

Analysis of Green Space Design in Residential Areas Based on Characteristics of the Elderly*

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Abstract—At present, the proportion of China's aging population has increased year by year, and the "family pension" model has put forward new requirements for the green space environment of existing residential areas. According to the analysis of the characteristics of the elderly, this paper summarizes the law and combines the problems of green space environment design in the residential area at the present stage to analyze the green space demand in the residential area to achieve the optimal design.

Keywords—elderly; residential green space; optimized design

I. INTRODUCTION

Aging is an inevitable trend of population development. Family pension and "Four Two One" family structure put forward new thinking on the green space environment in residential areas. As the physiological function declines, the psychology and behavior of the elderly will change. Social activities are no longer their main mode of behavior, and the green space environment in residential areas will be their main activity place, so a reasonable green space environment can improve the happiness and comfort of the elderly. Therefore, the analysis of the characteristics of the elderly is the basis for studying this group. The main purpose of this paper is to use

B. Analysis on the Living Conditions of the Elderly in Residential Areas at the Present Stage

At this stage, the pension mode of China's aging cities is mainly family pension. The residential area is the main space for the activities and life of the elderly. The green space in the residential area is an important part of the elderly's exposure to the natural environment. We need to study the special needs of the growing elderly population for living in residential areas. At the same time, we also need to study the impacts and challenges of aging on the development of green areas in residential areas, and through analysis and design, to create a more reasonable residential green space environment for the development of aging.

The elderly in the residential area include: the local elderly and the elderly who have moved in the field. The living

the conclusions of the study to guide the analysis of green space design in residential areas.

II. RESEARCH BACKGROUND AND CURRENT SITUATION

A. The Current Situation and Development Trend of China's Population Aging

The aging of the population has become a major social problem facing many countries in the world. In China, 21 provinces (regions and municipalities) have become population-aging areas. The sixth census in 2010 showed that people aged 60 and over accounted for 13.26% of the population, of which 8.87% were over 65 years old, up 2.93% from 2000. The average number of elderly people in China is growing at an annual rate of more than 3 million, with an average annual growth rate of more than 2.85%, which is higher than the annual growth rate of 0.57% of the population since 2000. In 2014, the number of elderly people in China reached 200 million. In 2026, it will reach 300 million. In 2037, it will exceed 400 million. It will reach a maximum in 2051 and will remain at 300-400 million. It is predicted that China is the country with the largest number of elderly people in the world.

conditions of the elderly in the family are basically: the elderly live alone, the elderly live together, the elderly live with the children (the adults go out to work during the day), and the adults accompany the elderly and so on. The device-aided elderly and the nursing-card elderly may exist in any living environment.

C. The Main Problems in the Construction of the Green Space System for the Elderly in the Residential Area at the Present Stage

The main problems in the construction of the green space design system for the elderly in residential areas are: the lack of functionality of public services and the targeted design based on the elderly population.

1) *The project of the existing system of public service facilities of the green space system of the elderly in the residential area needs to be deepened and improved* : In the design of the green space system, the facilities have less defensive design for the elderly activities, and the service facilities are imperfect and the area is insufficient, such as the

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number of seats, Railing handrails, and slope treatment in the terrain. The setting of the facility does not combine the actual needs of the elderly, the sports equipment is simple and the mode is single, which is not conducive to the use of the elderly. At the same time, due to the low frequency of use of facilities by adults in residential areas, cultural sports facilities may be idle during the day. Education for how to use facilities for the elderly can give full play to the potential of the elderly and improve the cultural quality of the elderly, but these are not specified in the norms.

2) *The layout of the existing system of the public service facilities of the green space system for the elderly in the*

residential area lacks hierarchy: The cultural sports facilities in the residential areas are relatively concentrated, which lacks the construction of group-level facilities. (see "Table I") The activity space for the elderly should be designed in the green space of the group according to its openness or privacy. However, the existing construction of cultural sports facilities in the group green space of residential areas has not received sufficient attention, which should consider the characteristics of the physiological decline and frequent home activities of the elderly, and also consider the reasonable service radius of the facilities.

