

Research on Landscape Design of Xi'an Metro Construction Project

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Abstract. The construction of rail transit has the characteristics of huge investment, long cycle, and extensive impact, which leads to the long-term occupation of urban space by subway construction sites, causing significant impacts on urban landscape and residents' lives. Taking Xi'an as an example, as a key city for the development of the northwest region, the expansion of its subway network is an important symbol of regional development and also indicates that subway construction sites will become a norm in the city. The report of the 20th National Congress of the Communist Party of China emphasizes the importance of green development, and exploring the optimization design of subway construction sites and their surrounding landscapes has become particularly important. Through observations during school and daily life, as well as on-site inspections and questionnaire data analysis of the construction projects of Xi'an Metro Line 6 and Line 8, this study found that the main environmental problems include poor environmental experience quality, blurred landscape features, difficulty in standardizing design, difficulty in meeting diverse needs with landscape measures, and lack of consideration for urban landscape system integration. Based on these issues, corresponding solutions are proposed: emphasizing the integration of external landscape design with urban and corporate culture, enriching functionality to achieve a win-win situation for economic and social benefits, pursuing standardization and sustainable development of design, adopting diversified design to meet the needs of different groups of people, and achieving unity between landscape design and the overall urban landscape. The aim of this study is to optimize recycling and improve the landscape comfort of subway construction sites and along the line by adopting measures such as green building technology and movable assembly landscape design, and to combine them with historical and cultural heritage to achieve effective integration of commercial advertising and public welfare. This will not only enhance the urban image of Xi'an and even Shaanxi, but also promote the experience gained to relevant projects nationwide and even globally, serving as an important public welfare publicity window and experience demonstration.

Keywords: Xi'an Metro; Project construction; Landscape design; Green development.

1. Introduction

1.1 Background of the Times

The subway, as an important component of urban infrastructure, is the artery of urban development. Xi'an, as a core city in the northwest region, has been seeing an increasing number of subway lines and growing mileage with the development of society. At the same time, the construction period of these projects ranges from one year to two or three years, or even longer. The construction sites of these projects will exist for a long time in the urban construction process and can be said to be a long-term part of the urban landscape environment[1]. Therefore, the green and ecological landscape development of the construction sites and along the lines of Xi'an's subway projects will undoubtedly become an important measure for the high-quality life development of the city's people in the future.

Since the 18th National Congress of the Communist Party of China, the Party Central Committee has proposed the development concepts of green, open and shared, which were written into the Thought on Socialism with Chinese Characteristics for a New Era at the 19th National Congress. The 20th National Congress report further emphasized the need to promote green development and

people-centered development and construction. It can be seen that cities across the country are responding to the call and implementing green construction[2] and civilized construction sites, reducing the impact of each link in the construction process on the surrounding environment and enhancing the social and ecological benefits of the entire project. The construction site environment of subway projects, as a temporary office and living place set up by project construction managers, has the conditions and effectiveness to achieve the effects of noise reduction, urban beautification[3] and ecological benefits through landscape creation.

In recent years, with the expansion of urban construction scale in central China, the urban transportation network has also begun to develop rapidly. Many cities have started to build subway projects, thus bringing "construction areas" into people's lives. With the grand entry of subway construction projects, temporary road occupation and enclosures have become a special sight in the city. Although design and construction units have taken certain temporary defense measures in project planning and construction routes, the effect they have played is negligible for such large-scale and long-term construction projects as subway construction on the ecological environment.

1.2 Source of the Topic Selection

On the way to school and in daily life, I have noticed some ongoing subway construction sites in Xi'an. It is reported that these projects typically last from one to two years at the shortest and up to three to four years at the longest. During the process of subway construction, there will be considerable impacts on the surrounding environment and landscape. Some construction areas will occupy large areas of urban roads or other lands to meet the needs of engineering construction. This not only may change the original natural features but also may have certain impacts on the surrounding ecological environment. In addition, problems such as noise and dust during the subway construction process[4] also bring certain troubles to the lives of nearby residents. Regrettably, some subway lines may pass through sites or scenic areas of significant cultural value[5]. How to protect these precious cultural heritages and natural landscapes during the construction process has become a key issue of concern and reflection.



Fig. 1 Site Map of Xi'an Metro Construction Project

1.3 Research Contents

According to General Secretary Xi Jinping's proposal at the Fifth Plenary Session of the 19th Central Committee, in the next five years, the country will vigorously develop transportation infrastructure, promote green development, adhere to the priority of conservation, deeply implement sustainable development strategies, and promote comprehensive green transformation of society. All industries should shift towards an environmentally friendly and resource-saving development model.

