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Research on Adaptability Analysis of Environmental Space Demand and Design Optimization of Daycare Centers: Taking Chongqing's Community F as an Example

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Abstract: Currently, there is a lack of research on the detailed environmental spatial design of community daycare centers at the micro level. This study focuses on Community F in Chongqing, using the elderly's "willingness to demand" as a central aspect. It examines indoor and outdoor environmental space needs at a micro level, considering both functional requirements and spiritual needs based on existing research. The analysis incorporates three adaptive elements: current construction, surrounding environment, and operational management. It explores the feasibility of restructuring spatial layouts, utilizing local resources, and integrating Bayu cultural characteristics. Finally, through design optimization practices, the study proposes three strategies for aging optimization: functional integration and interaction, user-friendly facilities, and emotional connections to place.

Keywords: Daycare center; Environmental space; Willingness to demand; Design optimization

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1. Introduction

Aging has emerged as a significant and pressing challenge for China in the twenty-first century, presenting a new national situation and task. According to comprehensive data, China faces substantial demographic shifts: the population aged 60 and above exceeds 260 million, placing it among the world's largest elderly population. The proportion of elderly individuals requiring support approaches that of the fourth-largest country globally. The nation's aging rate stands at 18.70%, reflecting a 5.44% increase since 2010, indicative of rapid and deepening aging trends. Notably, over 50% of the elderly are empty-nesters, with figures surpassing 70% in major cities and rural areas, underscoring profound societal implications and challenges posed by aging demographics [1].

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The concept of community daycare centers has gained prominence in response to China's aging society, particularly in the years before and after 2000. Research on these centers has become a focal point, addressing various aspects such as performance evaluation [2], optimizing building space models [3,4], and drawing lessons from advanced experiences in developed regions [5,6]. Scholars have focused on defining service demands, facility types, and standards [7,8], as well as categorizing services to meet diverse needs [9,10]. However, there remains a notable gap in research concerning the micro-level design of indoor and outdoor environments and facilities directly used by elderly individuals. These aspects significantly impact their sense of well-being and accessibility, highlighting the need for more detailed exploration and design considerations at this level.

2. Research on the demand for daycare services among the elderly

2.1. Site selection analysis

Due to the current inadequacies in China's pension system and the significant gaps between community daycare center construction and relevant state ministry requirements, there are widespread issues such as insufficient total floor space and activity scale [11]. In this study, we focused on a district in the western region (with a per capita GDP 15% higher than the national average), highlighting that out of 80 communities (villages) within the development boundary, only one care center meets the basic standards. Given these challenges, the study emphasizes a micro-level approach, selecting research subjects that already meet basic national ministry requirements regarding site selection, scale, and other macro and meso-level criteria. This approach aims to explore how the environmental spaces of daycare centers can more accurately cater to the elderly's needs and optimize their design and transformation effectively.

Community F, situated in the core urban area of Chongqing, benefits from a mountain park to the east, convenient transportation links, and comprehensive urban amenities. It encompasses 11 neighborhoods with a population exceeding 22,000, including over 1,000 elderly residents aged 65 years and above, typical of mountainous communities in the region. The community daycare center is strategically located in the southeast corner, adjacent to the mountain park, offering a picturesque environment. Comprising two buildings, it spans approximately 750 square meters. The main building adopts a simple Bayu residential style, characterized by green tiles and white walls, with two floors above and below. The auxiliary building houses toilets and ancillary rooms. Following onsite visits and research, which included evaluations of social workshops, service rooms, day lounges, health guidance areas, art rooms for painting and calligraphy, vocal practice spaces, committee rooms, an activity hall, and a kitchen, it is evident that the care center's basic functions are relatively comprehensive and well-equipped.

