Elderly-friendly and Sustainable Optimization Design and Renovation of Public Facilities in Old Communities of Small and Medium Cities

Xingzhou Zhu

Jiangxi Normal University, Nanchang, Jiangxi, China
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Abstract: In recent years, China's aging problem has become increasingly severe, with prominent issues surrounding solitary and left-behind elderly individuals. Urban elderly care resources are lacking, and since the 1980s and 1990s generations are mostly only children, the pressure of supporting elderly parents is substantial. Community-based elderly care has become a model encouraged by the state; however, most community public facilities in China face challenges in terms of elderly-friendliness, functionality, and sustainability, making it difficult to meet usage needs. This paper employs literature research and field investigations, focusing on old public facilities in communities. Under constraints such as unchanged area, limited funding, and minimal environmental modification, the study proposes optimization and renovation strategies for existing facilities. The aim is to address issues such as facility aging, lack of functionality to meet modern living needs, inability to cater to elderly requirements, and lack of sustainable design concepts, thereby improving the community public elderly care environment and providing theoretical references for related design practices.

***Keywords*:** community elderly care; public facilities; elderly-friendliness; sustainable development; old community renovation

1. Introduction

1.1 Research Background

Since the 1990s, China’s population growth has slowed, and since entering the 21st century, especially in recent years, the number of new births has continually decreased. Data shows that in 2012, the working-age population in China decreased by 3.45 million compared to the previous year, marking the first absolute decline in a long time. This indicates that the domestic economy will likely experience a period of slower growth as the demographic dividend gradually diminishes.

Apart from economic issues, the aging problem is becoming increasingly severe. As the younger generation tends to settle and work in major cities, the high cost of living and distance from their hometowns make traditional family-based elderly care challenging. This phenomenon exacerbates the issues faced by solitary and left-behind elderly individuals in small and medium-sized cities and rural areas.

Currently, there are three main forms of elderly care: family-based, community-based, and social elderly care. Family-based care appears unsuitable under China's current conditions due to the heavy burdens young people face. Social elderly care has been implemented to some extent, but there is a significant mismatch between supply and demand. Community-based elderly care combines the advantages of the other two forms, improves on their shortcomings, and incorporates their operable aspects, making it a state-supported model. However, public facilities in most communities face elderly-friendliness and functionality issues, making them unable to meet the needs of elderly users. With the continuing and deepening phenomenon of aging, facilities must incorporate sustainable development principles to meet the requirements for energy conservation, emission reduction, environmental protection, and long-term use. Therefore, the renovation of community public facilities is imperative to meet development needs.

1.2 Research Significance, Scope, and Methods

Research on the optimization of community elderly care facilities can fill the gap in academic studies in this direction, deepen related research, and promote advancements in relevant design studies. Issues such as barrier-free facility design, improvements to public signage, and the division of internal community roads can all benefit from this research. From a societal perspective, sustainable design principles can integrate public facilities with culture, environment, and economy, enhancing communication between people, environment, and society, thus contributing to studies related to social and cultural issues. Sustainable design enables public facilities to adapt to various needs, utilize green materials, and reduce construction consumption. Elderly-friendly design allows communities to support elderly activities, reducing urban elderly

care resource consumption and promoting community-based elderly care.

This study primarily investigates public facilities in residential communities in Feicheng, Tai'an, Shandong Province, and Qiaoxi District, Zhangjiakou, Hebei Province. By comparing the usage of public facilities and the condition of the facilities themselves, the study analyzes public facility spaces based on elderly people's usage frequency, material quality, functionality, and site characteristics.

The main methods used include:

Literature Research Method. By reviewing a large number of documents, this method helps in understanding concepts related to sustainable development and elderly-friendliness. It clarifies the development trajectory and research status of community public facilities and aids in learning about theories related to public facility design.

Field Investigation Method. This involves conducting on-site visits and studies to understand the usage needs of elderly individuals for public facilities and their behavioral habits. It helps to identify the current shortcomings of public facilities and assess the community environment to clarify the issues.

Comparative Analysis Method. By visiting public facilities in different communities and observing the usage by various groups and the state of the facilities, comparisons are made based on factors like usage frequency, functionality, and construction materials. This analysis helps to extract the necessary information for the research.

2. Current State of Community Public Facilities

2.1 Overview of Field Research

Designing age-friendly community public facilities should not only meet the current needs of the elderly but also incorporate sustainable development principles to leave room for future possibilities, ensuring a harmonious relationship among the elderly, public facilities, and the environment. For example, some community public facilities are mainly built for entertainment purposes, as shown in the image below. Although this neighborhood was built in the early 21st century and does not fall under the category of old communities, its public facilities are relatively outdated. In this environment, the interaction between the elderly and the facilities is low. These facilities are designed for a single target group, which means that apart from the intended audience, other age groups rarely use these public spaces.

