

# Research on Rural Aged Outdoor Seating Based on Fusion Design Concept

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**Abstract.** To improve the quality of life of the rural elderly and help them adapt to the rural environment, a design method of outdoor seating that can be widely used in rural public Spaces is explored. Firstly, key words representing the characteristics of outdoor seating in rural public space were identified through literature research and user interviews, and the results obtained were basically consistent with the conclusions of literature research, to establish the main characteristics of seating. Then, based on the Analytical Hierarchy Process (AHP), the key words are constructed into the integrated design index system of rural public space outdoor seating, and the weight of each index is calculated. Finally, based on the analysis results and the construction of index system, the design method of outdoor seat integrated design concept is discussed, and the design analysis, standard formulation, scheme design and comprehensive evaluation of an outdoor seat are verified in practice. This design process increases the objectivity of decision making in the design process. The research results show that the comprehensive application of qualitative analysis and quantitative evaluation can implement the concept into the design practice, so that the design scheme of rural public space outdoor seating for aging can play a role in the fusion of people, things and space, and provide innovative ideas for aging design.

**Keywords.** Fusion design, The country, Senility, Innovative design of outdoor seating.

## 1. Introduction

With the intensification of population aging and the implementation of the rural revitalization strategy, the number of middle-aged and elderly people in rural areas has gradually increased. The elderly are an important part of rural communities. To improve their quality of life and help them adapt to the rural environment, rural public spaces need facilities and services suitable for the elderly. As one of the important facilities of rural public space, outdoor seating has an important impact on the comfort, safety, and social needs of the elderly. However, the existing outdoor seating design often only considers the needs of the general population, ignoring the special needs of the elderly. Or to show that they have made a suitable design for the elderly, simply and roughly set up prominent signs and eye-catching facilities on the outdoor seats, so that the elderly feel that they have received special design care in the process of use. The purpose of this research is to design an outdoor seat in rural public space that is suitable for the rest of the elderly, considers the users of all ages, and conforms to the public aesthetic [1-3].

## 2. Aging design theory and demand analysis of rural public seats

### 2.1. Age-appropriate design theory and its connotation

Age-friendly Design, also known as age-friendly design or age-adaptive design, is a design method that focuses on meeting the needs of the elderly and improving the quality of life of the elderly. It mainly refers to the special needs and use habits of the elderly in product design, environmental design, service design, etc., so that the elderly can still carry out various activities conveniently, freely, and independently in daily life. This design approach recognizes the possible changes in the physical abilities, vision, hearing, cognitive abilities of the elderly, and therefore takes these needs into account as much as possible in the design of products, environments, services, and so on. Aging design mainly includes furniture that is easy to enter and move, comfortable space layout, safety facilities and measures, easy to operate and understand, and in line with ergonomic principles. In general, the goal of age-appropriate design is to provide a safe, comfortable, convenient, and meaningful living environment for the elderly.

### 2.2. Fusion design connotation

Fusion design was proposed by Lu Ji in the book “Barrier-free Fusion Design and Application” in 2021. Fusion design is a revolutionary barrier-free design idea, which can bring new ideas and methods to barrier-free design. First, as a conscious design behavior, the idea of fusion and unity design is based on the idea of harmony. Secondly, integrated design is barrier-free design. Then, fusion design is also a universal design methodology; Finally, fusion design is future-oriented design.

Fusion design attaches importance to the user's feelings, makes it clear that the purpose of design is people, and “no one can be left behind”, focusing on the observation and analysis of human behavior [4-5].

### 2.3. Demand and aging design trend of rural public seats

#### 2.3.1 The demand for seats in rural public space

Rural public space is usually a place for residents' activities and leisure. To allow people to have a comfortable place to rest and relax, it is necessary to set an appropriate number of seats. This can allow residents to have a suitable rest place in outdoor activities and increase the comfort of residents' activities.

#### 2.3.2 The design trend of age-appropriate outdoor seating

Wang Shanshan proposed that outdoor public seats should be suitable for the communication needs, behavior habits and comfort needs of the elderly; Sun Cuicui found through the survey that the elderly have a greater demand for seat armrests, backrests and waist rests. Tian Mi found that there are some problems such as the seat size is not suitable for the elderly group, and the seat modeling color is single. In addition, in view of the widespread sedentary problem of the elderly, Gong Yibing believe that the difficulty of the elderly standing up is the focus of research. Therefore, to provide the elderly with safe, comfortable, and can support the body of the seat, and reduce the psychological barrier of the elderly, is the trend of aging outdoor seat design [6-7].

