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Design of Aging Friendly Details based on Behavior Analysis of the Elderly

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Abstract: ***With the increasing aging of China's population, the silver economy has also developed rapidly. Organize and study the problems in the architectural space design of elderly housing in some institutions and some home-based elderly care homes, and summarize the physiological and psychological characteristics of the elderly. Ultimately, the demands generated by its corresponding features are applied to the design of residential spaces, guiding the design and handling of interior space details, thereby constructing more comfortable and reasonable aging friendly spaces.***

Keywords: Suitable for aging, Ergonomic behavior analysis, Detailed design.

1. Introduction

1.1 Research Background

China has maintained a low birth rate for a long time due to its birth policy. With the rapid growth of the economy and the rapid development of technology, the increasing economic level, quality of life, and medical level of the people have to some extent extended the average life expectancy and made the aging problem in China more serious. According to relevant data, China first entered an aging society in 1999, and it is expected that the population aging will reach its peak by 2050. Therefore, the issue of elderly care should not be underestimated in social development. At the same time, with the aging population, the silver economy is rapidly developing, and it has driven the development of related elderly care industries. The elderly have an increasing demand for elderly care and a higher demand for quality. Therefore, in interior space design with the main purpose of elderly care, analyzing the behavioral characteristics of the elderly and integrating them into residential space design with the main purpose of adapting to aging has become an important issue that cannot be ignored.

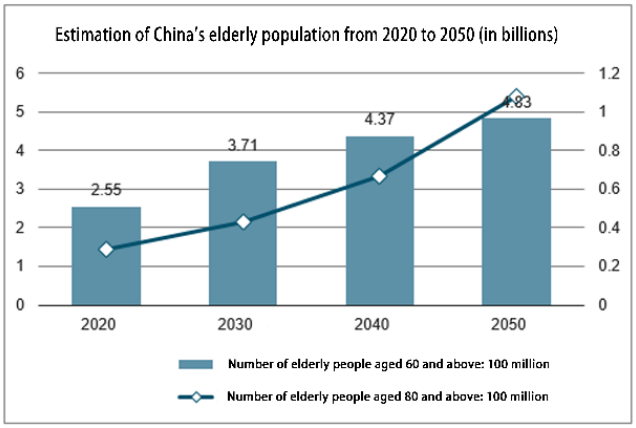

Figure 1: Estimation of Chinas elderly population from 2020 to 2050

The limitations of traditional aging friendly design are mainly reflected in the neglect of the diversity of elderly behavior. For the organization of spatial details, more attention is paid to the form of the interior of the building, neglecting the flexible design and detail construction of the space. This makes it difficult for many elderly people to meet their high comfort needs in indoor elderly care spaces.

1.2 Research Purpose and Significance

This study analyzes the behavior of elderly people and investigates their psychological and physiological characteristics in order to optimize detailed design and improve their quality of life from a behavioral analysis perspective.

2. Analysis of Behavioral Characteristics and Needs of the Elderly

2.1 Physiological Characteristics Analysis

From a physiological perspective, as people age, the functions of various parts of the body, such as vision, hearing, physical strength, and intelligence, will decline year by year. The decline of vision and hearing can lead to blurred vision, deafness, color weakness, hearing loss, visual impairment, and even blindness. And physical decline can lead to inconvenience in hands and feet, difficulty walking, and inability to stand for long periods of time or walk long distances. Neurological and intellectual decline can lead to poor memory, hesitation, and decreased accuracy in movement. Therefore, in the process of interior design for elderly living environments, special attention must be paid to the design of sound environment, thermal environment, light environment, etc. In the planning of indoor spaces and the introduction of facilities, consideration should be given to providing more accessible facilities, optimizing lighting and sound equipment, and better meeting the independence of elderly people's lives while ensuring safety and functionality.