As of June 2023, Xi'an Metro has 9 lines in operation, including Lines 1 to 6, Line 9, Line 14, and Line 16, with a total operating mileage of 301 kilometers. There are 187 stations in total, among which 19 are transfer stations. As of September 2023, there are 4 lines under construction in Xi'an Metro, namely the third phase of Line 1, Line 8, the first phase of Line 10, and the first phase of

Line 15. The total construction mileage is 114.31 kilometers, including 10.61 kilometers for the third phase of Line 1, 50 kilometers for Line 8, 34.2 kilometers for the first phase of Line 10, and 19.5 kilometers for the first phase of Line 15. There are 74 stations in total, including 7 for the third phase of Line 1, 37 for Line 8, 17 for the first phase of Line 10, and 13 for the first phase of Line 15. Meanwhile, the approval and routes of the fourth phase of Xi'an Metro have been frequently mentioned recently.

The existence of the subway project will accompany the subway construction process for a long time in medium-sized cities. Currently, Xi'an is actively fulfilling its main responsibility for urban rail transit construction and has included multiple subway lines in the fourth phase of construction planning for argumentation, including the second phase of Xi'an Metro Line 3, the first phase of Line 11, Line 12, and the second phase of Line 16. In addition, Xi'an is planning 12 urban rail transit lines and 4 branch lines, with a total mileage of 833 kilometers. This bidding project is also a pre-study project for the fourth phase of the construction plan. According to the provisions of the State Council General Office Document No. 52, in principle, a new round of construction planning can only be carried out when the last year of the current construction plan is implemented or more than 70% of the total investment of the planned projects is completed. Therefore, the urban rail transit construction in Xi'an will become more busy and diversified in the future.

Based on the current situation and future planning of Xi'an Metro, this paper sorts out and summarizes the design issues of the on-site environment and the landscape along the line of the Xi'an Metro construction project, and proposes corresponding renovation measures. It studies how to enrich the landscape environment of the project, better interpret and promote the historical and cultural characteristics of the city, how to meet the market demand and create distinctive urban architectural products under the limited investment cost, and how to make good use of the capital advantage under the limited conditions to create good office and living conditions, with the aim of providing design suggestions for the Xi'an Metro construction project.

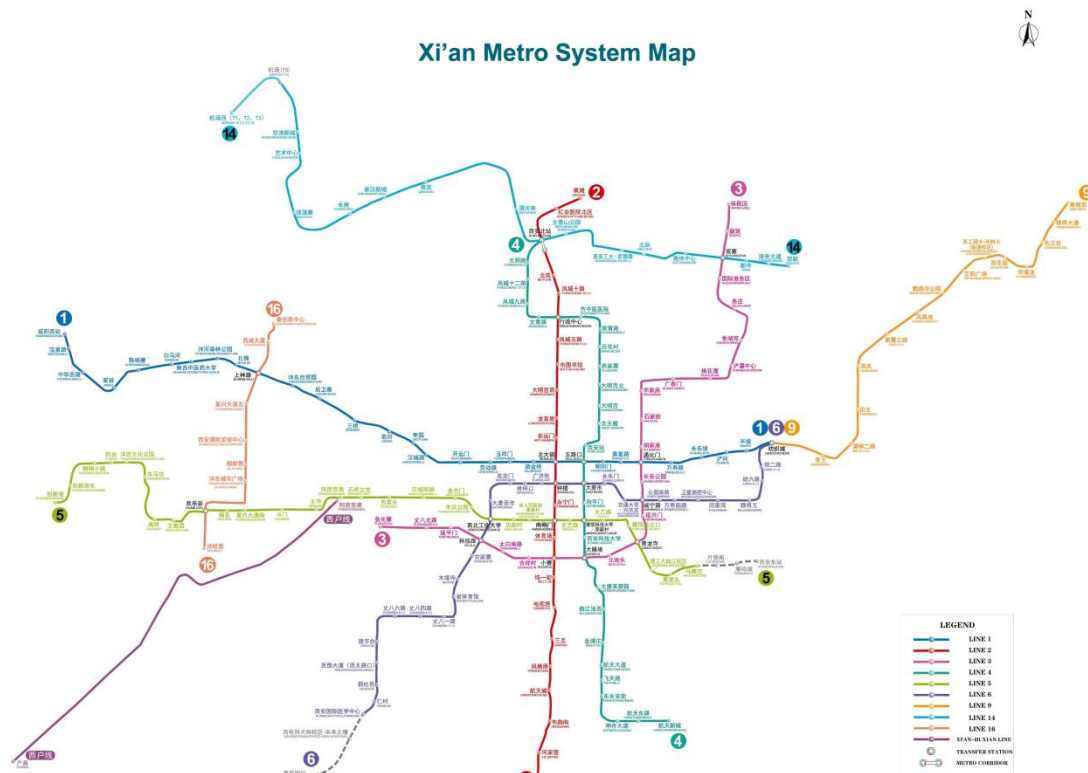


Fig. 2 Xi'an Metro Planning Map

1.4 Research Objectives

Integrating the creation of landscape comfort in metro construction projects with the spatial shaping of the surrounding environment and historical culture along the construction route aims to

achieve a dual improvement in economic and social benefits. It is expected that through in-depth research and innovative practices, metro construction can be transformed into a part of the urban landscape, providing citizens and tourists with a richer visual experience and enhancing the attractiveness of the city's image. Additionally, by exploring and integrating the unique environmental and historical cultural elements along the construction route, a metro construction landscape with regional characteristics and cultural heritage can be created, further deepening citizens' cultural identity and sense of belonging.

