

The Quality Improvement Strategy Study of Public Space around Rail Transit Stations in Built Areas

A Case Study of Jiukeshu Subway Station in Beijing

Jing Ma^{1, *} Wanqi Pang² Xiaoxi Liu³ Ming Fang⁴ Yuan Meng⁵

^{1, 2, 4, 5} Urban Construction Department Beijing City University

³ Beijing Urban Construction Design & Development Group Co. Ltd

*XiaoXi Liu, Email: lxx912800@163.com

ABSTRACT

With the development of many Chinese cities entering the stage of urban renewal, the quality improvement of urban public space in built areas has become an important part. With the increasing proportion of rail transit in urban travel sharing rate, it is extremely urgent to improve the spatial quality around the stations as an important growth point of urban development. Taking Jiukeshu Station of Batong Line of Beijing Metro as an example, this paper explores the strategies for improving the quality of public space around rail transit stations in urban built areas, and gradually deepens from the aspects of space characteristics and current situation, existing main problems and space reconstruction needs. This paper puts forward specific paths and methods of public space quality, such as optimizing and upgrading the overall planning of the slow system, rationally planning parking spots of the shared bicycle, refining the design of public space nodes, strengthening management and improving and implementing the system, so as to provide reference for similar regional projects.

Keywords: urban built areas, public space, rail transit station, quality improvement

1. INTRODUCTION

After the rapid growth, China's urban development has gradually entered a new stage of slow growth, Beijing issued the Beijing Urban Renewal Action Plan (2021-2025). In order to transform the urban development and construction mode and economic growth mode, comprehensively improve the quality of urban development and meet the people's growing needs for a better life. The Action Plan points out that urban renewal is implemented through various paths, including coordinating urban renewal with blocks as a unit and promoting urban renewal through the integration of rail transit stations and cities. As an important growth point for guiding urban development, the improvement of the environmental quality of the surrounding public space is closely related to the user experience, and is an important node for urban renewal. In urban built areas, with the increasing proportion of rail transit in urban travel sharing rate, it is extremely urgent to improve the quality of surrounding public spaces. Based on the limited space and the actual needs of users, this study takes Jiukeshu

Subway Station as an example to explore and study the strategy.

2. SURVEY OF JIUKESHU SUBWAY STATION AND CURRENT SITUATION OF SURROUNDING PUBLIC SPACE

2.1 Overview of Jiukeshu Subway Station

First, characteristics of the station. Jiukeshu Metro Station is a standard station of Batong Line of Beijing Metro, located in the southeast of the intersection of Beiyuan road and Tongma Road, Tongzhou District. The station has three exits: north exit, southwest exit and southeast exit. Within 200m of the southwest exit, it includes Ruidu International Center, Life New Life Plaza, Lingzhan Shopping Plaza, and many residential quarters are connected around it. In the peak hours of working days, commuting demand through rail transit is the main demand [1]. The public space around the southwest exit is extremely compact, which makes it difficult to meet the traffic demand during the peak hours. Accordingly,

the environmental quality of public space at the southwest exit needs to be improved.

Secondly, current traffic situation. Jiukeshu Station, as a standard station, has only one subway line passing through it. At present, the daily average passenger flow in and out of the station exceeds 10,000 people, and the pressure on each exit is relatively high. The periphery of the southwest exit is connected with important commercial buildings, office buildings and residential quarters in this area, while the periphery is connected with the urban space with only one urban road less than 5 meters wide, which is a one-way street from east to west. For the site itself is located in the periphery of the central city, users make extensive use of public transportation to meet their commuting needs [2]. Therefore, how to park the Last Mile vehicles connected with rail transit has become an important consideration for the utilization of public space around the station. Nowadays, the main means of transportation used by the surrounding users to connect with rail is shared bicycle. Based on the characteristics of shared bicycle, such as small size, large quantity and huge mobility, in terms of promoting the space around, in the rush hours, the traffic congestion on the road around the station and the quality of the environment are further aggravated.