2.2. Research on specific needs

The basic attributes of the elderly in Community F encompass nine key aspects: gender, age, education level (junior high school and above for over 76%), occupation before retirement (over 78% previously employed in roles like employees or in institutions), household composition (typically 2 elderly family members), retirement preference (close to 90% prefer aging at home or in the community), living arrangements (over 90% live with

their spouse or children), and utilization of daycare centers (56% utilize these services). Among those using daycare, over three-quarters reported feeling psychologically happier or physically healthier. This data reveals a community of elderly with a high cultural level, secure retirement finances, a strong preference for aging in familiar settings, and a significant demand for daycare services.

The analysis of demand and willingness among users of the daycare center in Community F is based on current utilization patterns and user feedback. Out of 120 elderly individuals studied, 67 were regular users of the center. Their primary reasons for using the facility included physical exercise, enriching their retirement life, and socializing with peers, with health care and public activities being the most frequented services, averaging over 45 visits. Home management services, psychological care, birthday celebrations, and access to organic food were utilized over 20 times. Meal assistance and daycare services were accessed more than 10 times. Regarding suggestions and demands, there was a recurring call for outdoor recreational and sports facilities, as well as spaces for outdoor social interactions, cultural enrichment, and improving indoor lighting. Additional requests included opening counseling services, installing indoor elevators and barrier-free stairways, creating storm corridors for safety, and establishing comprehensive geriatric file management systems, all highlighted more than 10 times by respondents.

The preferences of other family members should also be considered, particularly the adult children of the elderly. During the research involving guardianship groups and support networks for the elderly, there was a notable preference for daycare services, specifically during specific time periods to accommodate work schedules. Nearly 80% expressed willingness to pay between 300–600 yuan for these services. Additionally, feedback from these groups highlighted a strong desire for the establishment of a children's area within the daycare center. Overall, these findings align closely with the preferences identified among the elderly themselves, emphasizing the importance of catering to both generations' needs when planning and enhancing daycare facilities.

2.3. Summary of research

Based on the research and summary conducted above, it can be deduced that meeting the needs of the elderly involves both functional and spiritual aspects. Functionally, day care centers must cater to a wide range of activities for self-care elderly groups, including health care services, psychological counseling, advice on aging issues, and even childcare assistance. Additionally, facilities need to accommodate semi-self-care and disabled elderly groups, providing services like assisted living, daily care, and rehabilitative care. Spiritually, the centers should fulfill the elderly's desire for social integration, allowing them to both observe and be observed within their community. Cultural enrichment is also crucial, providing opportunities for intellectual stimulation and the preservation of personal memories. Furthermore, fostering self-realization and personal growth among the elderly is essential.

3. Adaptive analysis of environmental space needs

3.1. Key elements of adaptability analysis

3.1.1. Current conditions

The current conditions of Community Daycare Center F include two separate buildings with a frame structure connected by corridors. Each building features small, independent single rooms that serve specific functions but are not interconnected. The height difference between activity areas is minimal, and the plots are square-shaped. However, the center lacks a cohesive indoor and outdoor cultural atmosphere and does not evoke a strong sense of place memory or spiritual elements.

3.1.2. Surrounding environment

The surrounding environment of Community F Daycare Center encompasses various factors such as land conditions, transportation accessibility, commercial presence, and topographical features that influence the design of its indoor and outdoor spaces. Through research, it's observed that the center is situated east and north of a mountain park, where significant height differences exist. However, the interaction between the building and activity areas with the park is limited. To the west, the center interfaces with a community service center, allowing for some functional interaction. On the south side, there are terrace fortresses and residential areas, which do not significantly obstruct overall lighting and ventilation for the center. These environmental considerations play a crucial role in shaping the design and functionality of Community F Daycare Center.

3.1.3. Operation and management

The operation and management of Community F Daycare Center encompass several aspects including the range of services offered, service projects, activity organization, operating hours, operational mode, and associated costs. Currently, the center employs four staff members dedicated to medical rehabilitation services and another four for management and other services. Services are predominantly provided in a public mode, with no centralized or unified charging system in place. Only certain services incur charges, such as assistance for the elderly, psychological counseling, and massage. Additionally, there are non-revenue-generating services like nursing and bathing, as well as paid services such as home delivery and hourly wage earners.