1.5 Research Significance

Firstly, by promoting the subway construction industry towards a more environmentally friendly and aesthetically pleasing direction, it is expected to enhance the overall image and competitiveness of the industry, and inject new vitality into its sustainable development. Secondly, it can provide valuable experience and reference for similar projects, helping to elevate the landscape design level of subway construction projects across the country and even the world to a new stage. Finally, by meticulously crafting an important public welfare window for the city's external promotion, it will further showcase the urban charm and cultural soft power of Xi'an and even Shaanxi, attracting more tourists and investment, and contributing new strength to the prosperous development of the local economy. This not only has significant practical value but also holds profound significance for enhancing the city's image and the long-term development of the subway construction industry.

1.6 Research Methods

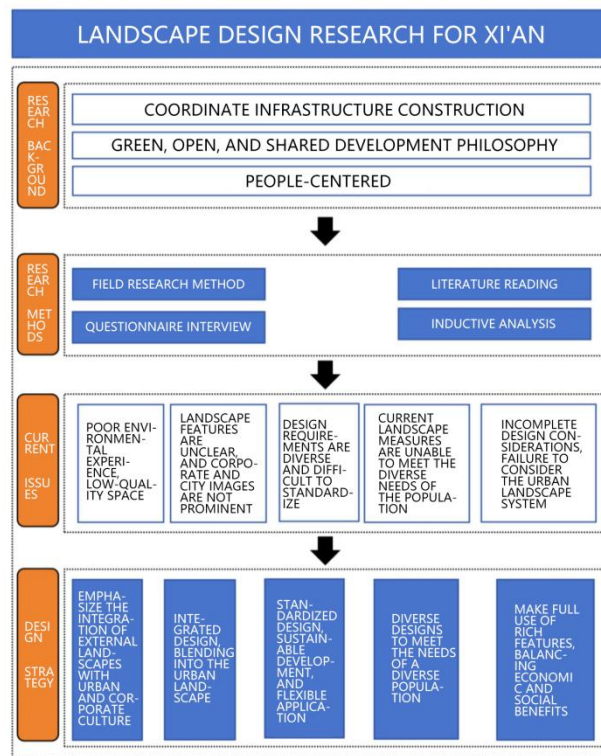
Field research method: Conduct on-site research on the current situation of the landscape of the Xi'an Metro construction project and its surrounding areas, summarize the problems and draw lessons, organize data, and analyze and summarize the fundamental issues of the design of the Xi'an Metro construction project and its surrounding landscape.

Questionnaire and interview method: Carry out visits and investigations on the Xi'an Metro Line 6 project and its surrounding areas, the 2nd section of the general contracting project of the Xi'an Metro Line 8 project, and other objects. The investigation targets include the project site and surrounding landscape, project personnel, and surrounding residents. Through visits and investigations, summarize the reflected problems and conduct analysis and summary.

Literature review method: Based on the determined research objects, extensively consult books and literature related to the discipline and topic in libraries, archives, and on the Internet, and conduct analysis, research, and summary by referring to similar domestic and foreign cases.

Inductive analysis method: Starting from the pressure that the construction area brings to the environment, summarize the existing problems and commonalities that need to be improved in the construction area, and further analyze the basis for the green transformation design of the construction area enclosure.

1.7 Technical Route



2. Research Subjects and Methods

2.1 Definition of Relevant Concepts

(1) Metro construction refers to a series of construction activities carried out underground in cities, mainly including tunnel excavation for metro lines, station construction, and track laying. Due to the underground operations, metro construction is characterized by large-scale engineering, high technical requirements[6], and great construction difficulties. During the construction process, issues such as drainage, ventilation, and transportation need to be addressed, while also dealing with challenges such as complex geological conditions and harsh environments.

(2) The landscape environment of a metro construction site refers to the overall visual, ecological, and cultural environment formed during the metro construction activities within the construction area and its surrounding areas. It encompasses temporary facilities, material storage, road layout within the construction area, as well as the impact of construction on the surrounding natural environment and urban landscape.

The landscape environment of a metro construction site mainly includes the following aspects:

- ① Environmental protection: Reducing pollution such as dust, noise[7], and sewage during the construction process to minimize the impact on surrounding residents and the living environment.
- ② Safety measures: Ensuring the safety of the construction site by setting up warning lines, warning signs, etc., to prevent unauthorized personnel from entering the construction site.
- ③ Beautification of the environment: Greening and beautifying the construction site by setting up green belts, sculptures, etc., to enhance the aesthetic appeal of the construction environment.
- ④ Convenience facilities: Providing convenience facilities for residents around the construction site, such as temporary parking lots and convenience service stations.
- ⑤ Cultural promotion: Displaying information such as the significance and progress of metro construction through bulletin boards and slogans to enhance communication and interaction with surrounding residents.

⑥ Ecological protection: Protecting the surrounding ecosystem, such as ancient trees and water bodies, to minimize the impact of construction on the ecological environment.