Serial Number	Name	Core content
1	Changes in body appearance	Hair graying, skin sagging, muscle atrophy, tooth atrophy
2	Decrease in sensory organ function	Hearing and vision decline, tactile sensation becomes dull
3	Functional decline of the nervous system	Accompanied by muscle atrophy and osteoporosis, decreased physical flexibility, and slow mobility
4	Decreased physical flexibility	Accompanied by muscle atrophy and osteoporosis, the body's flexibility decreases and mobility slows down
5	Weakening of body resistance	The resistance of the elderly to changes in weather and environment will be greatly reduced

Figure 2: Summary of physiological characteristics of elderly people

Serial Number	Name	Core content
1	Reduced psychological safety	The weakening and degradation of physiological functions, and the decrease in psychological security
2	Reduced adaptability	Fear of adapting to new environments reduces adaptability
3	Excessive anxiety	Worried about physical condition, becoming sensitive in the heart, causing anxiety and panic
4	Increased loneliness	Living alone at home for a long time can lead to feelings of loneliness and emptiness

Figure 3: Overview of psychological characteristics of elderly people

2.2 Psychological Characteristics Analysis

From a psychological perspective, elderly people generally exhibit cognitive decline, emotional instability, and the need for self-identity due to the decline in brain function and nervous system. In such a situation, the spiritual and social sense of belonging of the elderly will decrease. Therefore, in spatial layout, clear and prominent signs should be used to help the elderly better adapt to the living environment, maintain independent living and a good mentality. Focus on the emotional needs of the elderly at the psychological level. The need for family companionship and the feeling of helplessness caused by the decline in one's own health status [2].

2.3 Classification of Typical Behavior Patterns

The core premise of interior design for aging friendly residential buildings is to have a deep understanding of the behavior patterns and living needs of the elderly. Only by systematically evaluating the daily behaviors and actual demands of the elderly can we truly create a spatial environment that meets their living needs and optimizes their living experience.

The evaluation of the behavior patterns of elderly people requires a comprehensive consideration of their daily routines and activity trajectories. Designers can sort out the activity paths, high-frequency usage areas, and potential obstacles of elderly people in residential areas through long-term observation and detailed recording. The first-hand data obtained from these observations will become an important basis for design concepts. Taking the study of elderly behavior patterns as an example, focusing on key dimensions such as sleep, daily living, and activity range can help accurately locate the core functional areas in the design, optimize spatial layout and organization based on this, and ensure that the final design results can seamlessly adapt to the living habits and action rhythms of the elderly.

2.3.1 Daily Activities

The daily activities of the elderly mainly include living, washing, cooking, and other aspects. In the design of daily activities, not only should the basic functional needs of life be met, but also the individual living habits and environmental needs of the elderly need to be considered. In addition to meeting the requirements of barrier free design, the design also needs to be optimized and modified according to the elderly's usage habits to avoid the problem of being suitable for the elderly but not suitable. Through the analysis of ergonomic data and the collection of actual values, personalized adjustments can be made to the size of relevant items.

2.3.2 Emergency Actions

Emergency behavior is a crucial aspect to pay special attention to in the design of aging residential buildings, with the two most important aspects being emergency response when the elderly fall and timely medical calls for help. Preventing elderly people from falling can be considered by adding more handrails, using anti slip materials, and maximizing the resolution of threshold and ground height differences. Timely calling for help is another major aspect that needs to be considered. Therefore, for the establishment of emergency call facilities, emergency rescue buttons, and real-time safety and fall monitoring, intelligent devices and sensors are connected for real-time monitoring to improve the safety of elderly people's lives.

2.3.3 Social Behavior

Social behavior refers to activities such as socializing and entertainment between elderly people and cohabiting relatives or friends in society. After retirement, elderly people mainly stay at home, and their interpersonal relationships and daily social communication have changed. They have a stronger demand for entertainment and communication, often accompanied by feelings of loneliness. Therefore, in the design, it is necessary to consider the psychological needs of the elderly, such as privacy, independence, and avoiding feelings of loneliness.

3. Principles and Methods for Designing Details Suitable for Aging

3.1 Safety Principles

Safety is the primary prerequisite for designing elderly living spaces, which is reflected in the main purpose of reducing the probability of accidents and the harm caused to the elderly in emergency situations. For example, reducing the risk of falls for the elderly, providing accessible facilities to prevent them from falling due to sudden weakness, setting up lighting reasonably, preventing glare, and using anti slip materials on the ground to prevent slipping and ensure the safety of the elderly's living.

