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Research on Street Landscape Design Along Urban Rail Transit Lines

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Abstract: The study on the landscape design of urban streets along the rail transit lines is an important topic in urban planning and development. With the acceleration of urbanization, the construction and improvement of urban rail transit systems have become a top priority. However, there are numerous challenges and issues in the landscape design of streets along rail transit lines. In recent years, governments and relevant departments have actively promoted the construction of urban green streets and integrated ecological concepts into landscape design to address the pressures and challenges brought about by urbanization. Drawing on the experiences of ecological city construction, the establishment of urban green streets has become an effective approach to solving the functional and environmental problems of urban streets. By integrating green infrastructure into street design, it is possible to effectively manage stormwater and improve the street environment. Research indicates that the root cause of urban street flooding lies in the increase of impervious surface area, which alters the surface hydrological conditions and impedes the collection and utilization of rainwater. Therefore, the design of urban green streets should focus on functional zoning, awareness of stormwater management, and integration of urban cultural landscapes. Through the application of these design methods, not only can the existing problems of urban streets be solved, but valuable design experience and guidance can also be provided for future urban green street construction.

Keywords: Urban Streets; Landscape Environment; Element Design; Ecological Cities.

1. Introduction

The study of lan primary modes of transportation in modern cities. Therefore, research on the landscape design of streets along rail transit corridors is particularly important.

The study of landscape design along urban rail transit corridors involves the rational utilization and optimization of urban space. As one of the main transportation arteries in cities, the design of streets along rail transit corridors must consider not only traffic flow and efficiency but also pedestrian experiences and environmental comfort. Therefore, landscape design needs to comprehensively consider factors such as road width, pedestrian walkways, and green belt planning to create a comfortable and pleasant urban environment.

The study of landscape design along urban rail transit corridors involves the protection and improvement of urban ecological environments. In the process of urbanization, urban ecological environments face increasingly severe challenges. As the main transportation arteries in cities, landscape design along rail transit corridors can not only beautify urban environments but also increase green coverage, improve air quality, reduce the urban heat island effect, and enhance the quality of the urban ecological environment.

The study of landscape design along urban rail ransit corridors involves the inheritance and innovation of urban culture and history. As symbols of urban culture and historical heritage, streets along rail transit corridors carry rich urban cultural and historical connotations. Therefore, in landscape design, historical buildings can be protected and restored, cultural sculptures can be installed, and cultural theme districts can be created to inherit and promote urban cultural traditions. Additionally, through modern art installations and innovative designs, the city's fashion and vitality can be showcased.

The study of landscape design along urban rail transit corridors also involves the enhancement and provision of urban functions and services. Through rational planning and design, various convenient facilities and services can be set up along streets along rail transit corridors, such as public seating areas, bicycle parking spots, and cultural squares, to provide citizens with more convenient and comfortable travel and leisure spaces, thereby enhancing urban functions and service levels.

The study of landscape design along urban rail transit corridors involves the optimization of urban space, improvement of ecological environments, inheritance and innovation of cultural history, and enhancement of urban functions and services. It is of great significance for promoting urban sustainable development and enhancing urban quality.

2. Literature Review

"Research on Urban Street Landscape Design" by Zhao Xingao aims to explore the evolution of street landscapes in the process of urbanization and their importance in urban construction. Based on aesthetics and planning theories, the study emphasizes the critical role of street landscapes in urban development. Through case studies of representative streets in Xi'an, the paper delves into various aspects of street landscape environments and proposes solutions to current problems. The article validates the practicality and feasibility of design methods through the landscape renovation design of Shihua Avenue [1].

"Research on Street Landscape Design in Northeastern Cities under Regional Cultural Background" by Yin Junjie discusses the significance of street landscape design in Northeastern cities. The rich regional characteristics and

diverse ethnic cultures in the Northeast inject unique cultural elements into urban landscapes. The paper proposes new ideas and methods from the perspective of regional culture to explore the unique regional culture of the Northeast, making street landscape design distinctive and imbued with cultural atmosphere, thereby inheriting social, ethnic, and historical interpretations[2].