2.2 Current situation of public space around Jiukeshu Subway Station

The establishment of the whole city slow traffic system around the station is imperfect, and a large number of non-mechanized vehicles connected to the subway station, such as shared bicycle, are randomly placed, resulting in serious impact. In order to better understand the use status of the public space around the site, the urban road space, roadside public space, investigation was made about the current situation of passenger flow in rail transit and the public space around it.

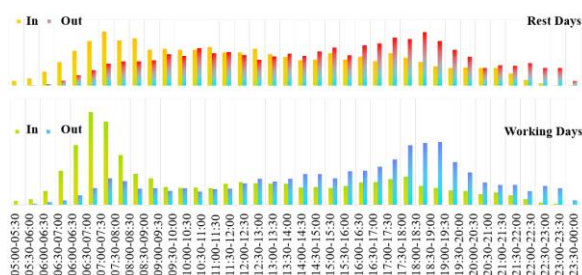


Figure1. Analysis of passenger flow in and out of Jiukeshu Station of Batong Line of Beijing Metro for half an hour on rest days and working days

Current situation of passenger flow in rail transit. In the process of connecting shared bicycle with rail transit, the parking situation in shared bicycle is closely related to the environmental quality of the surrounding public

space. Through the analysis of the passenger flow entering and leaving Jiukeshu Station, it is clear that the demand for sharing fade-out is the largest in the rush hours, showing obvious tidal characteristics, shown in Figure 1. In the early morning, a large number of shared bicycle gathered around the project, while in the off-duty peak, the transportation users rode away them. The passenger flow in and out of the subway station is directly related to the parking of shared bicycle around the station, which is also directly related to the surrounding public space.

Current situation of public space around the site. The use status of public space around the site is observed in different periods of working days and rest days, as shown in Figure 2. It is obviously to be found that the main users in this area are free non-mechanized vehicles, electric vehicles and motorcycles. For the private transportation, it will be idle for a long time during the daily connection with the subway. And hope to get more reliable storage and proper custody, therefore, users are willing to take a few more steps to park vehicles in a reliable position. This is also the organizational composition of the main users in the region at present. In the process of monitoring the parking situation in the project base on weekdays and rest days, through real-time monitoring of the parking data. It is found that there is sufficient parking space for self-owned non-mechanized vehicles, electric vehicles and motorcycles in the present land.

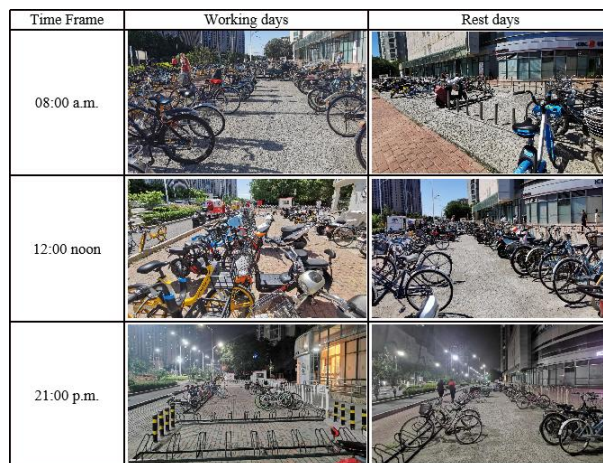


Figure2. Current situation of public space around the site in different time

In the statistical data of each stage, the peak of parking of self-owned vehicles during working days is about 150. At night, there are less than 40 vehicles in each day. From the perspective of efficient use of space, part of the parking of non-mechanized vehicles and part of the transformation into green landscape and leisure facilities are reserved within the scope of land use. It can make full use of the public space more effectively and improve the quality.

3.EXISTING PROBLEMS AND CAUSES OF PUBLIC SPACE AROUND JIUKESHU SUBWAY STATION

3.1The slow system should be combined with the overall planning of regional development

As a node in the slow system, the improvement of the environmental quality of a single public space depends on the whole regional transportation planning and the overall improvement of the slow system. Under the premise that the whole large slow system has not been effectively combed, simply adjusting and optimizing the environment at one point can be described as a drop in the bucket. This is also the core of improving the quality of public space. Therefore, in order to effectively improve the environmental quality, it is necessary to comprehensively consider the transformation and optimization of the slow system as a whole, achieving real improvement.