Additionally, due to spatial limitations, old communities cannot directly build new public facilities to meet the needs of the elderly. Instead, it's essential to observe the behavioral patterns of the elderly and optimize specific public spaces or facilities, giving them multiple functions. This approach can meet the needs of the elderly without wasting space or land resources.

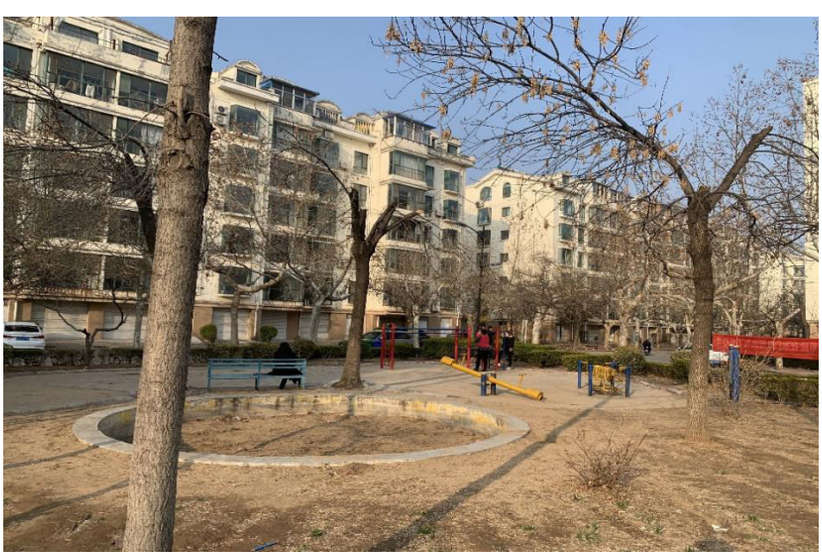

Figure 1. Current state of old public facilities (from the author)

The following images depict a neighborhood built around 2013. Compared to the previous community, this one offers more space for elderly activities, and its public spaces are open for various uses, allowing the elderly to freely choose suitable activities. With ample resting areas, seniors often stay in these spaces for social interactions even when they are not actively engaging in activities. Although there are no targeted age-friendly designs, the daily activity level of the elderly remains relatively high.

Figure 2. Current state of new community public facilities (from the author)

Figure 3. Current state of new community public spaces (from the author)

2.2 Prominent Issues with Old Public Facilities

Old communities, mostly built in the last century, often lack forward-looking designs and sufficient space reservations, providing minimal or no supporting facilities. After long periods of use, issues like inadequate public spaces and outdated public facilities become increasingly evident. The main problems with old community public facilities are:

(1) Outdated Facilities: Most facilities are either damaged or entirely unusable, serving only a decorative purpose. Even the usable facilities do not align with the habits of the elderly or children, and younger adults often lack the time to use these facilities.

(2)Lack of Age-Friendly Design: These facilities are not specifically optimized for elderly users. When used incorrectly, they can easily cause accidents among seniors.

(3) Insufficient Public Space and Facilities: Due to the design constraints of earlier times, only a limited number of public facilities were included. With insufficient redundancy, prolonged use leads to a shortage of public facilities and spaces.

3. Principles for Optimizing Community Public Facilities

3.1 Optimization Based on Behavioral Characteristics

As people age, their physical abilities gradually decline, leading to deteriorations in perception, cognition, and movement:

(1) Slower Response Times: The elderly become slower and more deliberate in their actions.

(2) Reliance on Sensory Feedback: Elderly cognition largely depends on sensory feedback due to the decline in cognitive functions.

(3) Need for Assistance in Specific Conditions: The elderly often require assistance when performing certain tasks due to their physical limitations.

Elderly individuals typically have a different travel pattern compared to other age groups, with frequent outings, short durations, and limited activity radii. With aging, the likelihood of accidents such as falls increases due to slower movements

and frail bones. Common safety hazards associated with public facilities include:

(1) Uneven Roads: Seniors have weaker vision, making it hard for them to detect road problems.

(2) Aged Facilities: Older facilities can fail unexpectedly, leading to falls.

(3) Lack of Safety Features: For example, elderly individuals often sit on steps in squares, which lack protective railings, increasing the risk of dizziness and falls after prolonged sitting.

3.2 Optimization Based on Social Needs

Due to their experiences and age, the elderly often enjoy interacting with peers or younger individuals. In communities, seniors gather in squares, green spaces, pavilions, activity centers, and other public facilities or resting platforms, primarily engaging in outdoor activities such as playing chess, cards, dancing, or singing. These activities, typically involving multiple participants, create a social environment that enhances seniors' sense of belonging, reduces social isolation, and promotes mental health.

