Research on Optimization of Environmental Protection Scheme of Retirement Housing from the Concept of Ecological Design

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Abstract. With the tide of aging sweeping the world, home-based care for the aged due to its unique advantages was replacing hospitals and institutions as the main and realistic choice for the elderly. For the increasing requirements of old-age care life, the concept of ecological design adhered to the characteristics of "removable, maintained, recycled and repeated", which was rising to the basic principle of environmental protection design for residential old-age care and also an important measure to solve the problem of old-age care. This article would reflect the ecological design concept from environmental protection decoration, sound, light, water, garbage, heat and other environmental aspects to optimize the environmental protection scheme for the elderly housing, which helped enhance the "sense of acquisition" of the elderly.

1. Introduction
The world is ageing for a combination of improved living conditions, longer life expectancy and low fertility. By 2018, the world's elderly population (65 years old or above) had reached 705 million which accounted for 9% of the total population and exceeded the international social standard of 7% for the elderly and the aging rate is accelerating. With "Everyone would grow old" pension had become a realistic and eternal topic. With the advantages of economy, resources and emotional sustenance, home-based care had gradually replaced hospitals and institutions for the aged and became the main home for the aged in the world. Therefore, how to design an environmentally friendly and comfortable house for the elderly who felt the new experience of the ecosystem and let the elderly enjoy a happy old age had become the top priority of the current pension housing design. Ecological design concept was a new architectural design concept, which was mainly used in the design of high-end residential areas, but rarely used in the construction of retirement homes. With the rapid development of the economic level and the improvement of the elderly's demand for ecological and environmental protection, the integration of ecological design concepts in materials decoration, sound, light, water, garbage, heat and...
other environmental aspects would surely become the inevitable choice of the environmental protection scheme for the future retirement housing, which would help meet the increasingly expanding ecological and elderly life.

Scholars had carried out extensive research on the design of retirement homes. In particular, developed countries entered the aging process earlier and the industrial revolution process was earlier. They had a strong economic foundation and could build environment-friendly retirement houses to cope with the aging problem. In 1943, planning and construction of senior housing in Stockholm first emphasized the environmental protection design of senior housing. In 1986, and the international charity organization formulated the classification standard of pension housing which divided pension housing into seven architectural design modes including environmental protection. As the benchmark of environmental design for retirement homes in Asia, Japan issued the design manual for retirement homes in 2011 focusing on general environmental design. Zhao Zijun (2014) studied the interior space and decoration of elderly people in residence. Wang Yonghui and Zhang Jun (2015) investigated the building energy conservation and retirement housing design in Japan. Chen Dao (2015) designed the indoor environment of the residential houses for the elderly in Chinese cities and towns. Chen Shuting (2017) took lingyuan village residential reconstruction as an example to study the design method of rural residential reconstruction suitable for aging. Zheng Xueying (2017) planned the aging residential products in Zhongshan. Gao Lu and Song Pei (2017) integrated BIM design into the interior decoration of retirement homes. In terms of ecological design, Lv Hui (2014) studied the application of ecological design in interior design of tourism real estate residences. Yang Ting (2017) applied ecological design concept in residential space design. However, there were few studies on the environmental protection design scheme of old-age housing by scholars and few measures to uphold the ecological design concept in the environmental protection scheme planning. This paper would apply the ecological design concept in the environmental protection design scheme for the elderly and discuss the advantages of ecological design and the recognition degree of the elderly.

2. Problems existing in the environmental protection design of existing residential buildings for the aged: based on 545 questionnaires

In order to know the present situation endowment residential environmental design, the article designed the "old-age residential environmental design questionnaire" for people over age 65. Based on the simple random sampling method to extract the child samples from the old people, 571 questionnaires recycling of 560 with effective questionnaire 545 who’s efficient was 95.44% and reach the standard the validity of the questionnaire. Table 1 showed the statistical description of questionnaire samples from the aspects of gender, age, marriage, culture, housing and old-age housing.

| Variable   | Attribute | Proportion | Variable   | Attribute | Proportion |
|------------|-----------|------------|------------|-----------|------------|
| gender     | male      | 46.6%      | marriage   | married   | 50.2%      |
|            | female    | 53.4%      |            | unmarried | 9.8%       |
| Age        | 65–70     | 52%        | Level of education | Divorce/widowhood | 40% |
|            | 71–75     | 27.6%      |          | Primary and below | 34.7% |
|            | 76–80     | 12.4%      |          | Middle school | 51.6% |
|            | ≥81       | 8%         |          | College degree or above | 13.7% |
| Housing    | His rent  | 20.7%      | Old-age homes     | Self house | 74.2% |
|            | Rent house with children | 25.4% |          | Social housing | 16.4% |
|            | Own home with children | 31.8% |          | Public housing | 5.5% |
|            | Live alone in a house | 22.1% |          | Private residential | 3.9% |
Through the investigation on the environmental protection status of the elderly pension housing, it was found that the elderly were less satisfied with the pension housing at present and there were the following problems in the environmental protection design:

Firstly, the high energy consumption of old-age housing increased the cost of old-age care. Due to the lack of rich sources of income for the elderly compared with the young, 78% of the surveyed elderly were unwilling to live in energy-intensive retirement homes and choose a cost-saving lifestyle for the elderly, so the energy consumption of retirement homes was relatively high. However, the wall of the current pension housing was common design, which had not the inside, outside, intermediate heat preservation function, outside doors and windows set less, where pay attention to natural ventilation thermal environment but lack of recycling of renewable energy. Too traditional in interior design using neuter colour less decorating a respect to be needed which strengthened in furniture plant.