"Urban Resilient Street Landscape Design in the Post-Pandemic Era" by Zhao Weijie focuses on the need for resilient urban street landscape design in the post-pandemic era as China's COVID-19 situation stabilizes. Against this backdrop, the flexibility of urban streets becomes a current demand and practical manifestation. Exploring new benefits of urban resilient street landscape design is crucial to meet the needs of public health and diverse urban street landscape usage. The paper analyzes the similarities and differences between resilient and traditional streets, deeply discussing methods and approaches for designing urban resilient street 2.landscapes[3].

"Street Landscape Design in Cold-region Cities Based on Ice and Snow Features" by Wang Xiaotian examines the significance of incorporating ice and snow features into street landscape design in cold-region cities characterized by unique climatic conditions. While cold-region cities have distinct seasonal landscapes due to their long winters, existing street landscape designs often lack distinct characteristics and interaction. Through case studies and analysis, the paper provides new insights and methods for designers to enhance the quality and attractiveness of street landscapes in cold-region cities[4].

"Research on Urban Street Landscape Design Based on Symbiosis Concept" by Hou Yinhang is grounded in the symbiosis concept proposed by Kisho Kurokawa, aiming to address the disconnection between some streets and the overall urban fabric due to rapid urbanization. By integrating symbiosis theories from different fields, the paper proposes principles and methods for symbiotic urban street landscape design, using the Kunshan Nansong Lake corridor as a case study to bring new ideas to street landscape design and enhance urban image quality and sustainable development[5].

"Green Street Landscape Design Based on Ecological City Background" by Hou Jingwen explores the problems faced by urban streets in the process of urbanization and the importance of green street design in ecological city construction. Grounded in landscape ecology planning theory, the paper integrates green infrastructure into urban street design. Through theoretical research, case analysis, and field research, the paper applies design methods to practical cases, employing low-impact development technology and street functional area transformation to promote the construction of urban green streets and address urban street issues[6].

"Urban Street Landscape Design from an Ecological Perspective" by Tan Yuetong analyzes urban street landscape design from an ecological perspective to improve the ecological environment and enrich people's experiences. The paper examines existing problems in traditional urban street landscape design and proposes optimization strategies based on actual cases to promote the development of more eco-friendly and humanized urban street landscape designs [7].

"Urban Street Landscape Design with Youth Culture as the Theme" by Bai Qi explores the concept, attributes, behavioral psychology characteristics of youth, as well as the composition and characteristics of youth culture. The paper analyzes the development history of urban street landscapes and the theoretical basis of youth culture-themed landscape design, with Figures 1 and 2 illustrating the comparison between the Old and New Appearance of Shanxi University. It presents methods for designing urban street landscapes with a youth culture theme, focusing on functionality, visuals, facilities, and emotional aspects. It delves into the development trends of contemporary urban street landscape design serving youth groups, providing valuable insights and suggestions for future urban street landscape design [8].