Many seniors also like participating in hobbies or learning new skills in community activity rooms. However, field research reveals that old community facilities often have smaller spaces, fewer outdoor seating areas, and lack weather protection for outdoor spaces such as squares. Community activity rooms are even rarer. Despite these shortcomings, many elderly individuals still prefer socializing on flower beds or steps, even when spaces and equipment are insufficient.

4. Public Facilities Optimization Concepts and Design Exploration – Gardener Community Facility Design

4.1 Elderly-Friendly Optimization Design Ideas

4.1.1 Adapt to Local Conditions

Adapting to local conditions is essential, especially in older communities where space constraints and limited funding prevent complete reconstruction according to the needs of elderly residents. The focus should be on optimizing existing facilities, taking into account the psychological, physiological, and behavioral characteristics of the elderly. This approach enables seniors to participate in broader social activities within certain limits.

4.1.2 Promote Modular Design

Modular design is characterized by high space utilization, flexible functionality, necessary comfort, safety, and variable forms. In older communities with limited public space, modular design allows the integration of multiple practical functions into a single space, catering to the diverse needs of elderly residents. Therefore, modular design should be considered when redesigning old community layouts.

4.1.3 Building Harmony between Seniors, Facilities, and Environment

Creating harmony between seniors, facilities, and the environment requires a people-centered approach, prioritizing the needs of elderly users while integrating sustainability. The key to harmonious coexistence between seniors, facilities, and the environment lies in the respect for the elderly’s living standards and whether the design is truly people-centered. Designs that fail to prioritize the user, regardless of their cultural significance or aesthetics, lose their value when not utilized. Thus, a people-centered approach is essential in fostering harmony.

4.2 Sustainable and Elderly-Friendly Facility Design Exploration - Garden Community in Zhangjiakou City

4.2.1 Design Background

The Garden Community in Zhangjiakou is an auxiliary residential area for Zhangjiakou No. 2 Middle School. It covers a small area and is located adjacent to the school campus. The community, established a long time ago, suffers from poor forward-looking design and planning. Current issues include road congestion, aging building exteriors, outdated public facilities, and unmanaged, chaotic landscape plants. Zhangjiakou, as the host city of the 2022 Winter Olympics, saw some maintenance work in 2018 and 2019 by the government. This included repainting buildings, resurfacing cement roads, and refreshing the corridors, which improved the appearance to some extent but did not fundamentally resolve the existing problems.

4.2.2 Design Concept

Based on the investigation, the current issues in the community include:

(1) Narrow Roads and Parking Issues. The roads are too narrow, with no designated parking spaces, leading to vehicles being parked haphazardly and causing one-way traffic problems and congestion.

(2) Insufficient Anti-Slip Design. With nearly 30% of residents being elderly and Zhangjiakou’s high altitude and

snowy winters, the existing roads lack anti-slip design, leading to frequent accidents due to icy surfaces.

(3) Lack of Public Facilities. There is only one large public space without fitness facilities, and elderly residents lack activity spaces. This area is located between two residential buildings, posing a risk if items are thrown from high places. Additionally, there is only one indoor elderly activity room, leading to situations where elderly people can only watch rather than participate.

(4) Wasted Landscape. The only green landscape near the public space is underutilized due to poor maintenance and inconvenient access.

Survey data from 50 questionnaires distributed among the residents revealed that 64% of elderly residents believe the roads need improvement, 52% find that random vehicle parking affects their mobility, and 74% consider the current landscape as unnecessary, preferring it to be converted into functional areas or cleaned up.

In the design, the following aspects are considered for the elderly-friendly renovation of the community's outdated public facilities:

(1) Visual Design. Vision is the most crucial sensory experience for people, and it is the most relied-upon sense in long-term use. Elderly-friendly design must consider visual elements to ensure safety and usability.

(2) Sensory Perception. People evaluate materials, functions, and safety through visual perception. Elderly individuals may have impaired visual perception due to aging, so guiding them visually is important to ensure their safety.

(3) Form. Effective design should allow users to understand how to use the facility without instructions. In elderly-friendly design, clarity in how to use public spaces enhances user experience and friendliness.

(4) Color Coordination. Proper color schemes are vital for elderly-friendly design. The colors should cater to elderly aesthetics and guide their perception, avoiding visual confusion.

(5) Auditory Elements. Hearing is a primary sense for processing information. Design choices should include less stimulating sounds to accommodate the auditory memories of elderly individuals.

(6) Tactile Elements. The touch experience, including materials and surface design, influences safety and comfort. For example, materials with good grip and tactile feedback enhance usability for the elderly.

