Elderly-oriented Reconstruction Plans of Outer Public Space in Small Town Communities

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Abstract. Along with accelerated “elderly-oriented” process, solving all kinds of social problems brought by elderly-oriented population has become our nation’s urgent task. At present, home-based care plays a significant role in old-age security model in China. Besides, the key step to promote harmonious development of society is to build a living environment suitable for the elders. In recent decades, we have built large numbers of residential communities. Environment quality of outer public space of some buildings is not suitable for elders to live. This thesis adopted some research methods such as document analysis, field research and questionnaire survey. The objects of thesis are residential communities built during 1910s to 1920s in Dujiangyan City. This thesis analysed the satisfaction and demands of elders for the communities’ outer space environment and communities’ public space environment. After considering elders’ characteristics and demands, this thesis put forward plans for elderly-oriented reconstruction of outer public space in small town communities from five aspects: community entrance and exit space, activity space, road system, lighting and marking system and public green, effectively optimized and improved the environment quality of outer public space of the communities.

1 Introduction

After entering 21th century, Chinese elderly-oriented problem has become increasingly serious and this trend is unstoppable. The population aged 65 or above has accounted for 11.9% of the total population [1]. It is estimated that our elderly population will reach 300 million by 2025 and elderly-oriented population will grow at fast speed. How to solve the social problems brought by elderly-oriented population and meet the material and spiritual needs of the elders has become our top task at current situation [2]. Nowadays, the elderly-oriented reconstructions put forward by society mainly refer to the barrier-free facility design, such like passage, handrail and other barrier-free infrastructure design, which is lack of content and far from satisfying multi-level needs of the elders today [3]. This thesis is to study the elderly-oriented reconstruction of outer public space in small town communities, with Dujiangyan City of Sichuan Province whose elderly-oriented population account for 3.79% of the total population as the research area. With the aim of home-based care and the premise of multi-level requirements such as physiological, psychological and requirements of the elders, the thesis seeks to create an outer public space suitable for the elders.

2 Analysis of Elder-oriented Outer Public Space of Community

2.1 Selection of Research Area

The research of elderly-oriented outer public space of the community in Dujiangyan’s main urban areas was divided into two steps. The thesis accomplished the general situation of the community through Internet and telephones and other methods. Gaoqiao Yangguang Community, Shangshang Chuntian Community, Jiefang Courtyard and Lianmeng Village are the objects of the research. These communities have different location and age of the building as well as living environment. Besides, they all have many elder residents, so it has many significant typical characters.

2.2 Analysis of Satisfaction and Demands of the Elders

In order to get to know the life situation and pension demand of the elders, the thesis adopted random questionnaires and interviews to investigate. The questionnaire was conducted by random sampling and anonymous filling. A total of 150 questionnaires were distributed, 142 of which were valid. The content of the questionnaire is mainly divided into the basic information of the elderly, the characteristics of the
elderly travel activities, and the elderly satisfaction and demand survey.

2.2.1 Analysis of Elders' Basic Information

The results of the survey’s statistics are shown as:

Table 1. Statistical table of the basic information of the aged.

| Type                     | Number of people | PCT   | Type                     | Number of people | PCT   |
|--------------------------|------------------|-------|--------------------------|------------------|-------|
| Gender                   |                  |       | Place of Domicile        |                  |       |
| Male                     | 66               | 46%   | Native                   | 132              | 93%   |
| Female                   | 76               | 54%   | Non-native               | 10               | 7%    |
| Age stage                |                  |       | Professional Background  |                  |       |
| 60-64                    | 54               | 38%   | Agriculture             | 70               | 49%   |
| 65-74                    | 71               | 50%   | Public Institution       | 21               | 15%   |
| 75-84                    | 13               | 9%    | Service Industry         | 37               | 26%   |
| Way of Residence         |                  |       | Length of Residence      |                  |       |
| Alone                    | 5                | 4%    | < 1 year                 | 0                | 0%    |
| A couple                 | 37               | 26%   | 1 - 10 years             | 11               | 8%    |
| Two Generations          | 64               | 45%   | 10 - 30 years            | 52               | 37%   |
| Three Generations        | 36               | 25%   | >30 years                | 79               | 55%   |

According to the results, the elderly women make up 54% and elderly men 46%. Most elder people live with their grandchildren. There are more elderly people in the age of 60-64 and 65-74. Most of the old people have lived for a long time and have been engaged in agriculture and service industry, which is consistent with the urban nature of Dujiangyan and the basic characteristics of small towns.