3.2 Comfort Principle

The principle of comfort is an important goal in design, which is to provide a comfortable sitting and sleeping experience through reasonable space, streamlined organization, and reasonable configuration of furniture, as well as through hard and soft decoration, appropriate color matching, selection of furniture materials, softness and hardness, etc. At the same time, efforts should be made to introduce natural lighting, create good ventilation, and create a warm spatial atmosphere, so that elderly people can feel more joy, peace, and warmth in their daily lives at home.

3.3 Principle of Convenience

The principle of convenience refers to the design of furniture

that emphasizes both functionality and convenience, reasonably sets the height and layout of furniture and equipment, ensures spacious and unobstructed corridors, facilitates the movement of the elderly, reduces bending and other movements, and meets the unique needs of the elderly. By simplifying the operation process, the convenience of activities is improved. By collecting ergonomic dimensions and appropriate styling designs, the elderly can easily complete daily activities and maximize their independence in life.

4. Detail Design of Key Spaces

4.1 Entrance Hall

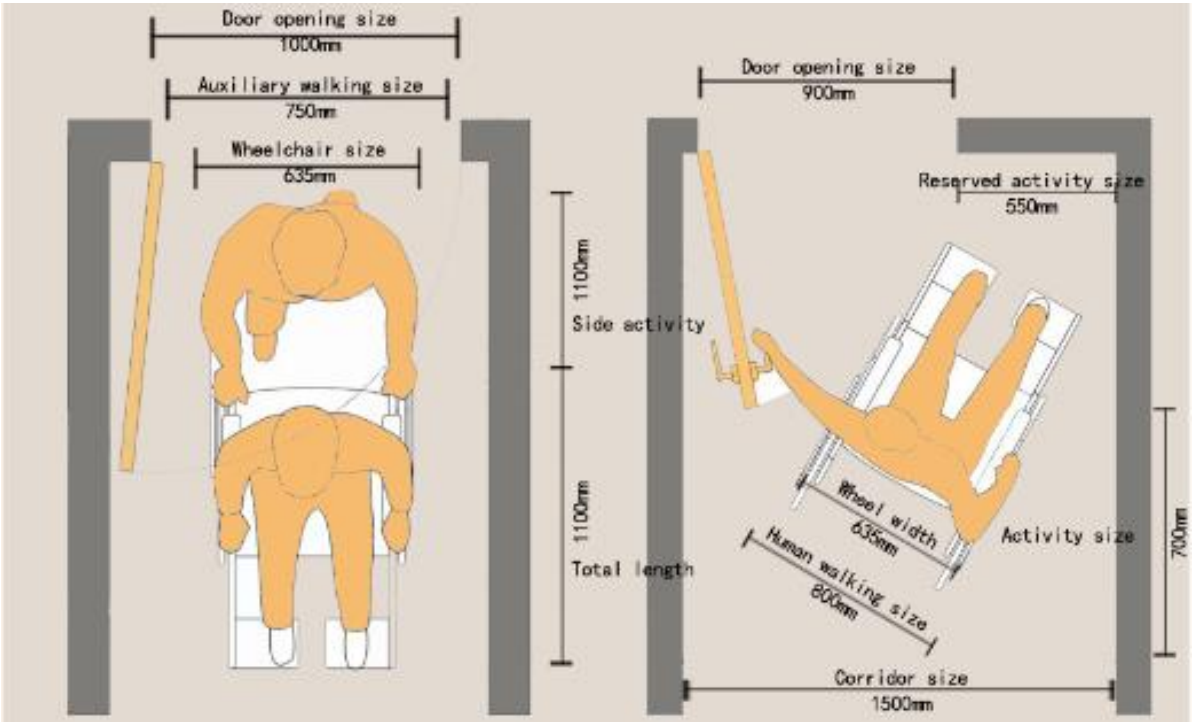

Figure 4: Standard for entrance door size

4.1.1 Reasonable lobby size

The entrance hall is a transitional space between the residential area and the external environment, responsible for the frequent use of exits and entrances. It needs to meet the requirements of open door passage and also serve the function of placing daily necessities. For the entrance hall, designers need to consider the activity space for nursing staff, the entry and exit of stretchers, and the potential need for elderly people to use walkers or wheelchairs in the future. The entrance hall should not be too deep and the width should not be less than 1000mm, which can accommodate stretchers and wheelchairs.

