Environmental And Behavioral Indicators Applied in Senior Living Design.

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ABSTRACT

Currently, Indonesia is experiencing the phenomenon of an *Aging Population*, along with the increasing elderly population. Then facilities are needed for the elderly in the form of nursing homes. However, existing nursing homes have limited facilities and activities for the elderly. One of the strategies for fulfillment above is the *Senior Living facility, as* a residence that focuses on the elderly community who are productive and active in social and economic aspects, as well as living prosperously and happily. To increase the productivity of the elderly, senior living design strategies can use environmental and behavioral architecture approaches. This study aims to determine the indicators of senior living design with an environmental, architectural, and behavioral approach. This research method uses descriptive qualitative with stages: (1) Observation of behavior and facilities in three Senior Living case studies. (2) Identify indicators of environmental architecture design and behavior in three *Senior Living case studies*. (3) Senior Living design recommendations with an environmental and behavioral architecture approach. The results showed the form of application related to the criteria that need to be considered in designing *Senior Living.*

Keywords: *Senior Living; Environmental Architecture and Behavior; Design*

1. Introduction

Indonesia is a country with a very large population. The population in Indonesia consists of various ages, ranging from the young, adults, to the special ones, namely the elderly (elderly). In almost five decades (1971-2020), the percentage of the elderly in Indonesia has doubled, to 9.92 percent or around 26.82 million people [1]. This phenomenon is referred to as *Aging Population*.

To solve this problem, the Assistant Deputy for Disability and Elderly Empowerment of the Coordinating Ministry of PMK, Togap Simangunsong stated that the government has provided elderly-friendly housing for services and care for the elderly [2]. However, most housing for the elderly in Indonesia is a nursing home, but nursing homes themselves mostly have restrictions and do not provide many facilities for the elderly. Thus, the context of housing development for the elderly is relatively low in supporting the success of the welfare of the elderly. According to Limbang, this causes the elderly to feel less accepted and cared for by society. If this continues, it can cause the elderly to experience a decrease in interest in socializing [3].

The need for *Senior Living* as a fulfillment of certain housing facilities is a new attraction for the elderly who pay attention to the elderly-friendly environment for comfort, safety, and supporting elderly activities. Jakarta itself does not yet have *Senior Living* as a special residence for the elderly that has public facilities for the elderly and provides freedom to meet the same needs of the elderly as at home.

In means *Senior Living* The complete one will present the concept *Continuing Care Retirement Community (CCRC)* Where every phase of a senior citizen's life can be served in one residential area and services that can meet the needs of the elderly for social interaction, sports, and other aspects [4]. In addition, the elderly can also still develop their talents to work productively, thus making the performance of the elderly

brain remain active and avoid excessive stress.

This study seeks to pay more attention to targeting a *Senior Living* residential design development specifically for active elderly residents of the upper middle and urban areas. *Senior Living* also serves as a forum to increase the productivity of the elderly and interactions between the elderly and the generation below, as well as build the confidence of the elderly making the elderly more empowered both psychologically and socially. This function is considered appropriate to be the focus of design to overcome this problem, with the scope of research focusing on the typology of *Senior Living* with an environmental architecture and behavioral approach that is appropriate to the context in Indonesia.

As for research questions that can be used as research material: How are environmental and behavioral indicators applied in *Senior Living design*? This study has the aim to explore and understand the application of design in environmental and behavioral architectural indicators in Senior Living.

2. Material and Methods

2.1. Senior living

By *Floor Plan for Real Estate FPRE*, *Senior Living* is a residence focused on the elderly community who live in apartments and private houses. This elderly community will share indoor and outdoor activity spaces [5].

Based on Rukun Senior Living, *Senior Living* is a commercial residential facility that presents residential options in the form of apartments or individual houses (*landed houses*) specially designed for the elderly. Residential units in *Senior Living* Usually can be bought or rented [6].

Based on the two understandings above, it can be concluded that *Senior Living* is a residence for the elderly in the form of apartments and residential houses that can be traded or rented, there are also facilities to carry out activities both indoors and outdoors.

2.2. Main principles of elderly housing

According to *Elderly-Friendly Design Guidelines* (2018), four main principles must be considered in designing for the elderly. This principle needs to be applied to the design of buildings and environments to respond to the elderly carrying out daily activities. The four main principles are [8]:

1. Safety
Safety is an important aspect of building design especially for older people who are more prone to falls and pay less attention to potential hazards in the built environment. Need to create an environment that facilitates mobility and safe activities.