### 3. Discussion on the integrated design method of rural outdoor seating for aging

#### 3.1. The embodiment of fusion design in the design of rural outdoor seating

Fusion design mainly discusses three fusion dimensions of human-object-space in the design of rural outdoor seating for aging. It should not only emphasize the special needs and physiological characteristics of the elderly, but also use appropriate design language and techniques to highlight respect for users of other ages. Reflecting the humanistic care of "no one can be left behind" and emphasizing the appropriate fusion of multiple functions in outdoor seats to meet the different needs of different people. In order to reduce the existence of special objects, it is also necessary to achieve harmony without difference in the fusion design of the concept of great harmony and realize fusion and play in different public Spaces in rural areas according to local conditions, reflecting the fusion of products and environment [8-9].

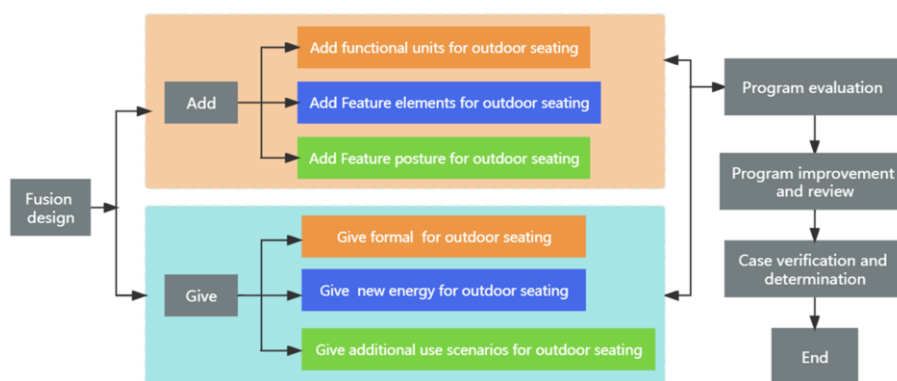


Figure 1. Fusion design process of rural outdoor seating

##### 3.1.1 Fusion of human and object in rural outdoor seating design

The elderly and people of other ages are the users of rural public Spaces, so people and the environment represent the two ends of the design elements of rural age-friendly outdoor seating. Therefore, the seat should provide basic functions such as rest and space for socialization. For the elderly, it is important to ensure that the elderly can reduce their physical burden when sitting and give adequate support when standing. The primary concern for children is safety, not getting bumped. For users of other ages, they pay more attention to the comfort of the seat, in short, reflecting the user-centered design idea at the physiological and psychological level.

##### 3.1.2 Fusion of human and space in rural outdoor seating design

The natural environment of rural public space is different in different regions. The space range is large and small, and the shape is different. When designing outdoor seating, it is necessary to consider the needs of the elderly and other age groups, such as being able to better appreciate and enjoy the natural beauty and the social needs of people to communicate and interact. Through reasonable layout and design, to create a comfortable, safe and pleasant outdoor activity space, so that people can better enjoy the beauty of nature.

##### 3.1.3 Fusion of objects and space in rural outdoor seating design

Integrated design is not only reflected in the universal applicability of users "no one

can be left behind", but also reflected in the appearance design of outdoor seats and the fusion of nature. The seats echo the surrounding natural landscape, echo the rural style, and use the appropriate formal beauty rules, the use of appropriate materials, shapes, colors, etc., so that the outdoor seats meet the aesthetic of most users.

### 3.2. *Fusion design method of rural outdoor seating*

Fusion design, as the name implies, is to put different elements together, and at the same time, it must be integrated into a whole through certain means. Different from the design method of general products, the fusion design of rural public space outdoor seating should first be concerned about what is the object of fusion. The objects of fusion can be divided into two categories: physical image (defined as "Add") and mental image (defined as "Give"). "Add" refers to adding one or more objective factors, while "Give" refers to more subjective factors. These factors may not be used all the time, but the design is started from these factors. The design process is shown in Fig1.

#### 3.2.1 *Add*

When using the method of fusion design, we increase the objective factor first, there can be three aspects of consideration, such as increasing the functional unit of outdoor seats to solve the special in general, but the simple combination is not to increase the functional unit. Or increase the functional elements of outdoor seating, try to break the traditional thinking inertia, and enrich the function or meaning of outdoor seating. Or do not consider the first two factors, retain the "shape" of the traditional outdoor seating, but increase or change the "attitude" of the outdoor seating. This posture can be either direction or position.