4.1.2 Smooth visual contact

In general residential design, partitions are usually set up at the entrance hall to block the line of sight at the entrance and ensure privacy in the space. However, the elderly are more suitable for an open entrance hall, which can see incoming people faster and provide a sense of psychological security. If it is not possible to design an open entrance hall or if there are corners due to spatial transitions, rounded corners should be designed as much as possible to ensure visual accessibility, or small windows should be opened to ensure good visibility.

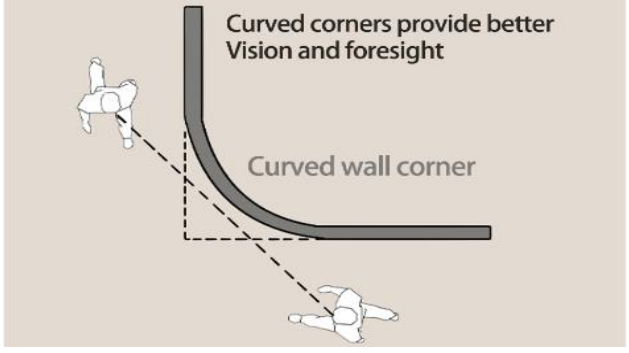

Figure 5: The rounded corners of the wall ensure visibility

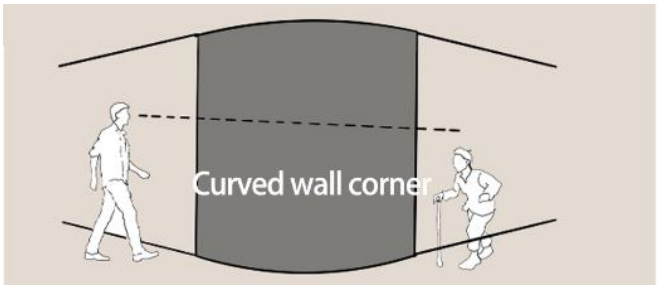

Figure 6: Older people can access information faster

4.1.3 Furniture layout considers convenience

The entrance hall of the elderly residence should have a shoe cabinet and a shoe changing stool, and the distance between the two should not be too large. The shoe cabinet should be in the form of a countertop, with a height of about 850mm, which is convenient for the elderly to easily put down their things when opening the door and can also serve as an invisible armrest.

Invisible handrails should be used as much as possible in the design of elderly living rooms, which not only ensures their original function, but also provides assistance for the elderly's

walking invisibly. Less obvious auxiliary settings can reduce the psychological pressure burden on the elderly and give them more confidence from independent walking.

Figure 7: Entrance cabinet and invisible armrest design

4.2 Living Room

4.2.1 Open and Bright Space Atmosphere

The living room is the activity center of the whole house and also the place where the elderly stay for a long time. The chatting between the elderly and friends, as well as the communication and entertainment between visitors and family members, are all concentrated in the living room. The coffee table and TV cabinet should be at least 800mm apart, allowing people to pass in one direction. There should also be space at the end of the living room for wheelchair rotation. A 1200mm * 800mm wheelchair placement area should be reserved on the side of the sofa for elderly people with limited mobility to communicate with family or guests in the living room. Multi level lighting, including ceiling lights, wall lights, and table lamps, should be installed in public areas such as living rooms to provide soft and uniform light, while fully considering the introduction of natural light. Large windows and transparent glass should be used to enhance indoor natural lighting, brightness, and comfort [5].

4.2.1 Flexible dining areas

The dining table is suitable to choose an adjustable form to provide a spacious passage space for the channel to flow out. If space allows, try to configure dining cabinets as much as possible, which can not only store miscellaneous items but also keep the dining table clean. At the same time, a dedicated drug storage area and a placement area for daily necessities such as toothpicks and tissues can be set up to improve comfort and convenience.

