language, and interacting with dynamic aesthetic elements. (4) Based on the sample analysis of Anran Mountain quarry landscape regeneration design as an example, the design inspiration, design concept and design objectives are proposed. It aims to realize the regeneration and revitalization of the site through the excavation and enhancement of natural aesthetic value. It is summarized that landscape restoration needs to comprehensively consider the ecological environment, historical culture and aesthetic value, and realize the organic integration of ecology, culture and aesthetics through ecological restoration, cultural integration and technology application, so as to inject new vitality into the sustainable development of Xuzhou.

Recommendations

Based on the results and limitations of the current study, the researcher's recommendations and specifics of the future step in the study are as follows:

1. Aspects of the research proposal

1.1 Academic Recommendations

Promote interdisciplinary cooperation, integrate multidisciplinary research on ecology, culture, society and economy, and deepen the comprehensive theoretical framework of mining wastelands regeneration. Establish a long-term monitoring and evaluation mechanism to track the ecological, social and economic benefits of the project, and provide empirical support for optimal design and research.

1.2 Policy recommendations

Improve policies and regulations, clarify the objectives and measures for the regeneration of mining wastelands, encourage multi-party participation, and form a government-led and socially coordinated governance model. Strengthen policy implementation and supervision to ensure that the project complies with regulations and environmental protection requirements, and safeguard public interests and implementation effects.

1.3 Operational Recommendations

Promote technological innovation and intelligent application, and utilize modern technologies such as big data and artificial intelligence to enhance the accuracy of design and implementation. Strengthen community participation and public communication, respect local needs, enhance the public's role in decision-making and supervision of the project, and improve social acceptance and sustainability.

2.Future directions for further research

2.1 Ecological restoration and biodiversity protection mechanism

In-depth study of the process and mechanism of ecological restoration of mining wastelands, and exploration of effective strategies and methods for biodiversity conservation. Through ecological research methods and technical means, we will reveal the intrinsic connection and interaction between ecological restoration and biodiversity.

2.2 Assessment and inheritance of social and cultural values

Carry out research on the assessment of the social and cultural value of mining wastelands, and explore their historical cultural heritage and regional characteristics. Through the perspectives and methods of culture and sociology, explore how to integrate social and cultural values into landscape regeneration design to realize cultural inheritance and innovation.

2.3 Economic effect and sustainable development mode

Study the economic effect and sustainable development mode of the landscape regeneration project of mining wastelands, and analyze the economic relationship between project input and output as well as the long-term benefits. Explore how to realize the synergistic development and win-win situation of economic, social and ecological benefits of the landscape regeneration of mining wastelands through economic theories and methods.

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