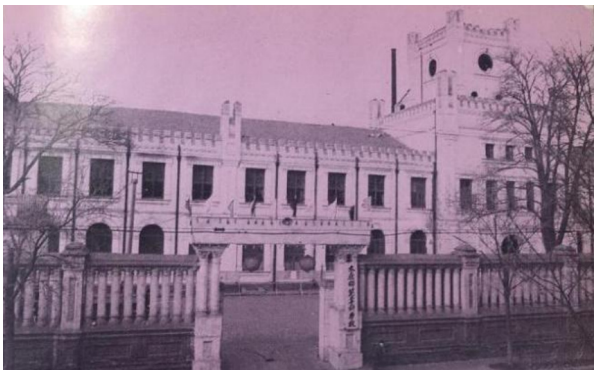

Figure 1. The Old Appearance of Shanxi University in the Late Qing Dynasty

Figure 2. Present-day Shanxi University

"Research on Urban Street Landscape Design in the Era of Smart Cities" by Zhang Jihui introduces the connotations and development status of smart cities, emphasizing the positive significance of strengthening urban street landscape construction for the development of smart cities. In this context, the paper elucidates the design principles of urban street landscapes in smart cities and explores relevant design strategies, aiming to advance the development of urban street landscape design in the era of smart cities. Through the analysis of the concept of smart cities and existing practices, the paper proposes design concepts and methods adapted to the needs of smart city development, providing feasible design solutions and ideas for smart city construction[9].

3. Data Collection and Methods

The research methods for urban street landscape design along the rail transit lines are diverse and comprehensive, aiming to deeply understand the urban environment, traffic characteristics, and residents' needs, providing scientific basis and practical guidance for creating pleasant and accessible urban streets.

The literature review method forms the foundation of studying urban street landscape design along rail transit lines.

Through systematic reading and analysis of relevant domestic and international literature, academic journals, and industry reports, different street design concepts, technological applications, and successful experiences from various cities can be understood. Especially in the theoretical frameworks and practical cases of ecological cities and green transportation development, these literatures provide important theoretical support and inspiration for research.

Case study method is one of the important means to study urban street landscape design along rail transit lines. Through in-depth analysis of various types of street design cases both domestically and internationally, the strengths and weaknesses of different design concepts, as well as challenges and solutions in practice, can be explored. By comprehensively evaluating the design, construction, and operation of completed streets, experiences and lessons can be drawn to provide reference and inspiration for future designs.

The method of induction and summarization is crucial in organizing and integrating the information obtained from literature review and case studies. By summarizing and synthesizing the research materials, the theories and practical experiences of green streets in ecological cities can be systematically organized, grasping the core elements and development trends of green street design.

The integration of theory and practice is a key link in the research of urban street landscape design along rail transit lines. Combining theoretical knowledge obtained from literature with practical experiences from case studies, continuously optimizing and improving design methods and technical means through practical application and validation in actual street design projects. This combination of theory and practice can promote the innovation and practice of urban street landscape design concepts, providing better support and services for urban transportation development and residents' quality of life.

4. Finding

4.1. Content of Green Street Landscape Design

(1) Content of Street Design Dominated by Motor Vehicles

Street design dominated by motor vehicles is a crucial aspect of urban planning. While considering traffic flow and efficiency, attention must be paid to pedestrian safety and environmental comfort. The greening of such street designs is manifested in several aspects. Green belts and landscape beautification are key elements. By establishing green belts on both sides or in the center of the street and planting various vegetation such as trees, shrubs, and flowers, the street becomes visually pleasing and enhances ecological aspects, augmenting the city's natural ambiance. The installation of pedestrian safety facilities is paramount. Properly placed sidewalks, crosswalks, and pedestrian bridges ensure safe passage for pedestrians and enhance pedestrian comfort. Pedestrians can navigate urban areas more securely and conveniently[10]. The installation of traffic management facilities helps maintain traffic order and safety. Facilities such as traffic signs, traffic signals, and curbstones guide vehicle flow, reduce traffic accidents, and enhance traffic efficiency. Environmental conservation measures also play a significant role in street design. The use of eco-friendly materials and technologies, such as permeable paving and rainwater collection systems, not only reduces surface water accumulation but also helps decrease water pollution, safeguarding the city's ecological environment. Street design dominated by motor vehicles requires comprehensive consideration of factors such as traffic, pedestrian safety, and environmental protection. Through proper planning and design, safe, comfortable, aesthetically pleasing, and environmentally friendly urban streets can be created, enhancing the overall image of the city and the quality of life of its residents.