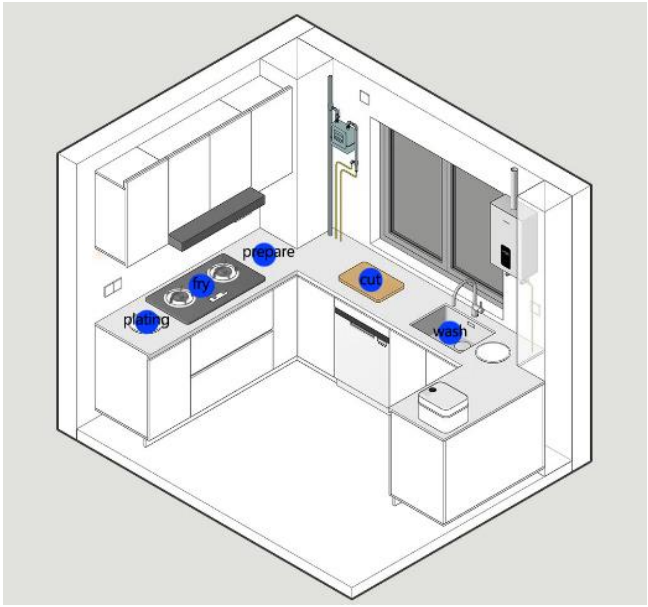

Figure 8: The setting of U-shaped kitchen

4.3 Kitchen

4.3.1 Efficient and Reasonable Plane Flow Line

The kitchen layout designed for the elderly should consider the order of food cooking, including storage containers for storing and preparing ingredients, as well as cooking utensils. Reserve enough countertops for commonly used appliances, and try to set up a U-shaped kitchen to reduce the frequency of elderly people's movements. You can achieve some corresponding operations by turning around, reducing excessive walking and taking actions.

4.3.2 Adequate lighting and illumination

In addition to sufficient overall lighting in the kitchen, local lighting on the countertop should also be relatively enhanced. Elderly people suffer from visual impairment. The demand for lighting is more obvious, so we need to add shadow eliminating lighting below the hanging cabinet, above the operating table, and above the pool. On the premise of avoiding glare, it is convenient for the elderly to accurately identify ingredients and perform cooking operations

Figure 9: Smoke and fire sensing alarm

4.3.3 Setting of Safety Warning Equipment

Due to the decline of memory and the decline of smell and vision, elderly people are prone to forgetting to close gas

valves and have difficulty detecting gas leaks or fires in the pot in a timely manner. Therefore, in the design, high-quality and safe gas equipment should be used, and automatic alarm devices should be installed to alarm and timely control electric leakage, gas leakage, and fires, effectively avoiding accidents such as fires and gas poisoning.

4.4 Bedroom

4.4.1 Adequate activity space

In addition to the basic functions of storage and sleep, the bedroom should also have a relatively complete space for the elderly to move around to the greatest extent possible. At the same time, the design size of the corridor should ensure that wheelchairs can pass through. Try to set the activity area around the balcony as much as possible to obtain better natural lighting. In the design of bedroom doors, a slanted opening method can be considered, which can effectively improve the efficiency of space passage and provide greater activity space for wheelchairs.

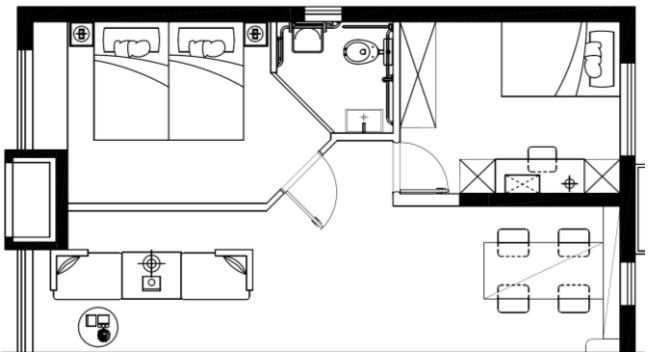

Figure 10: Diagonal door opening in bedroom

4.4.2 Adjustable Furniture Layout

The furniture placed in the bedroom space of the elderly should have adjustability, which can be changed according to the changing seasons and their own needs. The direction and method of placement should be adjusted in a timely manner, leaving enough space for future nursing staff to perform nursing operations and use wheelchairs, walkers, etc. And a countertop should be set up near the bed to facilitate elderly people's access and placement of items, as well as nursing staff's access and placement of medication.

Figure 11: Set up a night sensor light beside the bed

4.4.3 Setting of Nighttime Lights

The bedroom of the elderly should be equipped with a small night light under the bed to illuminate the floor. The brightness should not be too low, and it can automatically detect the elderly getting out of bed at night and illuminate the floor to prevent them from falling.