3.2. Main conclusions of the adaptability analysis

3.2.1. Flexible spatial layout

Firstly, the frame structure of the care center building offers flexibility to redesign the interior layout, moving away from small independent rooms connected by corridors. This allows for better integration between spaces and facilitates the creation of vertical circulation elements between the two buildings. Secondly, the flat and square outdoor activity space provides an ideal layout for zoning and facilitating movement, catering to the diverse needs and groupings of elderly activities. Lastly, by treating indoor and outdoor environmental spaces and functions as an integrated whole, enhancements to the building's exterior can create a more inviting and comfortable environment. This approach includes renovating the building's appearance and reconfiguring indoor and outdoor functionalities to foster seamless integration between the interior and exterior spaces.

3.2.2. Potential of exploring the surrounding environment

Due to the steep terrain of the mountain park and the care center, which are both integral parts of the community and significant public spaces, addressing this barrier involves micro-remodeling the terrain. This could include adding health ramps and introducing vertical transportation methods to integrate the three-dimensional landscape and leisure functions of the mountain park into the care center. This approach aims to expand the range of activities available to the elderly and enrich the functional offerings of the care center. Additionally, functions like the cultural library within the community service center can also be integrated into the activities offered by the care center.

3.2.3. Bayu characteristic scene imprints

Incorporating the concept of "improving cultural quality" into the deep investigation and interviews revealed that users of the Community F Daycare Center generally have higher education levels and a background in rural or urban life. Many have clear memories of traditional Bayu life, which aligns with the center's simple Bayu residential style. Therefore, during the process of reshaping and further integrating with the surrounding area,

efforts are being made to incorporate Bayu vernacular symbols. This approach aims to evoke emotional resonance among users by tapping into their cultural memories and enhancing the overall cultural identity of the care center.

4. Indoor and outdoor environment space optimization design research

4.1. Functional integration and interaction

4.1.1. Indoor and outdoor functional interaction

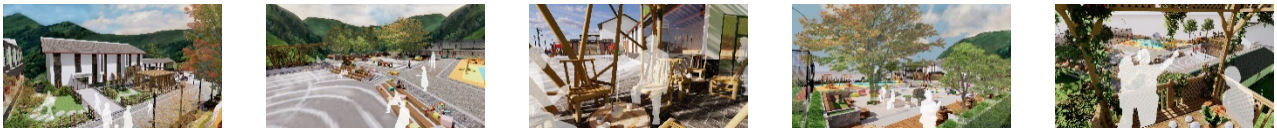
In this design approach, two integrated functional rings are constructed to break the traditional separation between indoor space and outdoor landscape: The first functional ring includes an outdoor entrance area → first-floor reception and counseling area for the elderly → first-floor calligraphy and activity areas → first-floor dining and tea rooms → outdoor recreation, sports, performance, and music areas → outdoor entrance area. The second functional ring features the first-floor reception and counseling area for the elderly → second-floor medical care and nursing service area → care and living area → mountain park or outdoor leisure spaces → outdoor sunshine leisure area (or outdoor entrance area). This layout aims to enhance interaction between internal and external environments, facilitating a holistic and enriched experience for users of the community daycare center (**Figures 1–3**).

4.1.2. Interaction between functional areas

In this optimization design process, the interior design employs the strategy of "zero to whole" and reduces boundary treatments to create a spacious and permeable layout conducive to group activities for the elderly. Meanwhile, the landscape design breaks away from traditional square zoning methods on the square plot. Instead of compartmentalizing, it centers around an outdoor performance area and integrates peripheral functions like music, sports, and leisure, fostering a dynamic environment that encourages interaction and participation, enhancing the overall sense of community.