#### 3.2.2 *Give*

Secondly, it gives relatively subjective factors, which can also be considered from three aspects. For example, the use of a recognizable, identifiable form to give outdoor seating more recognition and aesthetic value. The form here can also be color. To give new energy to outdoor seating, it can be the use of waste materials to transform into seats, or it can be the re-excavation of forms. Giving outdoor seating additional use scenarios does not have to be related to the function, but it can add value to the functional space and attract more people to use it [10-11].

## 4. **Application of the fusion method of rural outdoor seating**

### 4.1. *Based on literature analysis and interview, integrated design analysis of rural outdoor seating for the elderly*

Fusion design needs to find accurate objective factors and subjective factors, and then seek the optimal solution of the design problem. The key words in the fusion criteria of rural age-appropriate outdoor seating design are rural public space, age-appropriate design, and outdoor seating. Therefore, the design scheme should reflect the fusion with the rural public space and the fusion with the aging design. To verify the matching degree between the keywords obtained from the analysis of existing literature and the needs of rural elderly people for outdoor seating, 50 rural elderly people were invited to accept interviews. The outline of the interview focuses on the needs of users, outdoor seating, and rural public space. The sorted documents are analyzed by keyword word

frequency. In the analysis of the needs of people in the aging design of outdoor seating, the keywords such as “comfortable”, “safe”, “durable”, “multi-functional”, “support”, “armrest”, “non-slip” and “easy to identify” have the highest word frequency. In the analysis of the interview results on the fusion demand of outdoor seating and rural public space, the keywords such as “comfortable”, “safe”, “beautiful”, “multi-functional” and “easy to clean” have the highest frequency of words. In the statistics of the key features of people's needs in rural public space, “social”, “entertainment”, “leisure”, “convenience”, “service” and “activity” are high-frequency requirements for space, which are highly consistent in meaning with the keywords summarized in literature analysis. The key features of the integrated design of rural aged outdoor seats obtained from literature analysis are indirectly verified. The unification of the two provides a clear direction for the design issues such as key functions, positioning, and style of seats, and provides solid theoretical support for design practice.

#### *4.2. Based on AHP, the integrated design index system of rural outdoor seating was constructed*

Analytical Hierarchy Process (AHP) can stratify design ideas based on goals, criteria, and schemes, to decompose design tasks systematically and from top to bottom. It is often used in design decision-making and is one of the mainstream methods for weighting all elements of design system.

After the verification of the interview results, the characteristics of the rural age-appropriate outdoor seat based on the integrated design can be summarized as “comfortable”, “safe”, “durable”, “multi-functional”, “easy to identify”, “beautiful”, “social”, “leisure”, “harmonious” and “symbiosis”.

The design index system of rural outdoor seating based on fusion design is constructed by combining the keywords of the key features of rural outdoor seating with 6 fusion dimensions belonging to 3 target layers: user (fusion of user and seat, fusion of user and space), seat (fusion of seat and space, fusion of seat and user) and space (fusion of space and user, fusion of space and seat).

To further realize the quantitative role of the design index system in scheme evaluation, a judgment matrix of 3 target level demand analysis, 6 first-level criterion level and 10 second-level scheme level index is established according to AHP. An expert group composed of 5 design practitioners and 5 university teachers used Saaty 9-point scaling method (Table 2) to score the weights of indicators at all levels, and finally calculated the weights of primary and secondary indicators through SPSSAU (Table 3-8), normalized the weights of indicators at both levels, and added the final weights to Table 1.

Through weight calculation, it can be seen that the importance ranking of indicators in the integrated design criteria level of rural public space elderly outdoor seating is as follows: fusion of user and seat (0.3086) > fusion of seat and user (0.2442) > fusion of user and space (0.2063) > fusion of seat and space (0.1223) > fusion of space and user (0.0593) = fusion of space and seat (0.0593). The design indicators of the scheme level were normalized, and their weights were ranked as follows: comfort (0.21) > rest (0.14) > durability (0.13) > multi-function (0.11) > Safety (0.10) > Social (0.07) = beautiful (0.07) > Harmony (0.06) = symbiosis (0.06) > easy identification (0.05). The two indexes of comfort and leisure of outdoor seating occupy the top two places of importance, which reflects the characteristics of users' demand for outdoor seating in rural space.