(2) Content of Street Design Dominated by Residential Areas

Street design dominated by residential areas focuses on humanistic care and community functionality, aiming to enhance residents' quality of life and community vitality. In such street design, specific design content includes: the planning of community activity venues is crucial. Setting up parks, leisure squares, and sports facilities provides residents with recreational spaces and environments. These places not only offer residents spaces for relaxation but also promote communication and interaction among community residents, enhancing community cohesion. The establishment of community service facilities is key to improving residents' quality of life. Setting up community service centers, waste sorting stations, and convenience facilities can meet residents' daily needs, facilitate residents' lives, and improve the overall service level and convenience of the community. Pedestrian and vehicular separation is an important measure to ensure the coexistence of pedestrian and vehicle safety. By properly dividing driving areas and pedestrian areas and installing facilities such as slow lanes and traffic columns, pedestrian and vehicular safety can be effectively ensured, creating a safe and comfortable pedestrian environment. Green landscape creation is an indispensable part of street design[11]. Strengthening green belts and vegetation planting on both sides of the street not only enhances the ecological environment of the street but also improves its visual effects, creating a pleasant living environment and increasing residents' enjoyment of life. Street design dominated by residential areas focuses on residents' needs and community functionality. Through planning and design, it provides residents with a rich variety of recreational and entertainment venues and convenient life service facilities, ensures the safety of pedestrians and vehicles, creates a pleasant ecological environment and comfortable living atmosphere, and enhances the overall quality and vitality of the community [12].

(3) Design Content of Commercial Shared Streets

The design of commercial shared streets focuses on creating a commercial atmosphere and maintaining a balance between traffic and pedestrians, as shown in Figure 3. The design content mainly includes the following aspects. The planning of commercial activity spaces is crucial. By setting up outdoor markets, cultural squares, and street art zones, space support and platforms are provided for commercial activities [13]. These areas not only promote commercial transactions and cultural exchanges but also enrich the cultural connotations of the street and enhance the attractiveness and vitality of the commercial district. Slow system design is key to enhancing the attractiveness of commercial districts[14]. Designing suitable pedestrian and bicycle systems, reducing motor vehicle traffic, increasing pedestrian activity space, and providing a comfortable environment and more activity choices for tourists and residents, thereby enhancing the popularity and vitality of the commercial district. Environmental improvement measures

are crucial to the image and experiential perception of commercial areas. Strengthening environmental cleanliness and greening work, improving the environmental quality and overall image of the commercial area, creating a comfortable and pleasant environment for citizens and tourists, enhancing their experiential perception, and increasing the attractiveness of the commercial district. Convenient transportation facilities are essential to ensure smooth traffic in commercial areas. Setting up public parking lots, bicycle parking points, and public transportation stops provides convenient transportation services and support for tourists and residents, facilitating their shopping and consumption and promoting the smooth progress of commercial activities. The design of commercial shared streets focuses on creating a commercial atmosphere and maintaining a balance between traffic and pedestrians [15]. Through rational planning and design, it creates a pleasant commercial environment, enhances the attractiveness and vitality of the commercial district, provides citizens and tourists with better consumption and experiential environments, and promotes the sustainable development of commercial areas.

Figure 3. Commercial Street

4.2. Green Street Design Methods

(1) Design Methods Dominated by Motor Vehicles

In the design targeting motor vehicle dominance, it is essential to comprehensively consider aspects such as traffic flow management, traffic safety, and environmental improvement to create a safe, smooth, and aesthetically pleasing street environment. Traffic flow management is of paramount importance. By rational lane allocation and the installation of traffic signals, traffic flow can be optimized, congestion reduced, and traffic efficiency improved. Effective traffic flow management contributes to enhancing road conditions, providing smoother driving experiences for vehicles. The installation of traffic safety facilities is crucial for ensuring the safety of pedestrians and vehicles. Implementing pedestrian crossings, speed bumps, and other traffic facilities helps regulate traffic order, reduce accident rates, and ensure the safe passage of pedestrians and vehicles. Moreover, greenery and landscape improvement are integral parts of street design. Setting up green belts and landscape facilities on street sides or in the center not only enhances the street's aesthetics but also improves the urban ecological environment, increasing residents' comfort. Environmental protection measures are key to sustainable urban development. Adopting eco-friendly technologies such as permeable pavement and rainwater collection systems can reduce rainwater discharge, improve urban environmental quality, protect natural resources, and achieve sustainable development of urban ecology and environment. Regarding street design dominated by motor vehicles, it is important to consider comprehensive factors such as traffic flow management, traffic safety, greening and landscape improvement, and environmental protection measures to create a safe, accessible, and aesthetically pleasing urban street environment, enhancing residents' quality of life and the city's image.