4.1.3. Interaction within the functional area

Whether indoors or outdoors, the activity areas designed for self-care elderly groups are expanded to include spaces for children's participation and enjoyment. For instance, the indoor calligraphy area and activity room on the first floor are equipped with children's picture books and other interactive features. Outdoors, the sunshine recreation area, sports area, and performance area incorporate amenities such as sandboxes, colorful playgrounds, graffiti walls, and children's slides. These additions enable elderly groups to comfortably care for their grandchildren while enhancing their own quality of life.



(a) Building entrance (b) Performance Plaza Grandstand (c) Afternoon tea at the Wind and Rain Lounge (d) Yellow Oak Tree Storytelling Club (e) Mountain Park Pavilion

Figure 1. Functional index and traffic flow organization of Chongqing Community F Daycare Center

(a) Function room (b) Cafeteria (c) Calligraphy room (d) Daycare center (e) Living room

Figure 2. Nodal design of the landscape environment of Chongqing Community F Daycare Center

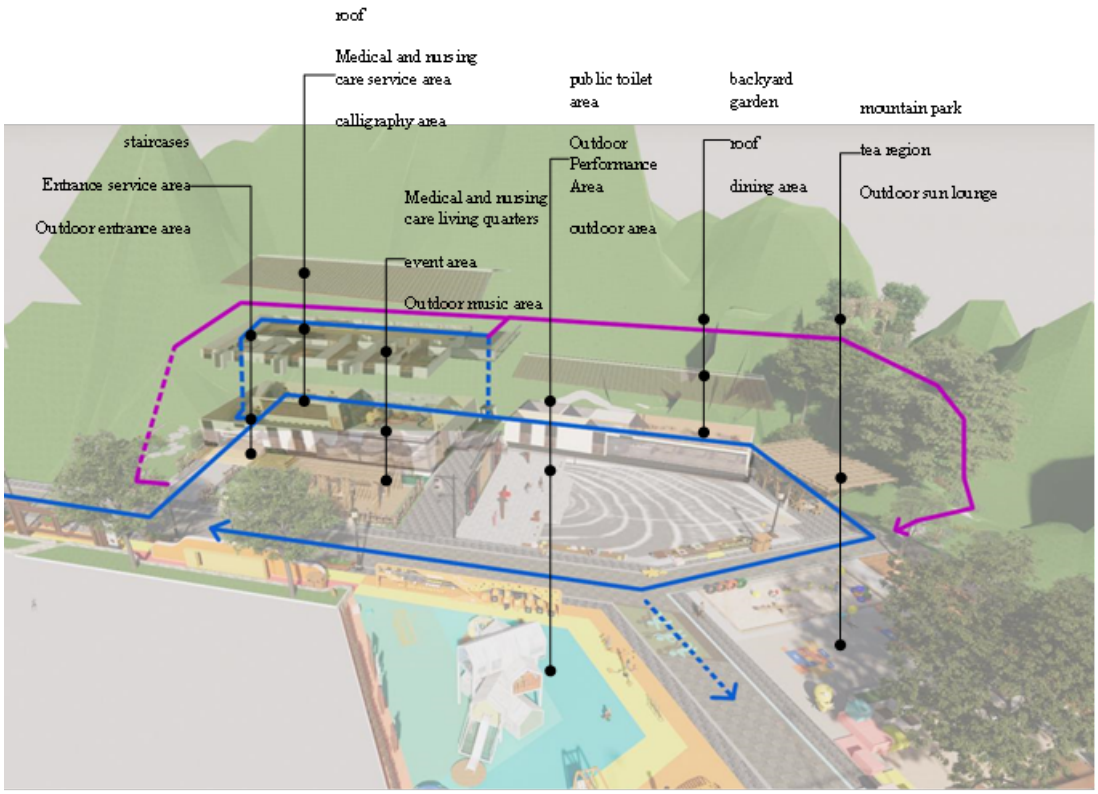


Figure 3. Nodal design of the indoor environment of Chongqing Community F Daycare Center

4.2. Facility-friendly assistance

4.2.1. Transportation facilities

The new wind and rain corridors between the two buildings introduce vertical elevators to create semi-outdoor platform connections, facilitating elderly groups requiring assistance to navigate stairs, deliver meals to the restaurant, and access the mountain park. Traditional slope stair handrails are replaced with “L” stacked handrails for easier movement and handling of goods by the elderly. Multiple barrier-free access routes are established to enhance transportation links between indoor and outdoor areas. Age-friendly transportation facilities further strengthen connectivity between people and various spaces, promoting efficient use of space and enhancing overall accessibility.