By creating a favorable landscape environment at the metro construction site, a harmonious coexistence between engineering construction and environmental protection and beautification can be achieved, providing citizens with a comfortable and convenient living environment.

2.2 Review of Domestic and International Research

In recent years, with the acceleration of urbanization, the subway, as an important component of urban transportation, has seen its construction...

With the increasing frequency of construction activities, the issue of subway construction not only involves engineering and technical problems but also the impact on the surrounding landscape and environment. Therefore, how to achieve harmonious coexistence between subway construction and the surrounding environment has become one of the current research hotspots.

Firstly, from the perspective of public space design, the landscape environment of subway construction sites should fully consider the convenience of public travel. Taking the Chunxi Road Station of Chengdu Metro as an example, Geng Zhirong and Song Yuxuan pointed out that in public space design, the integration of culture and environment should be the guiding principle[8], supported by ecological green landscapes, to create a unique public space landscape. This design concept is not only reflected in the simplicity and elegance of the shape but also in providing citizens with a comfortable and pleasant experience through a green and environmentally friendly environment. This design concept is of great significance for improving the overall landscape environment quality of subway construction sites.

Secondly, the square at the subway entrance and exit, as an important node connecting the subway and the city, is also crucial in terms of landscape design. Wu Miao, Duan Lijuan and Li Jiateng, in their research on the square at the entrance and exit of Wuhan Metro Line 3, found that the landscape design of the square had problems such as weak regional characteristics[9] and weak connection with the surrounding environment. This suggests that in the landscape design of subway entrance and exit squares, more attention should be paid to the integration with the surrounding environment, and through reasonable spatial layout and landscape design techniques, the overall image and functionality of the square should be enhanced.

In addition, the environmental impact during the subway construction process cannot be ignored. Jin Zhige and Li Wei conducted a comprehensive analysis of the environmental impact during the construction period of Shenyang Metro Line 1 and proposed measures to alleviate and control the environmental impact. These measures include the control and treatment of pollutants such as noise, vibration, wastewater, waste gas and solid waste to ensure that the impact of subway construction on the surrounding environment is minimized.

At the same time, the management of risk sources during the subway construction process[10] is also an important part of ensuring the safety of the landscape environment. Li Fei pointed out that the risk sources in subway construction mainly come from various factors such as construction technology, which not only affect construction safety but also pose potential threats to the surrounding environment. Therefore, during the subway construction process, it is necessary to strengthen the identification and management of risk sources and take effective risk control measures to ensure construction safety and the safety and stability of the surrounding environment.

Finally, the environmental impact assessment of specific construction types such as open-cut subway stations is also an important research direction. Liu Minghui et al. used the life cycle environmental assessment method to evaluate the environmental impact of the construction period of Beijing Metro open-cut stations and found that the energy consumption and greenhouse gas emissions caused by the extensive use of construction and transportation machinery[11] were the main environmental impact issues. This suggests that during the subway construction process, the mechanical usage plan should be optimized to reduce energy consumption and emissions and achieve green construction.

In conclusion, the research on the landscape environment of subway construction sites involves multiple aspects, including public space design, the landscape design of entrance and exit squares, the environmental impact during the construction process, and the management of risk sources. All these aspects are crucial for achieving harmonious coexistence between subway construction and the surrounding environment.

In the future research, more attention should be paid to the comprehensive consideration of these aspects, and more scientific and reasonable optimization strategies for the landscape environment of the metro construction site should be proposed to provide strong support for the sustainable development of urban metro construction.

3. Current Issues

As an inland developed city, Xi'an aims to build a national central city and shape an international historical and cultural tourism city image. As of June 2023, Xi'an Metro has opened 9 lines in operation, including Lines 1 to 6, Line 9, Line 14, and Line 16, with a total operating mileage of 301 kilometers. As of September 2023, there are 4 lines under construction in Xi'an Metro, including the third phase of Line 1, Line 8, the first phase of Line 10, and the first phase of Line 15. The total mileage under construction is 114.31 kilometers, with a total of 74 stations, including 7 for the third phase of Line 1, 37 for Line 8, 17 for the first phase of Line 10, and 13 for the first phase of Line 15. At the same time, the approval and planning of the fourth phase of Xi'an Metro have been repeatedly brought up. This indicates that Xi'an's rail transit development will remain in a high-intensity and large-scale construction phase for a long time in the future, and the construction site environment of Xi'an Metro will become a long-term phenomenon. In real life, most projects are located on one side of urban roads. While providing convenience for construction workers' living and working, the appearance and internal environment still have the problems of being dirty, messy, and poor. Therefore, most metro construction projects in Xi'an cannot meet the development needs of a civilized city and have not been well integrated with the urban landscape and culture.

3.1 Poor environmental experience quality and low spatial quality

Due to various reasons, the measure fees required for metro construction projects are generally low. The construction sites are mostly cement and steel[12], with little attention paid to site environment design and surrounding landscapes. As a result, landscape design is often not given due importance, further reducing the employees' experience. The metro project construction departments often need to dig roads and demolish buildings. Such large-scale earthwork excavation can lead to a series of phenomena that reduce the spatial experience, such as noise and dust.