Table 1. Integrated design index system of rural elderly outdoor seating.

S/ N	Target level requirement analysis	Criterion level firstId	Scenario level secondId	Indicator specification	weight
1	User: no one can be left behind	fusion of user and seat A (0.3086)	Comfort a1 (0.6667)	User feel comfortable, relaxed and happy	0.21
2			Safety a2 (0.333 3)	User's body is protected from harm	0.10
3		fusion of user and space B (0.2063)	Social b1 (0.333 3)	Promote communication among users	0.07
4			Rest b2 (0.6667)	Users get rest	0.14
5			Durability c1 (0.5396 )	Not easy to damage and deformation	0.13
6	Seat: unity of function and form	fusion of seat and space C (0.2442)	Multi-function c2 (0.4604)	Provides other additional functions	0.11
7		fusion of seat and use D (0.1223)	Easy identification d1 (0.4416)	The appearance has easily recognizable features	0.05
8			Beautiful d2 (0.5584)	Attractive, pleasant and harmonious in appearance	0.07
9		fusion of space and user E (0.0593)	Harmony e1 (1)	A state of balance and harmony is formed between space and people	0.06
10	Space: Harmonious coexistence	fusion of space and seat F (0.0593)	Symbiosis f1 (1)	Space and people are interdependent	0.06

Table 2. Saaty's 9-point scale

scale	implication
1	Both elements g are equally important than i
3	Compared to the two factors, factor g is slightly more important than factor i
5	Comparing the two factors, factor g is significantly more important than factor i
7	Comparing the two factors, factor g is more important than factor i
9	Comparing the two factors, factor g is more important than factor i
2、4、6、8	The middle of the above two adjacent scales
Count backwards	Judgment of comparison between element g and i fg,
	Then the judgment of the comparison between the elements i and g fgi=1/fy

Table 3. Judgment matrix and results of the primary index

firstId	A	B	C	D	E	F	weight	Consistency check
A	1	3	2	5	6	6	0.3086	CR=0.003<0.1
B	1/3	1	1/2	1/3	4	4	0.2063	
C	1/2	2	1	3	5	5	0.2442	
D	1/5	1/4	1/3	1	2	2	0.1223	
E	1/6	1/4	1/5	1/2	1	1	0.0593	
F	1/6	1/4	1/5	1/2	1	1	0.0593	

Table 4. Judgment matrix and results of the secondary index a

firstId	a1	a2	weight	Consistency check
a1	1	4	0.21	CR=0.007<0.1
a2	1/4	1	0.10	

Table 5. Judgment matrix and results of the secondary index b

firstId	b1	b2	weight	Consistency check
b1	1	1/4	0.07	CR=0.008<0.1
b2	1/4	1	0.14	

Table 6. Judgment matrix and results of the secondary index c				
firstId	c1	c2	weight	Consistency check
c1	1	1/2	0.13	CR=0.003<0.1
c2	2	1	0.11	

Table 7. Judgment matrix and results of the secondary index d				
firstId	d1	d2	weight	Consistency check
d1	1	3	0.05	CR=0.006<0.1
d2	1/3	1	0.07	

Table 8. Judgment matrix and results of the secondary index e and f							
firstId	e1	weight	Consistency check	firstId	f1	weight	Consistency check
e1	1	0.06	null	f1	1	0.06	null

4.3. Seating scheme design and evaluation

4.3.1 Seating scheme design

Rural elderly outdoor seating mainly reflects the fusion between User-seat-space, therefore, will not be affixed with the label of “chair for the elderly”, but will reflect the appearance of young and fashionable. However, considering that the elderly need certain support after sitting for a long time, a backrest with armrest shape is specially designed. The design of the sitting surface mainly uses the shape of circular sitting, creating a relaxed and pleasant rest atmosphere that can talk to each other. The sitting surface uses environmentally friendly recycled new concrete materials, which are durable, retain the texture of the material, and integrate close to nature and rural natural scenery. The seat leg armrests are made of dark stainless steel support material to isolate the ground moisture and keep the seat dry and comfortable ( Figure 2).

