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The Usage Mode and Optimization Path of Urban Public Space in the Time Dimension

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Abstract

development, the quality and adaptability of urban public spaces have increasingly become the core indicators for measuring livability. Urban public space is the core carrier of residents' daily activities, and its usage status shows significant differences over time. This article takes the time dimension as the core perspective, combined with time elements such as residents' daily schedules, seasonal changes, and urban functional cycles, to analyze the differences in the usage characteristics and patterns of urban public spaces at different times, and to analyze the problems of supply-demand mismatch and resource waste caused by neglecting the time dimension in current public space planning. Based on real urban development practices, it proposes a public space optimization path that adapts to time patterns, providing practical references for improving the efficiency of urban public space utilization and enhancing residents' sense of gain.

Keywords

Time dimension, urban public space, usage patterns, spatiotemporal coupling, optimization path.

1. Introduction

As China's urbanization process enters a stage of high-quality development, the quality and utilization efficiency of urban public spaces have become important indicators for measuring urban livability. Currently, most urban public space planning focuses on static dimensions such as spatial form and functional layout, but neglects the dynamic changes in residents' activities in the time dimension, resulting in some public spaces being overcrowded during peak hours and idle during off-peak hours. For example, the subway station plazas during commuting hours are overcrowded, while late nights are rarely visited; The waterfront walkway has abundant passenger flow in summer, but is almost idle in winter. This supply-demand imbalance in the time dimension seriously affects the use value of public spaces [1].

The core connotation of the time dimension is reflected in multiple levels such as differences in time periods, periodic patterns (daily cycle, weekly cycle, seasonal cycle), and changes in the times, which collectively constrain and guide residents' choices of public activities. Studying the usage patterns of public spaces from this dimension is essentially exploring the coupling relationship between "space-time-human", which is in line with the core orientation of "people-oriented" in urban planning. This article is based on real urban development practices, systematically sorting out the usage characteristics and mode types of public spaces in the time dimension, deeply analyzing existing problems, and proposing targeted optimization paths to make up for the shortcomings of static planning, providing theoretical and practical support for the refined planning and management of urban public spaces. The full text analysis is based on the universal laws of urban development and observable phenomena of public space use, without involving fictional cases and data.

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2. The core characteristics of urban public space use in the time dimension

The time dimension directly shapes the usage status of public spaces by influencing residents' activity choices, with core features concentrated in three levels. From the perspective of daily cycle, the use of public spaces exhibits a clear peak-valley alternation characteristic [2]: 7:00-9:00 in the morning is the concentrated period for commuting and morning exercise activities, with subway entrances, community squares, and urban parks serving as core carriers; From 12:00 to 14:00 in the afternoon, the main focus is on dining and relaxation, with activities concentrated in commercial districts and affiliated squares of office areas; From 18:00 to 21:00 in the evening is the golden time for the use of public spaces. Residents have diverse types of activities, including fitness, parent-child activities, and social activities. Community parks, waterfront trails, and surrounding spaces of commercial complexes have become the core carriers. On the other hand, during the three time periods of 0:00-6:00 in the morning, 10:00-11:00 in the morning, and 15:00-17:00 in the afternoon, the usage of public spaces is generally low, mostly operating at low load rates.

From the perspective of cyclical patterns, the differences between weeks and seasons are equally significant. During weekdays, the use of public spaces is mainly focused on commuting and office-related activities, with clear functional orientation; Entering weekends and holidays, leisure and entertainment activities, as well as family gatherings, have become mainstream. Public spaces around parks and scenic spots, urban greenways, and other areas have become hotspots for use, and residents' stay time in public spaces has significantly increased compared to weekdays. The impact of seasonal changes on the use of public spaces is equally prominent: during the high temperature period in summer, the peak of public space use will shift to the morning and evening, and waterfront spaces and ventilation corridors are more favored at night due to their comfortable environment; Under the low temperature weather in winter, the overall usage of public spaces is significantly reduced, and indoor-outdoor transitional spaces such as sunny squares, mall courtyards, and community service center entrances have become the main activity venues; The climate is suitable in spring and autumn, and the overall usage of public spaces remains high, with a more diverse range of activities.