Fig. 3 Project Diagram of Xi'an Metro Line 6

3.2 The landscape features are ambiguous, and the corporate and urban images are not prominent

Most people are dissatisfied with the on-site environmental design of metro construction projects, considering it lacking in aesthetic appeal and uniform. It fails to reflect the corporate image and also does not adequately represent the cultural and historical characteristics of the city. The design

should be carried out based on the project's geographical location, local cultural features, climate and geological and hydrological conditions, the developer's product positioning, the target consumer group, and the architectural style of the plot. Only such a design can meet the developer's needs. Therefore, as landscape design managers, during the review of design results, we must resolutely eliminate any "replicated" landscapes without any distinctive features. We should highlight the style characteristics of the product in combination with the project's own situation and find the selling points of the product based on its own features.

3.3 Diverse design requirements make standardization rather difficult.

In the landscape design of subway project construction departments, ecological sustainability is often overlooked. This may lead to environmental damage and resource waste[13]. For instance, the landscape design might not take into account the growth environment and needs of plants, or fail to adopt eco-friendly materials and technologies, or carry out sustainable and reusable designs. Landscape design is not only an engineering design but also a fusion of art and humanity. Therefore, the construction process is complicated, and during the design process, a large amount of investment is made to create image projects such as "civilized construction sites" and "green construction sites". As a result, most subway construction project departments lack attractiveness from design to manufacturing processes, and few enterprises can launch distinctive landscape design products.

3.4 The landscape measures are monotonous and it is difficult to meet diverse demands.

The current landscape measures lack diversity and inclusiveness. In many metro project construction departments' landscape designs, there is often a lack of diversity and inclusiveness, which may cause some groups to feel uncomfortable or neglected. Through research on objects such as the Xi'an Metro Line 6 project and its surrounding areas, and the 2nd contract section of the 8th line project's 1st branch, the types, intensities, and frequencies of activities carried out by different age groups, such as the elderly, young people, and children, around the project construction departments were summarized. The needs and directions of different types of people for the metro construction project's landscape when engaging in different activities were obtained. For example, for children, it is very necessary to enhance the safety, accessibility, and pleasantness of the streets, which has a long-term impact on their health, physical and cognitive development[14], and social well-being. For the elderly, as their physical functions decline, it is important to plan and design a good living street environment, provide comfortable spaces for their travel, create positive interaction spaces, and enrich their spiritual life[15]. And for young people and office workers, the metro is a place where office workers are the majority, and the surrounding environment directly has a great impact on the convenience and comfort of people going to work. The beautification of the environment will affect people's psychological pleasure and positive attitude towards life.

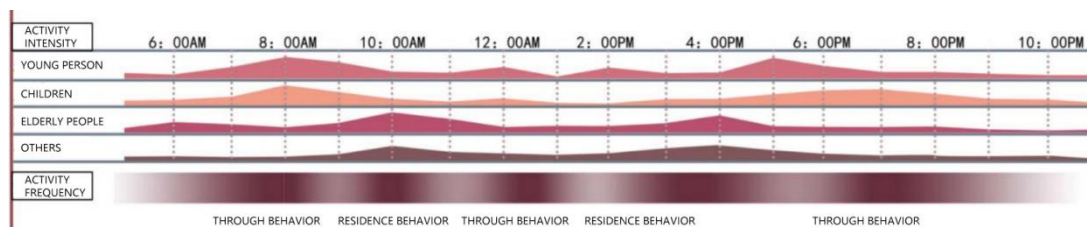


Fig. 4 Nalysis Diagram of Crowd Activities

3.5 Inadequate design considerations; urban landscape system needs to be integrated

At present, the phenomenon that the landscape design of some metro project departments does not take into account the urban landscape system does exist. Firstly, some metro project departments may lack a deep understanding and recognition of the urban landscape system, resulting in the failure to fully consider the factors of the urban landscape system during the design

process. They may pay more attention to the transportation function of the metro and the practicality of project construction, while neglecting the coordination and integration with the urban landscape. When designing the landscape, they do not consider the overall situation. Some metro stations and lines may not take into account the historical and cultural factors and natural environment of the city, resulting in a lack of individuality and cultural depth in the design.

4. Design Strategies

We should start from the integrity of the environment, the multi-dimensionality of visual perception, and the suitability of spatial scale, etc., to carry out in-depth exploration, so as to steadily conduct the landscape design of Xi'an Metro construction projects.

4.1 Emphasize external landscapes and integrate with urban and corporate cultures

Emphasizing external landscapes and integrating with urban and corporate cultures, the construction of Xi'an metro projects and their surrounding environments is classified based on the principles of cultural, ecological, economic and sustainable development, in accordance with the demands of different regional stations. Corresponding landscape contents are proposed that are in line with their development levels. The space facing the urban roads is fully utilized, and public service advertisements and corporate promotional signs are carefully arranged. This not only achieves economic benefits for the enterprises but also makes them a bright public welfare window for the promotion of Xi'an and even Shaanxi Province. These advertisement and sign designs are novel and rich in content, not only showcasing the image and strength of the enterprises but also conveying positive social values, adding a rich cultural atmosphere to the city. At the same time, professional and targeted landscape design plans for metro construction projects are provided for enterprises.