2.2.2 Analysis of Characteristics of Elders’ travel activity

This analysis includes three parts: the time when they go outside, the frequency and their outdoor activities. The results showed that the elders often go out mainly in two periods of time; the first one is 6-10 in the morning and 2-6 in the afternoon. Due to shorter sunshine time in winter, the time for the elderly to go out for activities is also reduced, and the distance for the elderly to go out is negatively correlated with the age of the elderly.

According to the literature, the thesis divided elders activities into 7 parts, chat and rest, walking, exercise, shopping, sends and picks up on the child to leave class, square dancing and chess and card games. However, most elders don’t exclude these kinds of activities, this neighborhood lack of activity space.

2.2.3 Satisfaction and Demands Analysis of Elders about Outer Public Space

Scholars divided the public space elements into seven parts, space and measure, accessibility, mix use and density, environment quality, public facility, street furniture and public cultural activities [4]. According to the research results, public space of the community was distributed into six parts: public greening, supporting facilities, community furniture, walking system, security and activity space. It can calculate the mean value and variance of many environment elements for the research of the importance of space elements, the formula is:

\[ \bar{X} = \frac{1}{n} \sum x_i \]  \hspace{1cm} (1)

\[ s^2 = \frac{1}{(n-1)} \sum (x_i - \bar{X})^2 \]  \hspace{1cm} (2)

Formula one is the sample mean formula of public space elements, which represents different environmental elements’ significance. Formula two is sample variance formula, which shows the fluctuation degree of the
elder’s cognition of the importance of environmental factors. X represents the score of the importance degree of different factors. (very important=5, important=4, normal=3, not important=2, doesn’t matter=1), n represents total number of survey samples, in this research n=142. The results of the importance degree of space environmental elements are:

Table2. Statistical table of the importance of environmental factors in community space.

|                | landscaping | ancillary facility | Community furniture | Footpath system | security | Active space area |
|----------------|-------------|--------------------|---------------------|----------------|----------|-----------------|
| mean value     | 4.44        | 4.41               | 4.41                | 3.98           | 4.70     | 3.89            |
| variance       | 0.490       | 0.669              | 0.405               | 1.127          | 0.170    | 1.576           |

We can know that the importance degree of security is the highest, with smallest fluctuation, which means the elders attach the highest importance to security. Apart from security, there are community public greening and community furniture which also possess the features of great importance and little fluctuation. Therefore, these three elements also become the focus of attention. Supporting facilities is another important space environmental element in elders’ minds, while walking system and activity space are less significant in the study, with great fluctuation. Considering the design should satisfy the common needs of different people, these parts should also be given enough attention.

2.3 Quality Analysis of Outer Public Space Environment of Community

2.3.1 Analysis of Entrance and Exit Space

The problems of entrance and exit of community are mainly including two aspects: the identification and accessibility of the entrance and exit space. For those who get into old age, they are facing deterioration of the sensory and motor function. The sensory system is to handle the outer information reception work of human body, of which vision and auditory sense are the most direct way of reception. The deterioration of sensory system make the elders lose their hearing, vision, response. Therefore, entrance and exit space should give the elders strong vision information, that is different entrance and exit space should has its different features [5]. However, entrance and exit space of most communities are lack of characteristics, some of them even don’t have a clear border. In addition, the serious damage of entrance and exit space is also posing a serious security threat to the elders. The elders with deteriorating motor function are having difficulties of tumble and tired. That is why the society needs a safe, wide and flat road to guarantee their safe. Many entrance and exit space of the communities have many barriers and problems like free parking of cars and sundries, space occupation and different heights.