(2) Design Methods Dominated by Residential Areas

In the design focusing on residential areas, attention should be paid to enhancing community services and improving residents' quality of life, creating a comfortable and pleasant living environment for residents. Community service facility planning is critical. Designing a reasonable layout of community service facilities, including parks, community centers, and cultural venues, enriches community functions, providing places for residents' leisure, entertainment, and cultural exchange, enhancing community cohesion and vitality. Pedestrian and vehicular traffic separation strategies aim to improve residents' walking and cycling experiences. By setting pedestrian zones and bike lanes, reducing motor vehicle traffic, a safe and comfortable pedestrian environment is created, providing residents with more convenient and healthy travel options. Green landscape design is also an indispensable part of street design. Strengthening green belts and vegetation planting on both sides of streets not only enhances the beauty of residential environments but also improves air quality, regulates the climate, and increases residents' comfort and happiness. Environmental improvement measures are crucial for enhancing residents' quality of life. Using noise barriers, air purification devices, and other technical means effectively reduces environmental noise and pollution, improves residents' living environment quality, safeguards their physical health and psychological comfort. For street design dominated by residential areas, attention should be paid to comprehensive considerations such as community service facility planning, pedestrian and vehicular traffic separation strategies, green landscape design, and environmental improvement measures to enhance residents' quality of life and happiness, create livable and pleasant community environments, promote healthy community development, and residents' happy lives.

(3) Design Methods for Commercial Shared Streets

The design methods for commercial shared streets should comprehensively consider promoting commercial activities and coordinating traffic and pedestrians to create an active and convenient commercial environment. Planning commercial activity spaces is crucial. Designing commercial activity areas, open-air markets, and other commercial places attract businesses and consumers, enlivening the commercial atmosphere. These places not only provide platforms for businesses to showcase and sell products but also offer consumers a variety of shopping and entertainment choices, promoting the prosperity and development of commercial activities. Slow system design is an important means to enhance the attractiveness of commercial areas. By setting up pedestrian streets, bike lanes, and other slow systems, walking and cycling are encouraged, reducing motor vehicle traffic, and enhancing the attractiveness of commercial areas. This not only provides citizens and tourists with healthier and environmentally friendly ways of travel but also increases the vitality and charm of commercial areas. Setting up convenient transportation facilities is crucial for commercial shared streets. Establishing public parking lots, bus stops, and other

transportation facilities provides convenient transportation services, facilitating citizens' and tourists' travel. This increases the accessibility of commercial areas, attracting more pedestrian and vehicular traffic, and promoting the development of commercial activities. Environmental beautification is an important measure to enhance the image of commercial areas. Strengthening the greening, cleanliness, and landscape beautification of commercial areas creates a pleasant commercial environment, enhancing the competitiveness of commercial areas. Good environmental beautification not only enhances the attractiveness and image of commercial areas but also increases citizens' and tourists' satisfaction and sense of belonging. The design methods for commercial shared streets should focus on promoting commercial activities while also considering the coordination of traffic and pedestrians. Through rational planning and design, create an active, convenient, and pleasant commercial environment, promote the prosperity of commercial activities, and enhance the competitiveness and attractiveness of commercial areas [16].