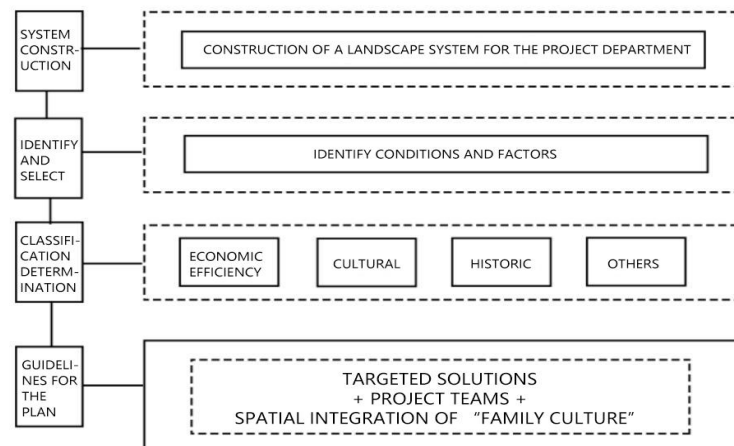


Fig. 5 Project Landscape Design Analysis Roadmap

4.2 Rich Function Utilization, Equal Emphasis on Economic and Social Benefits

The continuous pursuit in the process of external landscape design is to achieve a win-win situation of economic and social benefits through the full utilization of rich functions. A vibrant green plant landscape wall is created within the fence. Through the combination of real green plants, the design of soft patterns, and the integration of various types of plants, a series of beautiful natural scenes are presented. At the same time, movable landscape modules are set up, which can be flexibly adjusted according to seasonal and occasion changes[16], ensuring the best environmental adaptability of the landscape wall. Additionally, fully automatic sprinkler and drip irrigation systems are equipped to achieve precise irrigation and intelligent maintenance[17]. This not only increases the survival rate of green plants but also reduces maintenance costs, achieving effective resource utilization.

At night, through intelligent switch control, clean energy sources such as solar panels are actively used as the power supply for lighting[18], which is both energy-saving and environmentally friendly, as well as safe and reliable. These night lights not only add a beautiful night view to the city but also enhance the safety and convenience of the project. The new green construction project department is not only a beautiful landscape in the city but also a vivid embodiment of the pursuit of green, environmental protection, and sustainable development. This project not only brings economic benefits to the enterprise but also brings real ecological and social benefits to the society, achieving a true win-win situation.

4.3 Standardized Design, Sustainable Development and Flexible Utilization

Conducting overall design research on subway construction projects and landscape design can shorten the construction period while saving construction costs, ensuring a safe and comfortable office and living environment. By disassembling landscape design units and adjusting components, overall or partial movement can be achieved, creating green plant landscape walls and mobile landscape components, creating beautiful scenery lines, and quickly completing specific design strategies for spatial environments and reassembling landscape design units, as shown in the design combination of landscape boxes in the following figure.

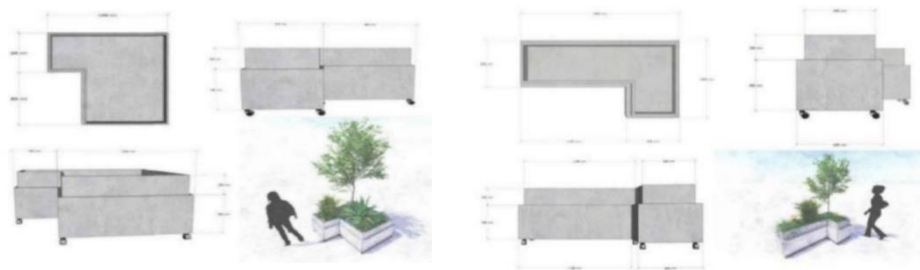


Fig. 6 Landscape Design Unit Module



Fig. 7 Combination of Landscape Design Unit Modules

4.4 Diversified Design to Meet the Needs of Diverse Groups of People

In the process of external landscape design, the needs of different groups of people should be taken into account, such as the elderly, the young, and children. For children's needs, in addition to meeting the basic safety requirements, some interactive facilities can also be introduced.

For instance, amusement facilities and interactive games can be provided to stimulate their interest and creativity. For special groups such as the elderly and the disabled, barrier-free designs should be taken into account, such as setting up ramps and handrails, to facilitate their movement and activities. Additionally, cultural elements such as historical buildings and cultural sculptures can be introduced to enhance the cultural connotation and appeal of the landscape[19]. By integrating cultural elements into landscape design, people can appreciate the beauty while learning about and experiencing the local history and culture. To maintain the beauty and functionality of the landscape, regular maintenance and updates of landscape facilities are necessary to ensure their integrity and attractiveness. At the same time, adjustments and optimizations should be made based

on the needs and feedback of different groups to provide a better user experience and meet people's demands. Through diversified design and continuous improvement, an external landscape that caters to the needs of different groups can be created, providing a beautiful, comfortable and meaningful space for people.