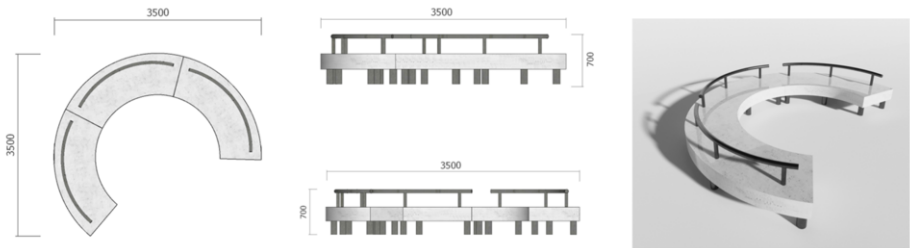


Figure 2. Preliminary design of rural outdoor seating fusion

4.3.2 Fuzzy comprehensive evaluation of design scheme

In order to verify the matching degree of the design scheme between the rural residents and the evaluation index, an evaluation team consisting of 10 members who participated in the formulation of the design index was invited again to evaluate the design scheme. Each index of the design scheme is scored by four grades: excellent, good, medium and poor. The membership degree was calculated based on the weight of the corresponding index by counting the number of evaluation times corresponding to the 4 levels of each index and its proportion in the total number of evaluations. The results are shown in Table 9.

10 members rated 6 primary and 10 secondary indicators of the design scheme. Among them: the molecules in each score represent the number of people who evaluate each index of the design scheme as each level; The denominator is the total number of

people participating in the evaluation (10).Through the comprehensive weight calculation, the four first-level indexes of the design scheme and the membership degree of the whole population in the four levels can be obtained. By assigning 10, 8, 6 and 4 points respectively to the four grades of excellent, good, medium and poor, the overall score of the design scheme can be calculated as  $S=9.18$ .Similarly, the scores of the four first-level indicators can be calculated and converted into a 10-point scale with 2 decimal places, so as to obtain  $SA=9.07$ ,  $SB=8.52$ ,  $SC=8.35$ ,  $SD=9.51$ , $SE=9.43$ ,  $SF=9.24$ .

**Table 9.** Detailed evaluation on design scheme

Evaluation index	Index weight	Membership degree of each design index to each level			
		excellent	good	medium	poor
a1	0.21	4/10	5/10	1/10	0
a2	0.10	7/10	3/10	0	0
firstId A	0.3086	0.1697	0.1235	0.0154	0
b1	0.07	9/10	1/10	0	0
b2	0.14	4/10	2/10	3/10	1/10
firstId B	0.2063	0.1341	0.0309	0.0309	0.0104
c1	0.13	7/10	2/10	1/10	0
c2	0.11	3/10	3/10	3/10	1/10
firstId C	0.2442	0.1221	0.0611	0.0488	0.0122
d1	0.21	6/10	3/10	1/10	0
d2	0.10	6/10	4/10	0	0
firstId D	0.1223	0.0734	0.0428	0.0061	0
e1	0.06	5/10	4/10	1/10	0
firstId E	0.0593	0.0297	0.0237	0.0059	0
f1	0.06	5/10	4/10	1/10	0
firstId F	0.0593	0.0297	0.0237	0.0059	0

4.3.3 Design scheme improvement

According to the evaluation results, the score of the design scheme in index B and index C is lower than the overall score of the scheme, and index A basically reaches the overall score. Therefore, the design scheme can be optimized based on the 3 firstId of “fusion of user and space”, “fusion of seat and user” and “fusion of user and seat” and the design indicators included. The evaluation results show that the main problems of the design scheme are the design scheme only focuses on creating a “social” environment, but ignores “rest”, and the compatibility between rest and social interaction is not strong. At present, the function of the program lacks diversity, and only stays on the basic function of the seat, and new functions can be developed. In addition, although the scheme is suitable for most people to use but not comfortable enough, it can also be designed from the perspective of ergonomics.

Designers focus on improving design solutions around issues.

- Designers focus on the problem to improve the design scheme. The design has changed from a ring to a rectangular single module design, which can be used in combination with a single module or a group of repeating seat modules. The flexible use of different site Spaces can meet the rest function of rural residents, facilitate the movement and assembly of seats, and realize the creation of social scenes.
- Designed as a simple and intelligent modular system, it consists of one or more seat modules made of recycled concrete material. Can also add green plant module, charging module, etc. (Figure 3)



- The design of the sitting surface mainly adopts organic streamline shape, ergonomic sitting position, and depth, forming smooth and convex curves. The legs of the seat use dark stainless steel support material to isolate the ground moisture and keep the seat dry and comfortable.