Secondly, the endowment housing consumed resources and was not sustainable enough. At present, with the acceleration of human industrialization, environmental problems had become particularly severe, and people's awareness of environmental protection was becoming stronger and stronger. The elderly were picky about the environmental protection of their homes. According to the questionnaire survey, 65% of the elderly interviewed were dissatisfied with garbage disposal and found it difficult to accept the high resource consumption of retirement homes. Currently lower endowment resources circulation utilization of the residence such as the lack of water resources recycling and reuse, sewage waste-water shunt was not much, waste lack effective recycle and reuse, 52% of the old man thought the sustainability of endowment residential water was very important, the current old-age homes attached importance to the use of existing resources ignoring the future resource love and destroyed the future pension housing resources recycling and hindered the sustainable resources.

Thirdly, the protection material application of elderly housing environmental was not strong and technical. The effective application of environmental protection materials and technology was the mandatory requirement of green and comfortable residence for the aged. In the interviewed group, 63% of the elderly people resisted the material of endowment housing which was harmful to physical and mental health and preferred the residence with environmental protection decoration. With the enhancement of environmental protection concept more and more old people liked green ecological materials, natural materials furniture, green plant configuration and against chemical fiber furniture, heavy metal materials, formaldehyde and other pollutants infringement. However, at present, environmental protection materials and technologies had not been widely used in old-age housing, which could not effectively meet the needs of the elderly.

Fourthly, the sound and light effect of residential care for the aged was not good for reducing the quality of life for the aged. Older people were more sensitive to sound and light due to age and physical health. The sound of higher decibel and strong light affect the rest and Morpheus of old people directly, producing serious effect to nerve, endocrine, body and mind even. In the survey, 56% of the elderly reported suffering from voice disturbance, while 43% suffered from insomnia and even neurasthenia in bright light.

3. Application of ecological design concept and comparison with traditional design of environmental protection scheme for elderly housing

3.1. Ecological design concept application in Environmental protection scheme for the elderly housing
The basic concept of "Ecological Design" was that products could be removable, maintained, recycled and repeated in design of old-age housing, the environmental impact and resource consumption of old-age housing should be reduced to promote the healthy and sustainable development.

The environmental protection scheme for the elderly housing was a systematic and huge project mainly including materials decoration, sound, light, water, garbage, heat and other aspects. As the elderly had higher requirements on living environment, they pursued comfortable, convenient,
ecological and environment-friendly living in the bedroom, which can better meet the requirements of ecological design concept (figure 1).

Figure 1. Ecological design concept application of environmental protection scheme for the elderly housing

Figure 1 was the ecological design concept in the pension program diagram of the application of residential environmental protection, which would endowment residential environmental design as an ecological circulation system from material decoration, sound, light, water, garbage, heat of six aspects, such as the extension of system, the connotation of the system embodies the ecological design concept including removable, maintenance, recycling, repeatable.

3.2. Application of ecological design concept and comparison with traditional design
According to the requirements of the ecological design concept, the first and second level indexes of the environmental protection design scheme for the elderly housing were designed and the second level indexes were explained. Meanwhile, the advantages and characteristics of ecological design concept compared with traditional design in environmental protection scheme were compared (table 2).
### Table 2. Environmental protection scheme design indexes of the Eco-design concept for the elderly housing and the comparison with the traditional elderly care

| Level indicators     | Secondary indicators     | Standard interpretation                     | Environmental advantages compared with traditional       | Characteristics       |
|----------------------|--------------------------|---------------------------------------------|----------------------------------------------------------|-----------------------|
| Material decoration  | Green ecological material | Material packaging, life harmless waste recycling | Green ecological materials were pollution-free          | Removable             |
|                      | Natural furniture         | Natural materials with rich colors          | Ecology and energy conservation                           |                       |
|                      | Green plant configuration | Dotted, linear, planar distribution         | Add green to the room                                     |                       |
| Sound Environment    | Wonderful voice           | Add wind chimes, birds and other natural sounds | Good sound experience                                    |                       |
|                      | Soundproof Windows and doors | Plastic steel sliding, other applications, ventilation | Reduce outdoor noise interference                        | Maintained            |
|                      | Sound insulation materials | Hollow, laminated glass, sound absorption board | Reduce internal noise interference                        |                       |
|                      | Sound-absorbing the adornment | Energy-saving, ecological construction techniques | Absorb the noise                                         |                       |
| Light Environment    | Natural lighting          | Transparent roof, study day-lighting        | Use natural light to reduce lighting costs               | Repeatable            |
|                      | Artificial lighting       | Green, energy-saving light source and recycling | Energy conservation and environmental protection to meet health needs |                       |
| Water Environmental  | Water supply and drainage system | Air pressure water, sewage, waste water diversion | Energy saving water                                       | Recycled              |
|                      | Return water system       | Feed water heating                          | Hot water reuse                                          |                       |
| Garbage Disposal     | Product recovery          | Add a household food waste processor        | Reduce pollution and cost, resource recovery             | Recycled              |
|                      | Garbage disposal          | Garbage sorting and reuse                   | Recycling, value preservation and appreciation           |                       |
| Heat Energy          | The wall energy saving    | Inner, outer and middle insulation          | Reduce heat loss, maintain heat                          | Repeatable            |
|                      | Doors and Windows energy saving | Energy saving and environmental protection | Improve air tightness and heat preservation               |                       |
|                      | Thermal environment       | Natural ventilation, renewable energy       | Reduce the use of refrigeration equipment                |                       |
|                      | Interior design           | Neutral colour, furniture, plant were decorated | Improve environmental comfort level                       |                       |