![Image](image.png)

Figure 3. Current situation of residential entrance and exit space.

2.3.2 Analysis of Rest Space

The research mirrors that the problems exist in the rest space are the lack of activity space and activity facilities. Being old means the elders’ falling physical functions and they are more inclined to feel sense of elderly-oriented. In addition, they often live separately from their children. Being alone, they don’t have so many social activities and often feel lonely. At this point, the relationship with neighbors becomes extremely important. It is of great significance to provide more space for social activities with the elders and create perfect environment and opportunities for them to socialize with people. Meantime, the elders also require relatively private and quiet space to be alone, which also put forward higher requirements for number and quality of the activity space [6]. Some communities only possess one place for the elders to rest and entertain themselves, far from meeting the elders’ multi-needs. The quality of activity space mainly depends on the facilities of inner space, while the number of recreational fitness equipment and rest seats is relatively small. Moreover, those communities with complete facilities usually lack of maintenance management.

2.3.3 Road System Analysis

The sharp decline in the motor system function of the elderly raises the possibility of accidents. Ensuring the safety of elderly’s activities becomes the most basic requirement of elderly-oriented Reconstruction. Therefore, the elderly-oriented Reconstruction of the external public space environment should pay special attention to the safety needs of the elderly, the accessibility of facilities and space, and the accessibility of the pedestrian system. The ideal road system should adopt the Separate Roads Mode with reasonable road width, barrier-free access and antiskid pavement on the walkway. However, many communities are still the Coexistence of People and Vehicle Mode, and communities with commercial space at the bottom floor increase the traffic chaos and risk to the elderly. Most communities have no barrier-free access. A few of them still have problems such as road damage.

2.3.4 Analysis of Lighting and Sign Systems

Lighting usually has some problems such as lack of facilities and insufficient brightness. Everywhere around
here is dark at night, and the elderly with poor eyesight are more difficult to identify the surrounding environment, so they need to use lighting to ensure walking safety. But the number, types and lighting brightness of lights cannot meet the needs of the elderly in the design of many old residential areas. The lack of maintenance of lights is serious, which seriously affects the safety of the elderly at night. There are also some problems such as the lack of quantity and identification in sign system. Due to the decline of nervous system function, the elderly are prone to slow reaction, memory decline and other problems. A perfect sign system can help the elderly identify things. At present, the number of sign systems in many old residential areas is not large, the identification degree is not high, and they fail to perform their due role [6].

2.3.5 Analysis of Public Green System

The elderly tend to be prone to “Sense of senility”, and a vibrant green system can help the elderly to ease the “Sense of senility” and create a good pension environment for the elderly [7]. It is difficult to meet the needs of people in quantity and quality of green in early-built residential areas. And among residential areas with relatively high green rate, part of them have the problems such as single greening level and plant allocation, lack of interesting and interactive. At the same time, the maintenance of greening landscape in each residential area is also uneven.

3 Elderly-oriented Reconstruction of External Public Space

3.1 Reconstruction of Entrance and Exit Space

The entrance and exit space of the external public environment of the community mainly includes the entrance space of the community and the entrance space of the apartments, as a transportation hub connecting two different spaces, it plays the role of guiding and organizing human flow, and is also an important place for the elderly to communicate in the community.

- Accessibility: The design of the entrance and exit should avoid height difference as far as possible. For the inevitable situations, the combination of entrance steps and ramps should be adopted without affecting the whole environment of the community. The common combination types are L-type, straight line type and reentrant type (Figure 4). It should also pay attention to the design of the height of the entrance step, the slope and width of the ramp, the height of the handrail and the sizes of the entrance platform.