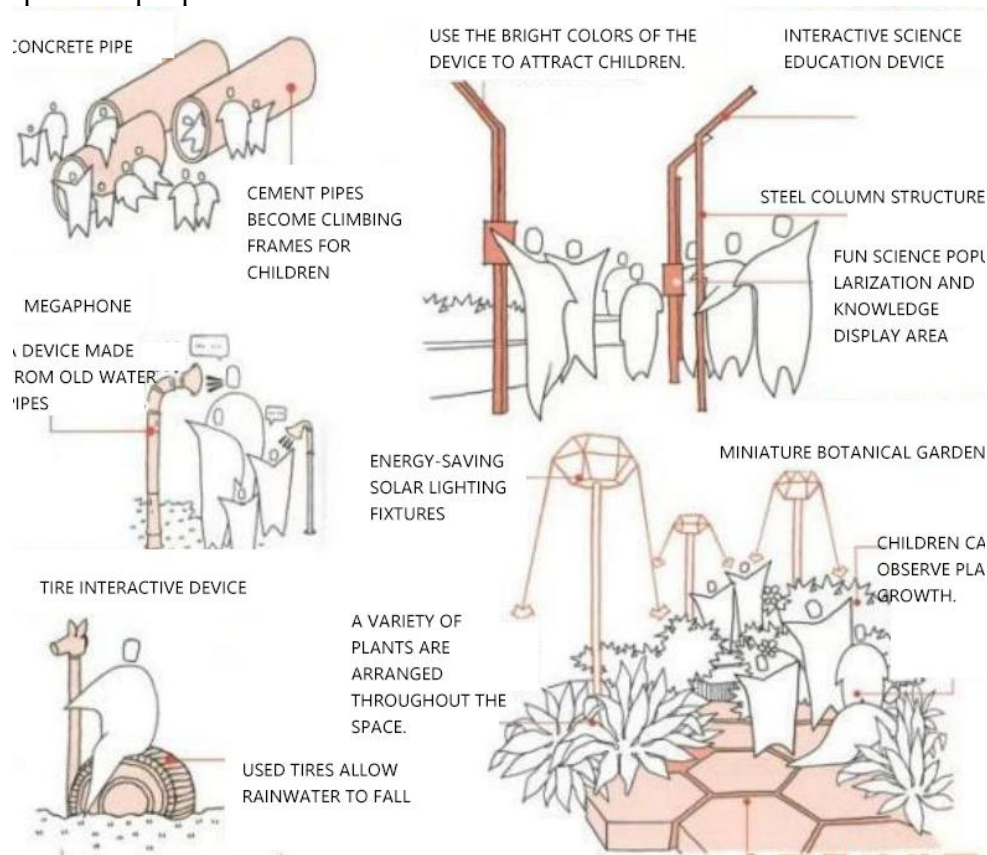


Fig. 8 Child-Friendly Landscape Design

4.5 Integrated Design, Blending into Urban Landscapes

Before commencing the design, it is necessary to understand the overall planning and design concepts of the urban landscape system. Research the historical, cultural, ecological and economic factors of the urban landscape system to determine the positioning and role of the metro project's landscape design within the urban landscape system[20]. During the design process, it is essential to follow the design norms and standards of the urban landscape system to ensure that the metro project's landscape design integrates with the urban landscape system, not merely as an isolated space, but as an integral part to be considered within the broader context of the community, neighborhood block, and even the urban district. Its landscape design should be sustainable and usable, not only taking into account the future development direction and trends of the city during the construction period, but also ensuring that the landscape design of the metro project can adapt to the future development needs of the city.



Fig. 9 Comprehensive Landscape Design

5. Case Reference - Beautification of Construction Site Fencing for the 12th Section of Chongqing Metro Line 9

5.1 Overview of Chongqing Line 9

Chongqing Metro Line 9 is a metro line in Chongqing, China. It is the first metro line in Chongqing to be constructed under the PPP investment and financing model. The first phase of the line (from Xinqiao Station to Xingke Avenue Station) was opened to operation on January 25, 2022, with its signature color being bright red. The first phase of Chongqing Metro Line 9 starts from Xinqiao Station in Shapingba District, passes through Yuzhong District and Jiangbei District, and ends at Xingke Avenue Station in Yubei District. The second phase is entirely located in Yubei District, starting from Xingke Avenue Station and ending at Huashigou Station. Chongqing Metro Line 9 connects the Xinqiao sub-center in Shapingba District, Huazhongqiao, the Guanyinqiao sub-center, the Jiangbeicheng Central CBD, and Huixing, among other areas. As of January 2022, the first phase of Chongqing Metro Line 9, from Xinqiao Station to Xingke Avenue Station, is 32.29 kilometers long and has 26 stations (including 3 stations that are temporarily not in operation), among which 23 are underground stations, 1 is semi-underground, and 2 are elevated stations. The trains are 6-car As-type trains. On May 15, 2022, the main structure construction of Dong Central Park Station on the second phase of Metro Line 9 was completed.