Figure 4. Satellite map of Yuanding Community (Source: Google Earth)

4.2.3 Design Content

For issues one and two, as shown in the figure above, the area of the community in the image is the current area of Yuanding Community. Without increasing the community area or making major expansions, it is not possible to widen the roads. Instead, the bicycle shed can be converted into a small parking lot, and random parking within the community should be prohibited. To address the road anti-slip issue, steps can be installed, and roads with slopes should have surfaces with increased friction. Additionally, pedestrian handrails can be set up along the roads. In winter, volunteers or property management staff can be recruited to clear snow, making it easier for the elderly to move around.

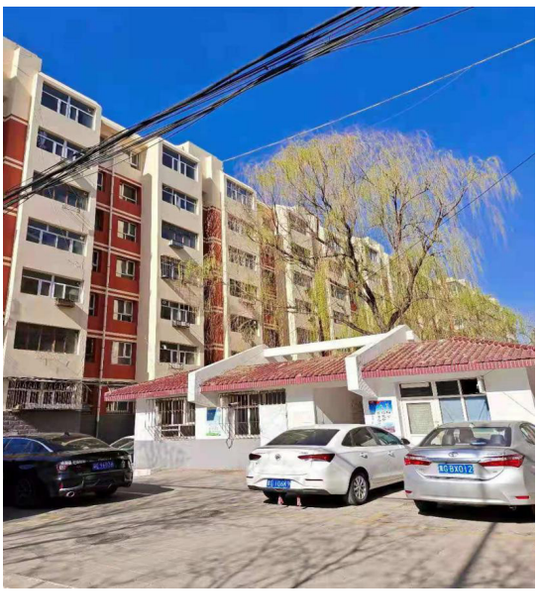

Figure 5. Existing elderly activity room in Yuanding Community (from the author)

Figure 6. New planning effect of elderly activity room (from the author)

The landscape area and the elderly activity room are adjacent. Due to the low efficiency of the current landscape, it will be handled using a "fifty-fifty" approach. The area closer to the elderly activity room will have its ground hardened while retaining the existing plants. Rest facilities will be set up around the trees. Given the high altitude and relatively dry climate of Zhangjiakou, with less rainfall and smog, outdoor temperatures can be high during sunrise. Therefore, part of the elderly activity room's activities can be moved outdoors. This approach not only preserves part of the original landscape but also expands the space of the elderly activity room.

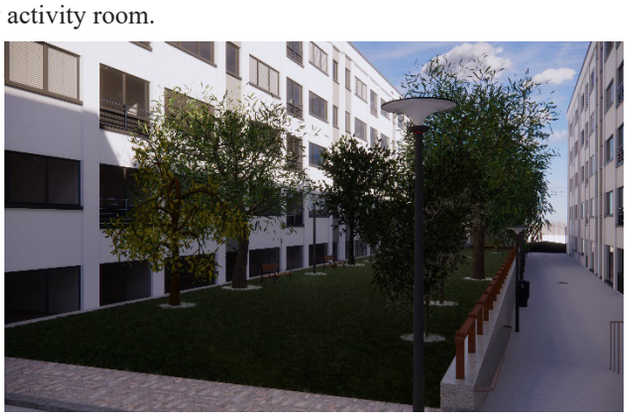

Figure 7. New planning effect of public landscape (from the author)

The original public space is located on the other side of the landscape. As the original public space has been in use for a long time, elderly residents have adapted to its presence. It will not be demolished but instead expanded in the area adjacent to the landscape planning, using a "fifty-fifty" approach. The ground of the original landscape area will be paved with "football grass" to provide a certain degree of hardening while preventing water accumulation. This area can have a certain slope to increase drainage efficiency and reduce ice formation from melted snow in winter. Fewer edge plants will be retained to keep the area more concentrated and provide a larger activity space. To avoid issues during nighttime activities and reduce visual blind spots, lighting fixtures will be installed on the trees at the edge of the area, minimizing redundant construction. The original public space can also have additional lighting fixtures installed, removing the elevation of the public space area to avoid accidents where elderly individuals might trip over steps due to lack of attention.

5. Conclusion

The application of sustainable design principles to the optimization of community public facilities for elderly people represents a design approach that considers human-related and people-oriented factors. It aims to create designs that meet the needs of elderly individuals while being cost-effective, safe, and culturally appropriate, despite constraints such as environmental impact, material cost, and the need for recyclability. From a sustainable development perspective, considering and evaluating elderly-friendly public facility design has dual significance. On one hand, it focuses on designing with economic, cultural, and environmental factors in mind, ensuring that designs are sustainable and meet the goals of sustainable design principles. On the other hand, as design concepts continue to evolve, incorporating various social factors into the design process has become a trend. With the accelerating trend of aging, adhering to elderly-friendly principles in public facility design and promoting the synchronized development of elderly facilities with various aspects of society has become a requirement of the times. As Chinese designers, we should take on this responsibility and strive to meet the standards required by the current era.

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