![Figure 4. Schematic diagram of the type of ramp combination at the entrance and exit](image)

- Identification: The elderly have poor memory, are easily confused and difficult to distinguish the entrance and exit space, and in facing the same design, they are also easy to be prone to upset mood. To enhance the identifiability of the entrance and exit space, the culture and community name of the area where the community is located can be considered as a whole, and the characteristics of different communities can be highlighted by working hard on the shape and color of the entrance and exit. For residential entrance and exit spaces in the community, the apartment entrance can be transformed by adding striking unit numbers or by applying different pavement and plant configurations at different entrances.

- Easy to communicate: the entrance space is generally composed of the distribution space in front of the door, the door space and the transition space inside the door. The distribution space before the entrance and exit of the community or the transition space inside the door can be one of the important places for the elderly to gather and communicate, which is of great significance to stimulate the elderly to engage in communication activities. For the case of too simple design of residential entrance and no vestibule is set up in the community, if the conditions permit, the entrance space can be expanded for different actual situations, and the expanded area can be provided with rest seats for the residents to chat, rest and create more opportunities for communication (Figure5).
3.2 Elderly-oriented Reconstruction of Rest and Activity Space

The rest and activity space is the main place for the elderly to join communication activities and exercise. Relevant research shows that moderate physical activity is a significant way to maintain the physical and mental health of the elderly.

The demand of the elderly for activity space can be generally divided into dynamic and static activity space, private and open activity space. The different gender, age and character of the elderly show the different needs for rest and activity spaces at different time, multi-level and multi-type activity space division can meet the different needs of the elderly well.

Dynamic activity space is the site for the elderly to carry out centralized activities. Its area should be large enough, in the edge space should also be set seats, gallery frame and other facilities for the elderly to have a rest or place objects after activities. The study found that the elderly in the outdoor activities will be in the mentality of “being seen”, it can bring satisfaction to them when others stop to watch, which requires that the dynamic activity space should be as open as possible. The static activity space is generally the place where the old people chat, play chess and have a rest. This kind of space requires less area and high privacy. In the treatment of such space, the space can be divided into areas of different sizes by plant arrangement, seat facilities, transportation, etc., to enrich the space level and meet the different needs of the elderly for openness and privacy.

There is also a large number of small communication space formed by the spontaneous gathering of the elderly, which is not originally designed, but formed spontaneously by people’s long-term habits and behavioral activities, is the most reasonable space for community activities. In the process of elderly-oriented Reconstruction of external public space, exploiting the potential of such space and improving its infrastructure will not only make full use of the space within the community, but also enrich the hierarchy of the community activity space for the old residential areas with tight land use.

3.3 Elderly-oriented Reconstruction of Road System

The road system in community constitutes the basic framework of the whole community. The convenience and safety of the road system are so significant to the daily life of the residents in the community. Walking is the most common way for the elderly to travel, and the main way for the elderly to exercise, it is very important for the daily life of the elderly, so the accessibility and convenience of the walking system is very significant. Into old age, the walking characteristics of the elderly are different from those of other groups [8] (Figure 6).

And the memory and recognition of the elderly have decreased, the design of the entire pedestrian system should ensure smooth passage, pay attention to the circulation of the pedestrian system, reduce the number of broken roads as much as possible. The circulation of the pedestrian system should also ensure the continuity of pavement spreading of the pedestrian system and avoid extensively using the step of spit of fland as much as possible. Addition, emphasis should be placed on linking the pedestrian system with the various landscape nodes and activity sites in the community, enabling the elderly to participate more in these activities, and on transforming road identifiability and avoiding overly tortuous road design. Research shows that the most suitable distance for elderly people to walk is generally about 150 m, so it is also particularly important to build the rest node on the way of walking, adequate rest space should be set at every appropriate intervals (Figure 7). And pay attention to the building of the landscape environment around such nodes to ensure the permeability of the landscape view.