Thirdly, the coupling between time and space is prominent. The efficiency of public space utilization is closely related to the temporal synergy of urban functions [3]. For example, if the public space around the office area can be accurately matched with commuting time, adding rest seats and convenient service facilities can effectively enhance its value; If the public spaces in old communities fail to meet the morning exercise and daytime leisure needs of elderly residents, they are prone to functional idleness. The degree of coupling between time, space, and function directly determines the quality of use of public spaces.

3. Typical usage patterns of urban public spaces in the time dimension

Based on differences in time dimensions, types of resident activities, and spatial functional attributes, urban public spaces can be classified into four typical usage patterns. Commuting-oriented mode is one of the most representative modes, mainly corresponding to the morning and evening rush hour on weekdays. The core carriers include subway station plazas, bus stop surroundings, and commuting corridors. Its core features are highly concentrated usage time, fast activity pace, and residents' needs focused on smooth traffic and short-term rest. There is an urgent need for basic supporting facilities such as directional signs and temporary seats [4], and the flow of people at the exit of subway transfer stations is a typical manifestation.

The daily-leisure mode covers a wider range of scenarios, including lunchtime on weekdays, weekends, and holidays. Community parks, community squares, and commercial block leisure

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areas are all of this type of space. The main types of activities are catering and leisure, parent-child interaction, and elderly fitness. The usage time is relatively scattered, and residents value the comfort, convenience, and functional complexity of the space more. Multiple facilities such as fitness equipment and children's play facilities are needed. The weekend family activity scene in community parks is a typical presentation.

The seasonal-adaptation mode shows significant differences with climate change, and the spatial carrier has a distinct seasonal orientation [5]. In summer, cool spaces such as waterfront trails and ventilated squares are the main focus, and activities are concentrated on cooling off and walking at night; In winter, it shifts to warm areas such as sunny squares, mall courtyards, community service center entrances, and the mall atrium, with short-distance leisure as the main activity; The climate is suitable in spring and autumn, and urban parks and suburban greenways are preferred. Activities such as hiking and picnicking are more common. Due to climate differences between northern and southern cities, this type of pattern is more prominent.

The special-time-period mode corresponds to holidays, large-scale events, and other nodes, with urban core squares and public spaces around scenic spots being the main carriers. Its core feature is the high concentration of people flow in a short period of time, strong activity purpose, and extremely high requirements for space capacity, evacuation routes, and temporary facilities (toilets, medical points). Scenes such as the Spring Festival temple fair and tourist flow distribution around scenic spots during National Day all test the emergency support capacity of public spaces.

4. Existing Problems in Urban Public Space Planning and Use in the Time Dimension

In current urban public space planning and management, there is a general lack of systematic consideration of the time dimension, with a focus on static design of spatial form and functional layout, neglecting the temporal dynamics of residents' activities. This static planning thinking leads to a serious mismatch between spatial supply and residents' dynamic time demands [6]. This problem not only leads to inefficient utilization of public resources, but also gives rise to multiple usage difficulties, which restrict the improvement of urban livability. The primary issue is the imbalance between supply and demand during different time periods, insufficient core space capacity during peak hours, and overcrowding of subway entrances and sidewalks around schools during commuting, which not only affects traffic efficiency but also poses hidden safety hazards; During low periods, a large amount of space is idle, such as the leisure plaza in commercial districts, which is almost deserted on weekdays, but still requires continuous investment in maintenance resources, resulting in significant waste. The root cause lies in the inaccurate prediction of changes in pedestrian flow during the planning stage.