4.3. Case Study

The Agar Street as Figure 4, located near the Asian residential area in Chicago, is a significant urban redevelopment project. Its design aims to transform a community facing drug and gang issues, with safety, environmental creation, and stormwater management as its construction goals. Regarding safety, the emphasis is on creating slow spaces suitable for pedestrian traffic to enhance residents' sense of walking safety. Environmental creation aims to create a comfortable site ambiance through streetscape design, providing residents with spaces for gatherings and social interactions. Stormwater management aims to effectively collect surface runoff from the road to reduce flood risks.

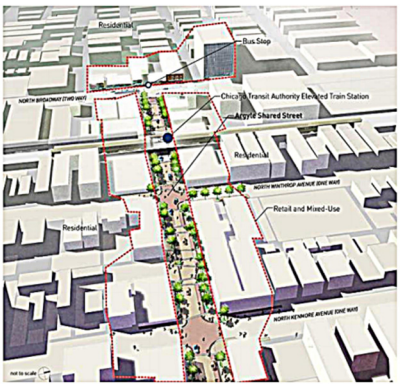

Figure 4. Aerial View of Agar Street

As Chicago's first shared street, the Agar Street incorporates stormwater management elements, setting a new benchmark for urban street design. In the design, measures such as raising road bases, removing curbs, and using permeable pavement have been adopted to enhance the functionality and aesthetics of the street. The expanded area creates a plaza-like feeling, providing more possibilities for the transformation space. The rainwater storage ponds and elevated stormwater facilities set up in the street effectively collect and manage street runoff, enhancing the stability and safety of the street. The setting of sensors provides important data support for the project's water resource management, aiding in maintenance and future design optimization. Through redesign, the street successfully reduces the area of impermeable surfaces, directing 89% of rainwater into the new stormwater management system, contributing significantly to the environmental sustainability of the city and establishing the crucial role of stormwater management in urban design.

In the design process, by re-integrating the spatial order of commercial shared streets, ground pavement effectively avoids traffic chaos during peak hours. Raising the ground base and removing curbs reduce the sense of boundaries of the street, enhancing its openness and spatial sense, providing pedestrians and vehicles with more spacious passage. The narrowed roadway after the transformation helps vehicles slow down, improving driving safety. In terms of plantings, suitable aquatic plants adapted to the local climate and environment have been redesigned and planted, while retaining existing vegetation, making full use of resources, and realizing the function of rain gardens. These transformation measures not only enhance the aesthetics and greening level of the street but also improve its environmental friendliness and sustainability, bringing a better living experience to community residents.

5. Conclusion

This article delves into the landscape design of urban streets along rail transit lines, aiming to propose feasible methods and suggestions for promoting the sustainable development and improvement of urban streets through the study and practical design of green street theory. In this research, we elucidate the core concept of green streets, which is centered around rainwater management. Through the application of low-impact development techniques in practical design, the objective is to create street environments with rainwater management functionality.

In exploring methods for green street landscape design, we propose three key aspects. Firstly, we emphasize human-centered functional design, integrating human care into the design of urban streets to ensure the rational division of street functional zones, mitigate traffic chaos, and thereby enhance residents' quality of life and walking experiences. We stress the importance of enhancing street rainwater management capabilities. At the outset of the design process, terrain and hydrological analyses must be conducted to cleverly integrate green infrastructure, namely rainwater management facilities, into street design to effectively manage rainwater, reduce the risk of urban flooding, and ensure the sustainable development of urban streets. We underscore the importance of enhancing the street's slow system. By incorporating local cultural characteristics into street landscape design, enriching the cultural connotations and charm of urban streets, and through the design of plant landscapes, selecting water-resistant plants and considering the use of local tree species, the hierarchical sense and aesthetics of street landscapes are enhanced.

Through this research, we provide feasible methods and concepts for the landscape design of urban streets along rail transit lines. It is hoped that these research findings can provide beneficial references for the improvement and development of urban streets, contributing to the creation of livable and accessible urban environments. Let us work together to create a better urban future.

About the Author

Zhao Wenjin (1983-), female, studying for a doctor of

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