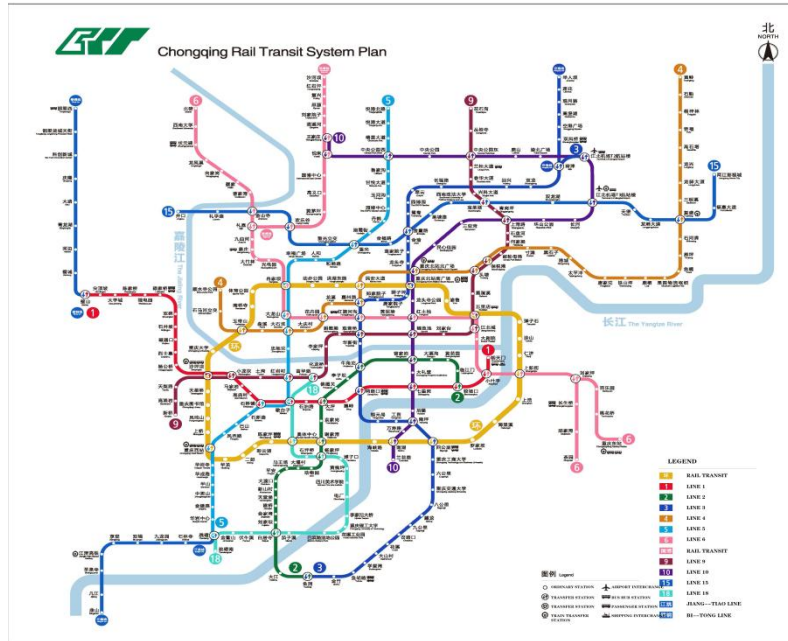


Fig. 10 Schematic Diagram of Chongqing Line 9 Route

5.2 Beautification of Construction Site Fencing

A pleasing green plant landscape wall has been perfectly completed in the TBM launch shaft project of the 12th civil engineering section of Chongqing Metro Line 9. It is the first green plant landscape wall of the Chongqing Metro project built around the goal of "green metro". The combination of real green plants, soft and beautiful pattern design, and various types of seedlings, along with the fully automatic sprinkler system and drip irrigation system, has become a beautiful sight in the city.



Fig. 11 The real scene of the green plant background wall of the 12th section of Chongqing Metro Line 9

Green plant walls not only provide a visual shock[21] to people but also have the functions of safety protection and green construction. Green plant landscape walls replace the traditional rigid color steel guardrails, effectively isolating the entire construction site from the outside area.

To ensure that the on-site construction and the normal passage of vehicles and pedestrians off-site do not interfere with each other and to play a role in safety protection, an automatic sprinkler and drip irrigation system is designed in conjunction. While nurturing the seedlings, it effectively achieves dust suppression and temperature reduction along the road, embodying the concept of civilized construction that is people-oriented, green, safe and environmentally friendly.



Fig. 12 3TBM Launch Shaft Spray System

The No. 12 Contract Project of Chongqing Rail Transit Line 9 was the first to build a water mist dust suppression system on the entire line at the construction site. This system generates micron-sized water mist particles that are comparable in size to dust particles, allowing them to adsorb and bond with the dust. When the water mist forms, it generates negative ions[22]. The large number of positive ions in the dust combine with the negative ions in the water mist, rapidly reducing the dust. The water mist and dry dust separate, increasing the humidity of the air and absorbing a large amount of latent heat in the air, achieving a good cooling effect. It controls the harm of inhalable dust particles to the human body at the source of pollution.



Fig. 13 Water Mist Dust Suppression System

6. Conclusion

6.1 Summary

Through in-depth analysis and implementation of this research, the successful integration of the metro construction project with the surrounding environment and historical culture has been made the core of the optimization strategy, significantly enhancing the urban quality and image of Xi'an and even the entire Shaanxi region. This strategy not only promotes the coordinated development of economic and social benefits but also enhances the night-time landscape effect through the application of solar photovoltaic panels, greatly enriching the visual beauty of the city and the experience of residents and tourists. Moreover, as an important window for external publicity of Xi'an and the Shaanxi region, this project effectively showcases the city's green development

concept and cultural charm, providing beneficial practices and experiences for the combination of landscape optimization and urban development for other regions.

6.2 Innovation Points

Through the application of green building technologies[23], mobile and prefabricated landscape design and other techniques, the maximization of recycling is fully achieved. The construction of landscape comfort for metro projects and the shaping of spaces along the construction route that integrate environmental and historical cultural inheritance are combined. The peripheral landscapes are integrated with public welfare and commercial advertisements, highlighting the equal importance of social and economic benefits[24], build an important public welfare window for external publicity in Xi'an and even in Shaanxi, and summarize the experience to promote the achievements to similar projects across the country and even the world for reference[25].

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