3.2Public space node design quality needs to be optimized

Because the project and its surrounding areas undertake the traffic connection function of subway stations and are short of land use, the problem is solved as comprehensively as possible by integrating various restrictive factors in a limited space. On the one hand, the design of public space nodes needs to consider the design problems within their own land use, von the other hand, it needs to be adjusted in combination with the coordinated use of multiple surrounding limited land space, improving the space utilization efficiency.

3.3Shared bicycle parking needs to be improved

At present, among all kinds of road traffic connecting with rail transit, the use and parking of shared bicycle has the greatest impact on the environmental quality. For the public nature of shared bicycle, users pay more attention to the convenience in storage, rather than the safety in storage. Shared bicycle is randomly parked around urban roads and inside and outside public open spaces, which seriously affects the space quality. In the management of shared bicycle, especially in shared bicycle, which is close to the subway station, during the rush hour, transshipment is only concerned about the intersection, but too limited attention is paid to some vehicles piled up in the slow lane. Parking space planning, operation and maintenance management, etc. of shared bicycle, which is used for connecting rail transit, need to be improved urgently.

4.DEMAND ANALYSIS OF PUBLIC SPACE AROUND JIUKESHU SUBWAY STATION

In order to better reflect in the process of improving the quality of public space and meet the needs of all parties as much as possible, public participation is fully carried out in the investigation of the needs of the renovation, which is divided into two stages. The first stage: public opinion collection (online), which is aimed at the residents and merchants around the project, as well as the shopping and leisure people who come to the shopping plazas around the subway station, to understand their satisfaction with the current situation of the land parcel in various aspects, the connection mode of daily travel rail transit, and the future reconstruction needs of the land parcel. Second stage: public participation (offline). It is carried out by directly observing the actual actions of the passengers at the site. The passenger flow participates in the display of the use function and time distribution of the base in the most concise and intuitive form. As observers, researchers are distributed on working days and rest days, and observe the use behavior of the public in different periods. It most accurately reflects the user's demand for the use of the project plot and its surrounding areas.

4.1Status satisfaction

In the survey on the satisfaction of the status quo of the changing public space in the site, over 70% of the residents and nearly 50% of the merchants think that they are dissatisfied or very dissatisfied. All the people who come here for dining and shopping think that they are very dissatisfied, which shows that there is an urgent need for renovation. In terms of the convenience of regional use, respondents showed relatively high tolerance. However, the special problem of nonmechanized vehicle parking is extremely dissatisfied, as shown in Figure 3.

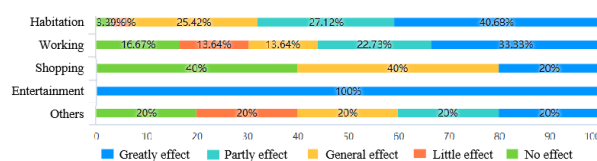


Figure3. Analysis of various users' satisfaction with regional status of nonmechanized vehicle parking

4.2Transformation needs

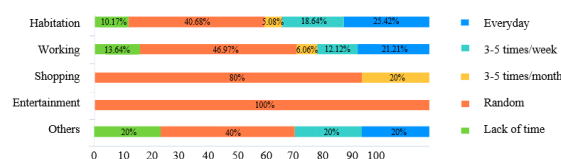


Figure4. Analysis of the frequency of use of facilities, rest& sunshade

The user's demand for regional use function was found through the investigation. Among resident respondents, there is a great demand for landscape and rest facilities, while among merchant respondents, the demand for parking and rest facilities for non-mechanized vehicles ranks high. Among the shopping respondents, the demand for basic shopping mall passages and rest facilities is ahead. For the respondents who come to catering and entertainment, parking of non-mechanized vehicles and access to surrounding businesses are 100% just needed. Many interviewed groups mentioned that they want to add facilities in this area, but when asked about the frequency of use, "random number of times" was the main body. In addition, over 40% of the residents can use this function 3-5 times per week, which shows that this function is mainly required by nearby residents, as shown in Figure 4.