TABLE I. SURVEY FORM FOR THE SETTING OF RESIDENTIAL GREEN AREA SYSTEM FACILITIES FOR THE ELDERLY ("√" STANDS FOR SETTING)

Facility Name		Xi'an of Shaanxi				Guangzhou & Shenzhen			Beijing		
		China Railway Colorful City	Hanhua City	Vanke Jade	Yishui Garden	Meixing Garden	Vanke Tianyu	Century Plaza	Fanha i Family	R&F 10	Huashilong Apartment
construction of service facilities of green space system	Sports space			√							
	fitness equipment	√	√	√	√		√	√	√	√	
	group-level activity facilities for the elderly		√						√		
	semi-enclosed space for activity and rest				√		√		√	√	

3) *The green space service design for the elderly in the green space of the residential area lacks hierarchy:* The proportion of "family pension" and "Four Two One" family support relationship has risen. Many young-middle-aged people are unable to balance the dual tasks of caring for the elderly and raising children, forcing them to ask the residential areas for alternative methods to compensate for the lack of family pensions. Establishing a perfect green space environment and facilities in residential areas to meet the needs of the elderly in residential areas is an urgent trend in the development of residential areas.

III. ANALYSIS ON THE CHARACTERISTICS OF THE ELDERLY

The elderly refers to those who are over 60 years old and their physiological function is gradually declining. They are experiencing a phase from being completely self-sufficient to needing help from others until they need someone else's care process. In the "Code for design of residential building for the aged" (JGJ122-99), the living ability is divided into three states: "the self-care elderly, the device-aided elderly and the nursing-card elderly". (see "Table II")

TABLE II. CLASSIFICATION OF THE ELDERLY

The self-care elderly	Be able to take care of themselves
The device-aided elderly	Need to rely on others' help or rely on handrails, crutches, wheelchairs
The nursing-card elderly	Relying on the care of others

The study of the physiological characteristics of the elderly is the most fundamental physical property research and the basis of all other studies. In the process of human growth, aging is a necessary stage. After entering the aging stage, people's body tissues, physiological structures and functions, and motor functions will all show signs of decline. Specifically embodied as:

- The metabolism is slow, the function is reduced, and the adaptability is weakened.
- Inner Organs such as skeletal muscles are atrophied, and external manifestations include deafness, hunchback, and shortening body proportions and so on.
- Muscle is easy to feel fatigue, poor endurance, poor elasticity, low resistance, and cannot adhere to long-term exercise.
- The performance of the respiratory system is: the number of alveoli is reduced; the elastic fiber of the

lung is degenerated, resulting in poor lung ventilation and decreased lung capacity.

- Hypomnesia, slow response, inattention, poor coordination of movement, shortened physiological sleep time and prone to fatigue and other symptoms.
- The order of visual, auditory, olfactory, and tactile decline.

An analysis of the decline and weakening of the physiology of the elderly is conducted to study the physiological characteristics of the elderly, which can guide the design of the demand for green areas in the residential areas of the elderly. Specifically embodied as:

A. Sound and Light Environment

Visual sense and auditory sense are the first two declined sensory functions of the elderly. Visual sense is the first way to perceive the environment, but as vision and color discrimination decline, the eye's requirements for light quality will increase, the adaptation time to light changes will become longer, and it will be sensitive to glare. The elderly need more natural light to adapt to their needs, and artificial lighting environment should also meet certain design requirements to avoid more visual reactions under the light environment.

After the visual sense decline, the auditory sense not only plays the role of discriminating sound, but also complements the visual. The decline in hearing is manifested in the frequent loss of hearing for short periods of time and insensitivity to high frequency sounds. In the conversation, the elderly often needs to listen repeatedly, improve the decibel, body roll to make up for the lack of hearing. However, the decline of hearing does not mean that we need to increase the decibel of the whole acoustic environment, because it will generate noise, and the elderly are more likely to suffer from insomnia, fear of being disturbed, and prefer a quiet environment.

B. Temperature Environment

Winter and summer are the high incidence of diseases in the elderly. In the green space environment of residential areas, it should be fully considered whether the arrangement of the resting space and semi-open space with solar radiation in the cold environment is reasonable; whether there is ventilation and coolness in the hot environment.