Secondly, there is a disconnect between facility configuration and time requirements, with most spaces adopting a "one-size-fits-all" facility layout that ignores differences in time periods. For example, community parks lack fitness equipment and rest chairs during peak morning exercise periods, while lighting and monitoring facilities are insufficient at night; The shortage of midday rest seats in commercial districts, coupled with the lack of landscape lighting and leisure facilities suitable for nighttime activities, directly lowers the user experience.

The lack of seasonal adaptability planning is also prominent, with outdoor spaces in the north experiencing a sharp drop in usage during winter due to the lack of windproof and thermal insulation facilities; public spaces in southern cities lack shading, ventilation, and cooling equipment in summer, and are basically idle during daytime high temperature periods [7]. Moreover, some waterfront spaces and greenways have not adjusted their management strategies according to the season, and there is a lack of temporary toilets and drinking water

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points in summer. The lack of timely ice and snow removal in winter further deteriorates the user experience.

Finally, there is insufficient emergency support during special periods, poor response to peak pedestrian flow during holidays, large-scale events, etc. The core square lacks temporary evacuation routes, emergency toilets, and other facilities. Parking and guidance signs around the scenic area are not reasonably planned, which can easily lead to congestion and chaos; During extreme weather, there is a lack of emergency shelter facilities, making it difficult to ensure the safety of residents' activities.

5. Optimization principles of urban public space based on time dimension

To solve the above problems and improve the efficiency and quality of public space utilization, optimization work needs to follow three core principles.

The principle of spatiotemporal adaptation is the primary principle to be followed, and the core is to achieve precise matching of public space capacity, function, and time requirements around the residents' activity patterns in the temporal dimension. During the planning phase, it is necessary to conduct on-site research and systematically grasp the scale of pedestrian flow and types of activities at different time periods, based on which the capacity and functional layout of public spaces can be reasonably determined [8]; During the management phase, it is necessary to dynamically adjust usage strategies based on changes in time periods, such as increasing service personnel during peak hours, opening up temporary evacuation or activity spaces, optimizing resource allocation during off-peak hours, and reasonably controlling maintenance costs. This principle is the key means to solve the current problem of temporal supply-demand imbalance in public spaces.

Next is the principle of elastic adaptation. The planning and design of public spaces need to have a certain degree of flexibility to adapt to the usage needs of different time dimensions such as daily cycles, weekly cycles, and seasonal cycles. In terms of spatial layout, a combination mode of "fixed-function + flexible-function" can be adopted. Fixed-function areas ensure the normal activity needs of residents, while flexible-function areas can adjust their usage functions flexibly according to time periods and seasonal changes; In terms of facility configuration, priority should be given to using movable and foldable facilities, such as temporary seats, mobile sales kiosks, activity stages, etc., to achieve dynamic allocation of facilities [9]. Through this principle, public spaces can break through the limitations of a single function, better adapt to the needs of different time dimensions, and enhance the flexibility of space utilization.

Finally, there is the principle of safety assurance. We need to establish a comprehensive security system to address usage risks across different time dimensions. On the one hand, improve the configuration of safety facilities during regular hours, such as lighting systems, monitoring equipment, emergency call devices, etc. in public spaces at night, to ensure the safety of residents' nighttime activities; On the other hand, we will strengthen our emergency support capabilities during special periods, develop special emergency plans for holidays, large-scale events, extreme weather, and other scenarios, add temporary emergency facilities in advance, clarify pedestrian flow guidance routes, and ensure the safety of residents' activities. Safety is the fundamental prerequisite for residents to use public spaces, and this principle is an important foundation for enhancing residents' sense of gain in using public spaces.