5. STRATEGIES FOR IMPROVING THE QUALITY OF PUBLIC SPACE AROUND JIUKESHU SUBWAY STATION

5.1 Overall planning and upgrading of slow system

The public space around rail transit stations is an important open space node in the whole transportation system, especially in the slow system. In order to improve the quality of public space, it is necessary to plan the whole transportation system reasonably and orderly, organize motor vehicles and slow systems in an orderly manner, as well as other green landscapes, activity facilities and other areas. The improvement of the quality of each public space is not a problem of the design and transformation of a single point, and it needs to be fully placed in a large space environment for comprehensive planning before it can be effectively transformed and upgraded.

5.2 Reasonable planning of parking spots in shared bicycle

Paying attention to the shared bicycle utilization, parking, operation and maintenance management is an important part to solve the environmental quality of public space around the site. On the one hand, it is necessary to rationally plan parking space based on the actual situation of land use space to ensure sufficient parking space. On the other hand, it is necessary to combine various technical means to guide bicycle users to standardize their behaviors, such as guiding users to park in designated areas through APP software positioning. For the effective management of shared bicycle, an important environmental factor around rail transit stations, it is an important guarantee to improve the environmental quality of the surrounding public space.

5.3 Fine design of public space node

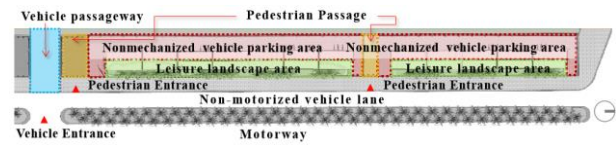


Figure 5. Schematic diagram of public space design function on the exit of Jiukeshu Subway Station

For the specific public space node design, in the limited stock space of urban built areas, it is necessary to comprehensively consider the needs from all parties and solve the functional requirements as much as possible. In the design and reconstruction of the public space at the southwest exit of Jiukeshu Subway Station, the actual needs of the public are fully respected, and some parking areas for non-mechanized vehicles are reserved in terms of functions. It is located near the plaza of Ruidu International Center, which is convenient for management while ensuring its use, shown in Figure 5. At the same time, green landscapes, leisure seats and sun-shading facilities will be added in the space for the rest of nearby residents and leisure shopping users. Located on the east side of the plot near the urban road, there are green landscapes and facilities, which are convenient for residents, and is beneficial to street landscape. In the non-mechanized vehicle parking section, 150 ones can be parked, meeting the peak storage. Parking area is near the Plaza, shown in Figure 6.

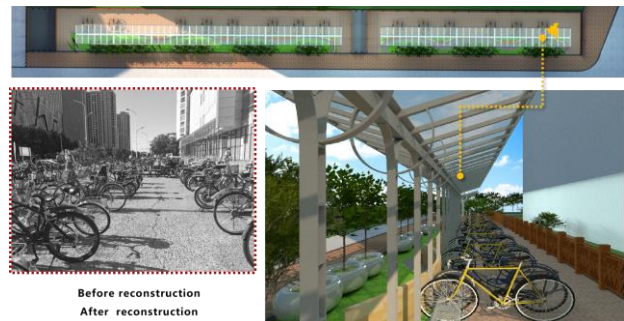


Figure 6. Comparison of public space before and after on the exit of Jiukeshu Subway Station

5.4 Strengthen management and system improvement and implementation

While planning the transportation system and upgrading the slow system, policy support from the government, sub-district offices and other levels is an important institutional guarantee. Especially for the surrounding area of the site where the surrounding space is cramped, the surrounding area can be revitalized by making use of idle space and land to provide more open and flexible space for the city. To solve practical problems such as limited existing space. Accordingly, shared bicycle operation management company should

not only introduce corresponding measures to ensure its operation, but also implement relevant policies.

6.CONCLUSION

Based on the results and discussions presented above, the conclusions are obtained as below:

In the process of urban renewal, the quality of public space around rail transit stations in urban built areas should be improved according to local conditions. In this study, Jiukeshu subway station can make full use of its land during off-peak hours, especially after the end of the evening peak, although its area is limited due to the tidal passenger flow connected to the rail transit standard station and the particularity of parking of non-mechanized vehicles. Using the land alternatively, and additional leisure facilities for residents are well renovation of the public space.