C. The Ergonomic Environment Adapting to the Elderly

Ergonomics is a discipline based on human scale standards. The research on the green space environment of the elderly in the residential area should be based on the physical function of the elderly, and their physical function shrinkage is a prominent feature. According to medical research, the body's function shrinks faster after the age of 60, and the height is reduced by 2.5%-3% compared with the maximum height of the youth stage, and the female's reduction is up to 6%. The average height of Chinese elderly males is 1.623M, and that of females is 1.516M, which is much shorter than that of young people. It should be used as a reference for green space design in residential areas.

IV. DESIGN PRINCIPLES AND METHODS FOR VARIOUS TYPES OF GREEN SPACES IN RESIDENTIAL AREAS BASED ON THE CHARACTERISTICS OF THE ELDERLY'S NEED

A. Design Principles for Various Types of Green Spaces in Residential Areas Based on the Characteristics of the Elderly's Need

The design of various green spaces in residential areas based on the characteristics of the elderly's need should follow some principles:

- A space design standard with reasonable size based on the physical condition and body size of the elderly.
- The design of recognizability of the green space.
- The design of controllability of green space.
- The design of the convenience of communication and emotional expression.

B. Design Methods for Various Types of Green Spaces in Residential Areas Based on the Characteristics of the Elderly's Need

1) *Design method of green space next to the house:* The green space next to the house is a residential land, including the greening of the front and back of the house, the house, the place close to the house, and the building itself. The green space next to the house is the green space that people first come out of when they walk out of the building. It is the green space for the high-frequency activities of the elderly. It is the main scope of activities for the nursing-cared elderly and the device-aided elderly.

The green area near the house is generally small. In the range of tens to hundreds of square meters, terrain changes and height difference staggering should be reduced. For example, in combination with the barrier-free ramp of the building, the railing can be extended into the green space. Combined with a gallery or flower stand, it is designed as a semi-enclosed space to meet the needs of the elderly to sit, rest and chat. The space can be designed near the east side of the gable of the building, so that it does not affect the residents on the first floor. On the other hand, the location avoids direct sunlight and meets the needs of the semi-enclosed space for summer cooling.

The neighborhood relationship in the residential area is general, and even do not know each other. Strengthening the neighborhood communication is also an effective means to reduce the loneliness of the elderly and prevent accidents. The green space next to the house is an important space for neighborhood communication. Appropriately adding rest seats here allows the elderly to chat, communicate and sunbathe here. Relative to the semi-enclosed space of the flower stand or gallery, the seat can be designed on the west side of the gable of the building to ensure sufficient light. And it is necessary to pay attention to the distance between the seats and first floor residents. At the same time, shrubs can be planted between the seat and the building to separate and reduce noise.

2) *Green space design method in group:* The group is the smallest unit of the residential area, and the public green

space serving the area is the group green space. The area of the group green space is calculated according to the number of buildings in the group and the number of households and the number of people. The green space index is greater than or equal to 0.5 m²/person, and the area is generally in the range of 150-350 m². Compared with the green space next to the house, the group green space is slightly farther away from the building, but the group green space is rich in elements and targeted of group.

The design needs to consider the activity space of small groups. The elderly who are healthy or young (60-69 years old) have strong vitality in the activities of green space in residential areas. Exercise and fitness are their main activities. Therefore: martial arts, Tai Chi, dance, badminton, table tennis and other sports should be arranged in the dynamic zone of the group green space. The design should consider the soft paving of the ground, the adjustment of the landscape color, the selection of plants, the setting of the rest seat, etc. At the same time, it is necessary to pay attention to the interweaving of enclosed space to ensure the living environment.

The green space design also needs to consider the static space of small group activities, and the static space is suitable for all the elderly. The green landscape of the group is rich in elements, and the elderly can read and talk in the quiet area. The static space should have a certain line of sight to form a quiet, semi-open space with psychological support. At the same time, the quiet space needs to be set with reference to personal distance and social distance, and can't form a crowded feeling in space.

The children's activity area also needs to be set up in the group green space. In the current family mode, the elderly is generally cared for by the elderly, and the elderly living alone also like to play with the children. Therefore, the activity space of the elderly can be connected with the space for children, or it can be set up a space setting for the elderly to rest and take care of the children in the children's activity space.