3.4 Lighting system and Tag system of Elderly-oriented Reconstruction

- Lighting system: Because the eyesight of the elderly drops in different degrees, the elderly’s
exercising in the dark place is very difficult. And because they are older, their ability to adapt to the changes in light and shade gradually diminishes. Excessive intensity of light and shade changes can easily lead to glare and other discomfort for the elderly, and even make them unable to see things for a short time. Therefore, appropriate lighting brightness is extremely important. (Table 3)

- In the crossroads, steps and other areas prone to safety accidents, lighting should be set 0.4m away from the ground. Surface lighting should avoid the use of unmasked design, choose a lamp with a shade to prevent direct lighting and affecting the line of sight. Acoustic switches should be used in residential corridors and emergency lighting systems should be installed and regularly checked and maintained [9].
- Tag system: The elderly become less sensitive to color as they get older. Similar colors should be avoided in the design of the identification system, and the outline on the bottom of the picture should have obvious contrast. At the same time, it also should consider different illumination circumstance the choice of bottom colour of the following graphs (Table 4), and consider the psychological characteristic of the old person. It also should avoid large areas to use cold colors, choose warm colors at the same time, try to choose easy to identify font. And set different levels of the two signs, to meet the needs of the different elderly’s using.

Table3. Recommended standards for outdoor lighting in elderly residential buildings

| Place              | horizontal intensity(lx) | vertical intensity(lx) |
|--------------------|--------------------------|------------------------|
| residential entrance | 30                       | 15                     |
| entranceway         | 10                       | 5                      |
| slope, stairway, step | 10                       | 5                      |
| active region       | 10                       | 5                      |
| access road         | 5                        | 3                      |
| main road           | 10                       | 3                      |

Table4. Color combinations adapted to different brightness levels

| High brightness | Medium brightness | Under low brightness |
|-----------------|-------------------|----------------------|
| tracing black   | tracing black     | tracing black        |
| tracing yellow  | tracing black     | tracing black        |
| Red White       | Orange black      | White black          |
| Orange black    | Red black         | Black yellow         |
| White black     | White black       | Blue                 |

3.5 Elderly-oriented Reconstruction of Public Green System

The plant disposition of the community should be matched with the overall environment in the community. To avoid too obvious colors is to pay attention to the combination of evergreen plants and deciduous tree species. Choosing plants that can be appreciated in all the year round, avoiding the decline of the surrounding environment due to seasonal changes, and bring negative viewing experience to the elderly. Considering the characteristics of the old man's field of vision is generally lower, the visual focus of the landscape can be set in a relatively low place [10]. Plants disposition should also be considered for the safety of the elderly, and in areas accessible to humans, avoid plants that are prone to pests and thorns. Due to the sensitive respiratory tract of the elderly, they often suffer from lung diseases, heart diseases and other diseases, in order to prevent the elderly from allergic, asthma and other adverse reactions, plant configuration should also choose non-toxic plants.

4 Conclusion

With China’s social economy constantly developing, the design of the newly built community has started to consider the needs of all ages. However, in some small towns, the existing community has found it difficult to meet the spiritual and material needs of the elderly in terms of architectural quality, environmental quality and community facilities. Go by the "Updating a little" a new idea of urban planning, how to comprehensively consider both community geographical location, population structure, social environment and other circumstances, scientifically to transform update community external public space environment, improve the living standards of the community elderly, at the same time improve the image of the urban area of great research significance and value. This thesis analyzes the elderly’s psychological, physiological and behavioral characteristics and discusses the needs of the elderly. By investigating the environmental quality of the external public space in Dujiangyan typical community and the elderly’s demands in the community, this thesis puts
forward the elderly-oriented Reconstruction strategy of the external public space in the community of small towns. The thesis aims at providing design ideas and methods for the elderly-oriented Reconstruction of the external public space environment of existing communities in small towns, and to improve the environment for the elderly.

Because of the influence of social, economic, policy and cultural conditions on the elderly-oriented of the external public space environment of small town communities, that this thesis studies the policies and economy is relatively not perfect, so the understanding of the difficulties in the implementation of the Reconstruction is also partial. In the future research, problems should be found and improved constantly in the practice process, and at the same time, the influence of economic and policy factors should be taken into consideration, and different Reconstruction strategies should be proposed according to different situations, so as to explore the feasibility of elderly-oriented adaptation Reconstruction of small town communities and improve the research conclusions.

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