As a large number of existing conditions in the built area are the limited conditions for upgrading, higher requirements are put forward for renovation. Fine design should be carried out with the changes of demand and environment, and the quality of public space in the built area can be effectively improved by darning the space and connecting functions.

In the design process, it is difficult to solve the problem effectively by paying attention to the transformation of a single node in public space. It is also necessary to promote the truly implemented transformation process of co-governance and sharing through transportation system planning, slow system optimization, user habits improvement and multi-sectoral joint efforts.

After the completion of the pilot project, it is necessary to pay attention to the timely investigation and feedback of users' post-use evaluation, so as to help the project itself to be better applied sustainably and provide reference for related projects.

AUTHORS' CONTRIBUTIONS

The first author contributed 65%, the second 15%, the third 10%, and the rest 5% respectively.

ACKNOWLEDGMENTS

This work was supported by the Beijing Higher Education ' Undergraduate Teaching Reform and Innovation Project ' in 2020 (Industry-university-research Collaborative Innovation and Practice of Architecture Specialty under the Opportunity of Urban Renovation), and the Scientific Research Project of Beijing Municipal Education Commission (Grant No. KM201911418001).

REFERENCES

- [1] LIU Ruilin. Research on Optimization Strategy of Slow Traffic System in Rail Transit Station Area[J]. Architecture & Culture, 2021(01): 133-135.
- [2] BAI Xue. A Preliminary study of Slow Urban System under the concept of "Double Scale"[D]. Zhengzhou University, 2018.
- [3] Moore G. E. The effectiveness of small-scale urban public open space regeneration processes at delivering sustainable communities : UK case study - Groundwork North London[J]. University College London (University of London) . 2010
- [4] H. Nordh, T. Hartig, C.M. Hagerhall, G. Fry. Components of small urban parks that predict the possibility for restoration[J]. Urban Forestry & Urban Greening. 2009 (4)
- [5] Looking at Barcelona through Jane Jacobs's eyes: Mapping the basic conditions for urban vitality in a Mediterranean conurbation[J]. Xavier Delclòs-Alió, Carme Miralles-Guasch. Land Use Policy. 2018
- [6] Mohadeseh Mahmoudi, Faizah Ahmad, Bushra Abbasi. Livable streets: The effects of physical problems on the quality and livability of Kuala Lumpur streets[J]. Cities. 2014
- [7] WANG Zhenbao, LI Huiqing, SHANG Haichao. Convenience Analysis of Public Service Facilities in the Walking Circle of Urban Housing Estates[J]. Journal of Landscape Research. 2021(04)
- [8] Guowei Lyu, Luca Bertolini, Karin Pfeffer. How does transit-oriented development contribute to station area accessibility? A study in Beijing[J]. International Journal of Sustainable Transportation. 2020 (7)
- [9] John Zacharias, Qi Zhao. Local environmental factors in walking distance at metro stations[J]. Public Transport. 2018 (1)
- [10] Craig Townsend, John Zacharias. Built environment and pedestrian behavior at rail rapid transit stations in Bangkok[J]. Transportation. 2010 (2)
- [11] Haixiao Pan, Qing Shen, Song Xue. Intermodal Transfer between Bicycles and Rail Transit in Shanghai, China[J]. Transportation Research Record. 2010 (1)
- [12] Xiaolei Ma, Xi Chen, Xiaopeng Li, Chuan Ding, Yinhai Wang. Sustainable station-level planning: An integrated transport and land use design model

for transit-oriented development[J]. Journal of Cleaner Production. 2018

- [13] Eunji Ha, Yongjin Joo, Chulmin Jun. An empirical study on sustainable walkability indices for transit-oriented development by using the analytic network process approach[J]. International Journal of Urban Sciences. 2011 (2)
- [14] Hyungun Sung, Ju-Taek Oh. Transit-oriented development in a high-density city: Identifying its association with transit ridership in Seoul, Korea[J]. Cities. 2010 (1)