6. Optimization Path of Urban Public Space Based on Time Dimension

Based on the above principles, optimization can be promoted from three levels: planning and design, facility configuration, and management and operation. At the planning and design level, the core is to construct a spatial layout system that is spatially and temporally coupled [10]. In

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the early stage of planning, it is necessary to conduct full-time on-site research and pedestrian flow monitoring, establish a "time-space-activity" correlation database, and accurately identify differences in spatial demand at different time periods; In terms of spatial layout, for the commuting-oriented mode, the focus is on optimizing the traffic efficiency of the surrounding space of subway entrances and bus stops, adding sun-and-rain shelters and temporary rest areas; To create a multi-functional community public space for daily-leisure mode, integrating multiple functions such as fitness, parent-child, and social interaction; For the seasonal-adaptation mode, northern cities can add wind-proof warm pavilions and sunshades in outdoor public spaces, while southern cities can focus on adding sunshade racks and spray cooling facilities; For special time periods, reserve temporary evacuation routes and emergency facility land in advance, and improve the pedestrian flow guidance signage system.

Secondly, dynamic adaptation: optimizing time-oriented facility configuration strategies. Establish a dynamic allocation mechanism for facilities and adjust facility layout according to the needs of different time periods. For example, in community parks, temporary fitness equipment should be added during peak morning exercise periods, and lighting facilities and emergency call devices should be added at night; In commercial districts, movable seats will be added during lunchtime peak periods, and landscape lighting and interactive facilities will be turned on at night. At the same time, we will strengthen the seasonal adaptability of facilities, adding drinking water points, toilets, and shading facilities in waterfront spaces and greenways in summer, and adding anti-slip facilities and warm rest areas in outdoor public spaces in winter. In addition, improve the configuration of emergency facilities during special periods, add temporary toilets, medical assistance points, and mobile sales kiosks in core public spaces during holidays, use emergency shelters during extreme weather periods, and equip necessary emergency supplies.

Thirdly, fine operation: establish a full-time management and service system. Build an operational management model of "government-led, social participation, and market-oriented operation" to enhance the full-time service capabilities of public spaces. In terms of personnel allocation, dynamically adjust the number of service personnel according to the demand of time periods, increase cleaning, security, and service personnel during peak hours, and optimize personnel allocation during off-peak hours; In terms of management strategy, intelligent management methods are adopted to monitor the real-time usage status of public spaces through monitoring systems and crowd flow statistics systems, and adjust management measures in a timely manner; At the community level, encourage residents to participate in the time-periodic management of public spaces, establish volunteer teams, and be responsible for guiding foot traffic and maintaining facilities during peak hours [11]. At the same time, we will strengthen collaboration among different departments, establish linkage mechanisms among planning, urban management, public security, emergency management, and other departments to jointly address the management issues of public space use during special periods.

7. Conclusion

The time dimension is a core element that affects the usage patterns of urban public spaces. Through multiple patterns such as daily, weekly, and seasonal cycles, it directly shapes the temporal usage characteristics and diversified usage patterns of public spaces. The core reason for the current problems in urban public space planning and management, such as temporal supply-demand imbalance, mismatched facility configuration, and insufficient seasonal adaptability, lies in the systematic neglect of the time dimension. Based on this, this article proposes an optimization path of "precise planning, dynamic adaptation, and fine operation", which achieves accurate matching between public space supply and residents' demand in the time dimension by constructing a spatiotemporal coupled spatial layout system, optimizing

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time-oriented facility configuration strategies, and establishing a full-time management and service system.

In order to promote the planning and management of urban public spaces in the future, it is necessary to further strengthen the concept of "spatiotemporal collaboration", combine technologies such as big data and the Internet of Things, accurately capture the temporal patterns of residents' activities, and achieve refined and dynamic management of public spaces. At the same time, attention should be paid to public participation, and residents' needs and suggestions for the use of public spaces at different times should be widely collected through field research, discussions, interviews, and other methods to ensure the pertinence and feasibility of the optimization path. The research findings of this article provide a temporal perspective and practical reference for the high-quality development of urban public spaces, which can help improve the efficiency of public space utilization and residents' sense of gain, and promote the construction of livable cities to a higher level.

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