Source: Self-collated

Table 2 showed that the environmental protection materials and decoration were the core of the endowment residential ecological design concept, mainly reflected in the green ecological materials, natural materials furniture, green plant configuration, relative to the traditional old-age homes, ecological design concept had green pollution-free ecological material in the environmental protection,
ecology, the effect of energy saving and add green to the room. Sound environmental protection was an important part of the ecological design concept of retirement housing including the addition of beautiful sound, the use of soundproof doors and windows, soundproof materials and sound-absorbing decoration which could give the elderly a better sound experience, reduce outdoor and indoor noise interference and absorb noise. Lighting and environmental protection were mainly to absorb natural lighting and artificial lighting with the use of natural lighting, reducing lighting costs, energy conservation and environmental protection to meet the health needs. Water used environmental protection was mainly to optimize the water supply and drainage system and backwater system to achieve the efficiency of energy saving and water saving and hot water reuse. Waste disposal including product recycling and waste disposal was helpful to reduce pollution and costs, resource recycling, recycling and value preservation and appreciation. Thermal energy environmental protection was a difficult point in the ecological design concept of old-age housing mainly including wall energy conservation, door and window energy conservation, thermal environment and interior design. The function was to reduce heat loss, maintain heat energy, improve air tightness, improve heat preservation, reduce the use of refrigeration equipment and improve environmental comfort.

4. Conclusion

After the ecological design concept was applied to the environmental protection scheme of old-age housing, this paper conducted a return visit to the interviewed elderly to evaluate their opinions before and after the environmental protection scheme of old-age housing (figure 2).

![Figure 2](image.png)

**Figure 2.** Interviewed elderly's satisfaction with the traditional design and ecological design of the environmental protection scheme for the elderly housing

As shown in figure 2 by comparing the ecological design concept applied to pension residential environmental protection schemes of the satisfaction degree of the old man found that the old people's recognition of the ecological design concept was higher, the material decoration, sound environment, light environmental protection, water environmental protection, waste disposal and environmental protection, waste heat from traditional respectively were 37%, 44%, 57%, 48%, 35%, 22%, accordingly up to 79%, 67%, 72%, 75%, 78% and 65%. From 40.5% of the satisfaction with the traditional environmentally-friendly design of retirement homes to 72.67% of the ecological design concept, the leapfrog development had been achieved.

With comfortable, convenient, ecology, environmental ecology environmental protection design concept, it would be removable and serviceable, recyclable, reusable application to endowment home
decoration materials, sound, light, water, garbage, heat which could effectively fit endowment residential environmental solutions, broadly welcomed by the elderly, the concept of green design satisfaction was significantly higher than the traditional old-age home environmental protection scheme.

Acknowledgments
This work was financially supported by Ministry of Education Humanities and Social Sciences Research Projects (17YJC840013), Ministry of Education Humanities and Social Sciences Planning Fund Project: Influencing Factors of Social Support for Long-term Care Services for Disabled Elderly on Their Subjective Well-being(14yjazh008), Soft science project of Hubei (2018ADC122), National social science fund (17BJY080), Young talents program of science and technology research of education department of hubei (Q20181502).

References
[1] Chen Fei, Chen stretched, ShiKaiXin, Bai Zhibin, Lin jiajie. Research on the demand for home endowment housing renovation. [J] chongqing architecture, 2018, (9): 26 - 38
[2] Zhou jianjun. Design of pension housing and community in the context of aging population -- a case study of pingxiang lulinhu pension community. [M] nanchang university, 2018-06-21.
[3] Yao Lei, Ma xiao. Research on spatial organization model of ecological endowment industrial park. [J] shanxi architecture, 2017, (10): 32 - 43.
[4] Li jiajia. Research on green ecological design and technical strategies of old-age buildings in southern jiangsu. [M] southeast university, 2017-05 - 31.
[5] Prince Chou. Humanized design of retirement housing. [J] popular literature and art, 2017, (10): 45 - 57.