3) Design method of small park and residential area park: The area of small and medium-sized gardens in residential quarters is about 0.7-1.5 hectares, the green area index is greater than or equal to 1m²/person, the number of designs can be more than one, and the single area is generally no more than one hectare. The district park is a first-class public green space in the residential area of the district. The green area index is about 1.5m²/person or more, and its scale is equivalent to the urban small park. In the district structure, the green space formed by a district park and a number of small amusement parks is the most abundant.

a) Waterscape landscape design: The waterscape landscape is an important group landscape element in the public green space of the residential area. It can form the landscape axis or the central point, forming a good landscape view, and can increase the air humidity to improve the microclimate, which is conducive to improving the living environment of the elderly. Healthy walks can be set around the waterscape to meet the needs of the elderly for walking, sports, and viewing. The small waterscape can meet the needs

of the elderly to view the scenery, listen to the sound, and watch the water flow. However, no matter what form of waterscape landscape should be set in the large public green space, while strengthening the marking tips to control the depth of the water body, the shallow pool generally has a depth of about 300mm. If the water depth is large, it is necessary to widen the waterfront construction for protection.

b) Terrain design: The public green space in the residential area is large, and the terrain adjustment can increase the sense of landscape space and create a landscape perspective. In the green space of residential areas for the elderly, it is necessary to consider: First, the area where the elderly are concentrated should be leveled, with soft ground paving to reduce the frequency of ground uplift and sinking. Secondly, in the area of non-concentrated activities of the elderly, micro-terrain should be the main design, and there are many underground building spaces in the residential area. The thickness of the covering soil in the green space is mostly 1.1-2m, which is not conducive to the growth of trees and shrubs. Micro-terrain adjustment can increase the thickness of local overburden, thus forming a topographical relationship similar to natural topography, forming windward slope, leeward slope, sunny slope, and shady slope. Although the slope is not large, it can increase the barrier of the landscape through the undulations. The space before and after the landscape reflects each other, enriching the landscape elements and spatial types, which is conducive to the formation of shades of trees and shrubs, thus forming a landscape of interest and enriching the elderly.

c) Planting design: First of all, plants with thorns or rhizomes that are easily exposed to the ground should be avoided to avoid obstacles such as berberis thunbergii atropurpurea and locust forest. Secondly, the elderly prefers brightly colored flowers. When trees and shrubs are planted, flowers and colored foliage plants with bright colors and distinct seasons can be arranged for planting, such as salvia splendens and bougainvillea. In addition, people can choose to plant aromatic plants, such as osmanthus, jasmine, etc. for olfactory stimulation, enhance the landscape experience.

d) Ground paving design: The hard paving is a ground form made of hard materials such as concrete, floor tiles, cement blocks, etc. It is commonly found in collection squares and other places. It has good floor decoration patterns and colors, and can also be combined with tree pool, flower beds, waterscapes and other elements to form an overall landscape performance.

The soft paving is a ground form made of planting, plastic, polymer materials, etc., which has a certain sense of foot and has a protective effect. The area where the elderly is concentrated mainly adopts the soft paving, because it can form large-scale patterns and color relationships, and beautify the environment to emphasize space.

The green space has rich forms of garden roads, such as pebble paving, gravel inlay, stone slab stepping, etc., which has both decoration and road fun. For example, cobble paving has the effect of foot massage, which is very popular among

the elderly. However, because some elderly people have inconvenient walking on their legs, the pavement of special materials should be planned and designed so as not to hinder the normal passage of people.

e) *Space graphic design*: There are three types of space that can be formed in the green space of the residential area: open, semi-open and semi-closed, and closed. Each space needs to be determined according to various factors such as the proportion of the elderly's body, needs of barrier-free, behavior and psychological needs. First of all, body size and needs of barrier-free are the physical attributes of space design and are the necessary space sizes. On the basis of the necessary space size, the space is expanded or merged according to different behavior patterns and psychological needs, for example, extending the barrier-free ramp to the green space. This can be defined as the selection space size. The necessary space size and the selection space size together form a spatial pattern in the green space to form a space-optimized performance.

V. CONCLUSION

Green space and group characteristics are mutually influential. Green space limits human behavior, and group characteristics determine the form of green space. Based on the group characteristics of the elderly, this paper summarizes the problems existing in the green space structure of residential areas at present, which are designed for the needs of the elderly; based on the analysis of the characteristics of the elderly, the methods of designing various green spaces in the residential areas under the influence of the elderly groups are summarized, in order to meet the needs of the new mode of green space in residential areas under the aging development.

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