4.5 Toilet

4.5.1 Reasonable spatial layout

The frequency of using the bathroom is relatively high. Within a limited space, try to divide the wet and dry areas as much as possible, keeping the wet area inside the bathroom, the dry area near the door, and setting up a changing area in the transition area to facilitate the elderly to change clothes in a timely manner after drying their bodies. Try to choose a dedicated shower chair and equip it with corresponding armrests when taking a shower. The width of the bathroom door should be kept above 850mm, and the opening method should be sliding door or external door. In case of elderly fainting accidents, timely rescue can be carried out.

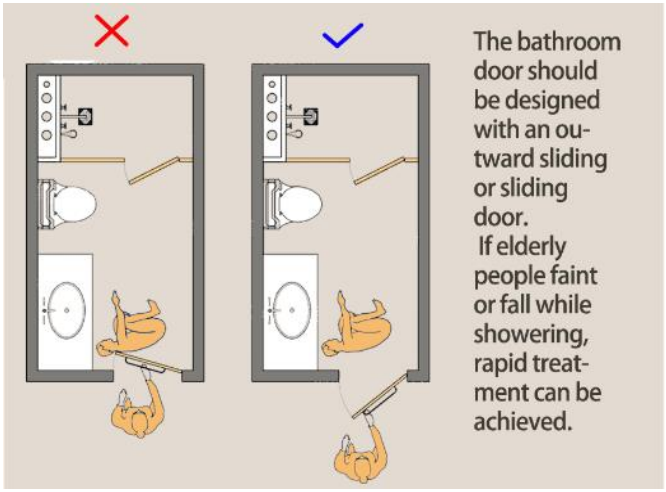

Figure 12: The help of opening the door for rescue

4.5.2 Ground anti-skid treatment

The bathroom is prone to falling accidents, so it is necessary to avoid keeping the floor wet and slippery for a long time. Use floor tiles that can still prevent slipping after absorbing water or add anti slip mats in some areas to provide protection. And provide soft pack anti-collision coverage for sharp areas as much as possible.

4.5.3 Adequate accessibility design

Using an invisible floor drain at the threshold to address the issue of threshold height difference, installing handrails next to the washbasin toilet to facilitate the elderly's grip when getting up, and preventing slipping and falling during bathing. Some emerging smart toilets also have automatic lifting angle functions to help the elderly stand and get up autonomously.