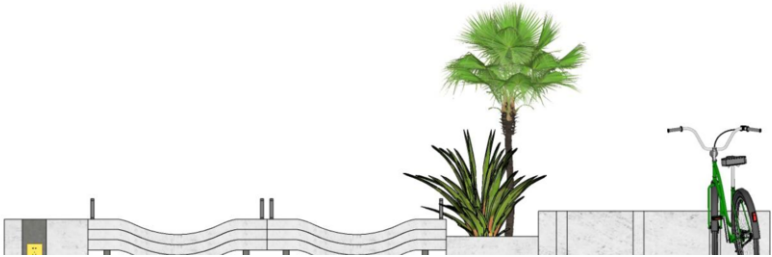


Figure 3. Combination of Seat Module, Green Plant Module, and Charging Module

4.3.4 Determination of design scheme

After improvement, the design scheme has been thoroughly designed (Figure 4).Based on the design intent diagram , 10 judges were invited to review the design proposal, and the results showed that S’A=9.63, S’B=9.46, S’C=9.67, S’D=9.51, S’E=9.36, S’F=9.48.It can be seen that the overall improvement of the design scheme has been achieved through improvements in three aspects: “fusion of user and space”, “fusion of seat and user” and “fusion of user and seat” .The design scheme fully expresses the fusion of multiple dimensions of rural elderly friendly outdoor seat design, fully reflects respect for the elderly, improves the quality of life of rural residents, and realizes the harmonious coexistence of human-object-space in the integrated design concept.

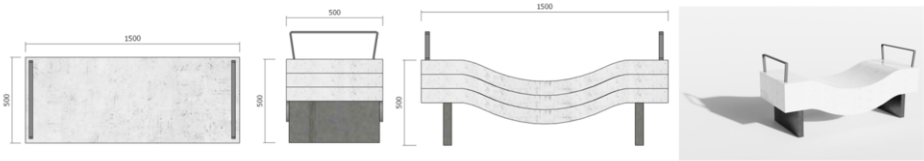


Figure4. Improved Rural Elderly Adaptability Outdoor Seating Fusion Design Scheme

5. Peroration

Introducing the concept of fusion design into the design and research of aging friendly outdoor seats is a more systematic solution to the aging needs of rural public spaces. This helps to build an outdoor environment where “human-object-space” coexist harmoniously. A design index system that “fusion of user and seat” “fusion of seat and user”, “fusion of user and space” “fusion of seat and space”, “ fusion of space and user “ fusion of space and seat”. It has also provided sufficient guidance for specific outdoor seat design, achieving a complete closed-loop from theoretical research to design innovation.

The design case is based on the fusion of “human-object-space “in rural public space environment. However, there is a lack of more comprehensive thinking on the

production and processing costs that may be involved in the later stages of the product, as well as the new problems that may be faced in the actual use process. A complete design practice approach should include a broader exploration of the product lifecycle. For example, in the process of product design iteration and update, factors such as engineering and cost are included in the design standards to guide the design scheme. Future research can further improve the design scheme of aging outdoor seats and conduct practical applications and evaluations to make it more feasible.

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## References

- [1] LU J. Barrier-free Fusion Design and Application. Liaoning People's Publishing House, 2021
- [2] Wang Jiangping. Planning and Design of living environment for the elderly. China Electric Power Press, 2009.
- [3] Architectural Society of Japan, Ed. New concise barrier-free architectural design data fusion. China Building Industry Press.2005
- [4] Yu Yuning. Psychology and Behavior of the Elderly. Beijing Normal University Press,2015.
- [5] Liu Shaoshuai. Research on rural aging space based on Maslow's Demand Theory. Shanxi Architecture, 2017
- [6] Takahashi Yingzhi Group. Environmental Behavior and Space Design. China Building and Architecture Press, 2006
- [7] Song Chenxu. Study on the suitability of outdoor public space in rural areas of Handan. Hebei University of Engineering, 2020.
- [8] Wang Jiangping. Planning and design of living environment for the elderly. Beijing: China Architecture and Building Press, 2009.
- [9] Chen Chongxian, A meta-analysis of studies on the effects of natural landscape on physical and mental health of elderly people. *Journal of Landscape Architecture* **27** (2019), 11, 90-95.
- [10] Yan Lin, Study on physical characteristics of 60 ~ 69 years old people in the context.of aging: A case study of Anhui Province. *Journal of Shijiazhuang University* **21** (2019), 3, 117-123.
- [11] Chang Xiaofei, Lai Feng. Research progress on outdoor environment of elderly residential areas in China. *Chinese Garden*