4.2.2. Shared facilities to assist movement

Based on the construction of two functional interaction rings, along with the shared functional areas, numerous shared facilities are incorporated to enhance the diversified use of space. The outdoor activity stage serves as both a space for elderly activities and a key venue for other community events. The shared kitchen island functions not only as a daily culinary hub but also as a participatory space for the elderly. The activity room podium accommodates children’s picture books while also hosting health lectures and skill workshops for the elderly. Additionally, the platforms within the mountain park, designed as vegetable gardens, serve as both aesthetic landscape features and tangible reflections of labor processes.

4.2.3. Other facilities

Based on the construction of two functional interaction rings, along with the shared functional areas, numerous shared facilities are incorporated to enhance the diversified use of space. The outdoor activity stage serves

as both a space for elderly activities and a key venue for other community events. The shared kitchen island functions not only as a daily culinary hub but also as a participatory space for the elderly. The activity room podium accommodates children's picture books while also hosting health lectures and skill workshops for the elderly. Additionally, the platforms within the mountain park, designed as vegetable gardens, serve as both aesthetic landscape features and tangible reflections of labor processes.

4.3. Place emotional touch

4.3.1. Implanting Bayu small micro-life elements

By integrating Bayu's traditional bamboo weaving tables and chairs, wooden furniture, ceramic vessels, traditional farming tools, seasonal paving, hanging local agricultural products, and warm yellow herringbone slope roofs into indoor and outdoor furnishings, landscape paving, and decorative structures, traditional elements are harmoniously fused with modern design. This integration aims to enhance the spatial texture and warmth while showcasing the charm and historical heritage of Bayu's traditional way of life.

4.3.2. Reproducing the lifestyle scene of Bayu

Through modern design methods and an open, integrated spatial layout, the project not only meets the requirements of modern living environments but also recreates scenes of small-scale Bayu life. Examples include storytelling under the yellow oak tree and afternoon tea in the wind and rain corridors, which facilitate post-dinner discussions and family interactions. The micro vegetable garden in the mountainous area and countryside canteen evoke memories of rural labor and life. Furthermore, the performance plaza hosts traditional folk performances such as Sichuan Opera Face Changing and Bayu Dance, blending traditional and modern spatial elements seamlessly.

4.3.3. Utilizing Bayu materials and plants

In the process of interior decoration and landscape construction, environmentally friendly, renewable, lightweight, and flexible local bamboo and wood materials are incorporated, and the building and landscape paving is mostly made of earth and stone, green bricks, and grey tiles, which have unique colors and textures, making the space appear rustic and elegant. In terms of the use of native plants, the outdoor recreation area is planted with yellow rafter trees alone, and the intersection with the mountain park adopts column planting of bamboo, ivy, etc. as vertical greening in order to offset the sense of steepness of the mountainous terrain, and the other areas are combined with the needs of the landscape, with tea trees, osmanthus, azalea, etc., to ensure that the space is aesthetically pleasing and practical.

5. Conclusion

This study focuses on exploring the willingness to use the care center as a starting point, particularly examining the adaptability of indoor and outdoor environmental spaces at a micro level. Through an analysis of adaptability, the research emphasizes optimizing design practices in three key areas: functional integration, user-friendly facilities, and spaces that evoke emotional responses. The goal is to enhance the environmental quality of community day care centers, ensuring they better cater to the needs of elderly groups. This research aims to provide valuable insights for enhancing environmental space quality in community day care centers and effectively meeting the needs of elderly users.

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