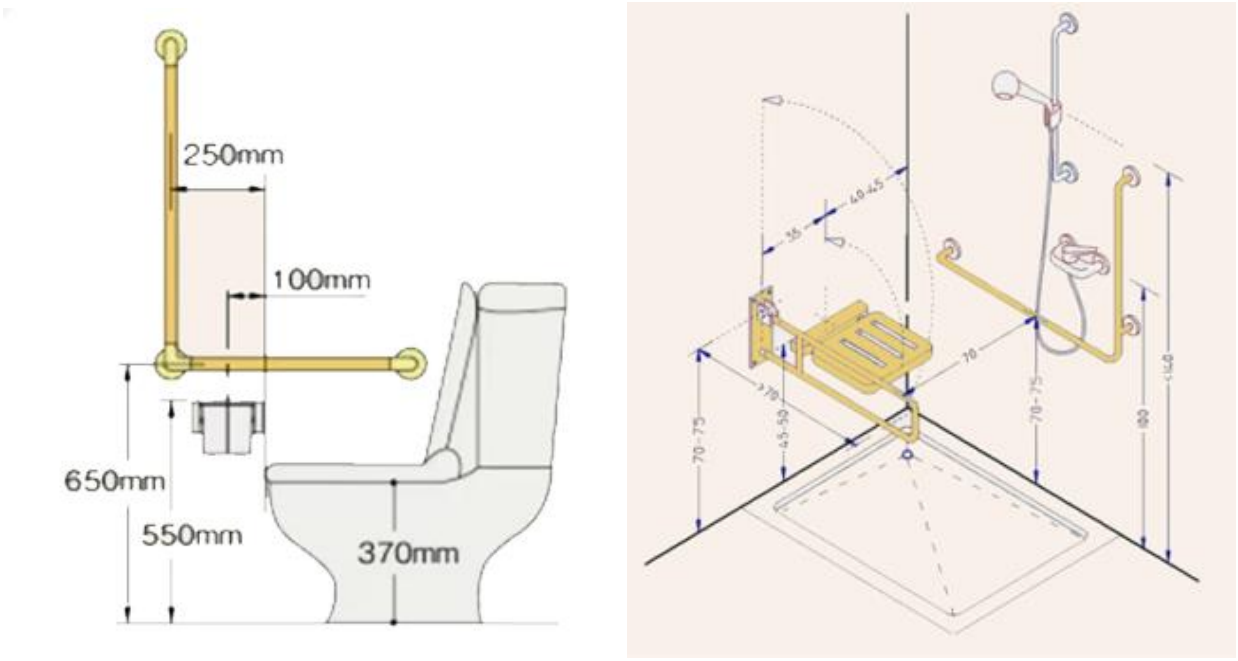

Figure 13: Scale of accessible handrails

Figure 14: Invisible floor drain eliminates threshold height difference

5. Detail Renovation of Soft Furnishings and Furniture

5.1 Color Selection

The color selection of the elderly care space should be mainly elegant, supplemented by bright warm tones. This can give people a sense of vitality, taking into account the characteristics of the elderly's poor eyesight and creating a warm and peaceful atmosphere. It is advisable to use white sanitary ware, which can promptly detect certain lesions in the elderly and make them feel clean psychologically. In some names and labels that prevent forgetting and omission, they should be represented in bright colors [6].

5.2 Details of Furniture Styling

In design, attention should be paid to the shape and detail design of furniture, especially in the design of coffee tables and chairs. Rounded corners should be used as much as possible to avoid injury to the elderly due to collisions. The shape and lines of furniture should be chosen in a simple style, which is convenient for the elderly to wipe. At the same time, attention should be paid to the stability of furniture to prevent tipping incidents from injuring the elderly. Storage cabinets should not be too deep or too high, as it is convenient for the elderly to easily retrieve items.

5.3 Appropriate Embellishment of Green Plants

Moderate introduction of green plants can embellish the space, enhance vitality, purify indoor air, and soothe the emotions of the elderly. However, it should be noted that plants release carbon dioxide at night, and excessive concentration of plants in the bedroom should be avoided.

6. Introduction of Intelligent Facility Systems

By building an intelligent elderly care monitoring system and connecting the home system with an app, real-time monitoring of indoor temperature and humidity can be achieved. And it can unify the allocation of indoor intelligent appliances, improve the comfort of indoor physical environment through the control of air conditioning fresh air system and lighting system. At the same time, an emergency alarm system will be set up, with detectors and monitors installed in various spaces to promptly detect special situations such as falls, suffocation, and fainting of the elderly. At the same time, the information will be uploaded and promptly reported and called for help to ensure the safety of

the elderly [7].

7. Conclusion

This study systematically explores the theoretical and practical paths of age appropriate detail design through in-depth analysis of the behavioral characteristics of the elderly. Research has shown that starting from the dimensions of physiological decline, psychological needs transformation, and social activity characteristics of the elderly, accurately translating behavioral analysis results into spatial, product, and service design details can significantly improve the safety, convenience, and emotional satisfaction of the elderly's lives. Whether it is the precise calculation of the height of handrails in residential spaces or the simplified design of intelligent product interaction interfaces, these aging friendly detail designs based on behavioral analysis not only effectively solve the pain points in the daily lives of the elderly, but also reflect society's humanistic concern for the elderly population.

However, age appropriate detail design is a continuously evolving field. With the deepening of population aging, rapid development of technology, and changes in the lifestyle of the elderly, future research and practice still need to be continuously expanded and deepened. On the one hand, it is necessary to strengthen interdisciplinary cooperation, integrate knowledge from multiple disciplines such as psychology, ergonomics, and artificial intelligence, and further explore the deep needs behind the behavior of the elderly; On the other hand, we should actively explore the innovative application of new materials and technologies in aging resistant design, and promote the intelligent and personalized development of design results. At the same time, it is necessary to pay attention to the dynamic updating and improvement of aging design standards to ensure the standardization and universality of design practices. I hope this study can provide useful references for related fields, and I also look forward to more researchers and designers joining in to jointly build a warmer and more inclusive aging friendly social environment.

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