2. Support
Creating a more suitable built environment to support the various variables of the functional needs of the elderly by further fostering self-confidence and independence in daily life activities.

3. Cognition
As we age, it takes longer to process information and recall memories. Most seniors with cognitive decline often have difficulty finding direction in a building, especially in large buildings with complex layouts. To minimize confusion and anxiety in the elderly, the built environment should support cognitive abilities and reduce anxiety.

4. Wellbeing
Well-being can be defined as a sense of contentment. It is increasingly realizing that the built environment can influence an individual's emotional and social behavior. Creating a fun and eco-friendly senior-friendly environment will empower parents to dare to go out and choose ways to stay physically and socially active in the community, thus increasing the sense of satisfaction in the elderly.

2.3. Environmental architecture and behavior

Environmental architecture and behavior is a design approach that emphasizes the need to consider the quality of the environment lived by users and its effect on users of that environment.

According to Amos Rapoport [9], the study of environmental architecture and behavior is concerned with how the built environment affects human behavior in it and the physical elements that cause

humans to behave differently in a setting (space). Thus, the arrangement of space and building shape must consider the needs and characteristics of the elderly. [10]

1. Basic Environmental and Behavioral Architecture Design
According to Rapoport (1977), There are basic environmental architecture designs and behaviors that affect human behavior, namely [9]:

a. Space Organizing
The arrangement of space for various needs is associated with rules that reflect the needs, values, and desires of a community group, aimed at obtaining good environmental quality, where the interaction process between space and users can be carried out optimally.

b. Time
The aspect of organizing the tempo or time of space is very important because it will involve aspects of optimizing the use of space and related to the possibility of crowding.

c. Meaning
This meaning is usually manifested in the form of colors, details, signs, decorations, and shapes, which can also be called iconic aspects.

d. Communication
Space that is intended as a medium of communication between residents of the space, or between residents and other people.

2. Architectural Factors Affecting Environment and Behavior
Several Factors affect the environment and human behavior, namely [10]:

a. Room
Space design can influence human behavior based on the function, activity, and use of space.

b. Size and Shape
The size and shape of the space can affect the psychological wearer. So, it needs to be adjusted to the functions and activities to be carried out.

c. Furniture and Arrangement
The form of furniture arrangement needs to be adjusted to the nature of the activities carried out. The symmetrical arrangement gives a rigid and official impression. Meanwhile, the asymmetrical arrangement gives a dynamic and less official impression.

d. Color
Color plays a role in giving the atmosphere of the space, influencing the quality of the space and encouraging certain behaviors.

e. Sound, Temperature and Lighting
Sound, temperature, and lighting affect psychologically so it needs to be regulated so as not to adversely affect the user.

3. Concepts in Environmental and Behavioral Architecture Studies
According to Haryadi (2020), there are several important concepts in the study of behavioral and environmental architecture, namely [10]:

a. Behavior Setting
Behavior Setting is the process of identifying behavior that contains elements of a group of people who carry out an activity, activity or behavior that appears constantly or periodically in a certain place or setting. Behavior settings are divided into two, namely:
- *System of setting*, namely the spatial system as a series of physical or spatial elements that have a certain relationship and are related so that they can be used for a certain activity
- *System of activity*, which is a series of behaviors deliberately carried out by one or several people.

b. Environment Perception
Perception of the environment is the process of interpretation of a setting by an individual based on the individual's cultural background, reason, and experience.

c. Perceived Environment
The perceived environment is the result of environmental perception in the form of human cognition, affection, and cognation processes with their environment. The process of cognition includes the process of acceptance, understanding, and thinking about an environment. The process of affection includes the process of feelings and emotions, desires, and values about the environment. The process of cognation includes the emergence of actions, and treatment of the environment.

d. Environment Cognition, Image, and Schemata

Environmental cognition is a process of understanding and giving meaning to the environment and deciphering the mechanism of the relationship between humans and their environment. Imagery relates to symbolic or prominent things in buildings. Schematics are often defined as *coding* processes that allow individuals to absorb, understand, and interpret the environment at hand.

e. Environmental Learning
Environmental understanding is the whole process of thorough and continuous understanding of the formation of cognition, schemata, and mental maps in humans towards their environment.

f. Environmental Quality
Environmental quality is a good environmental condition by the ideal view of humans, related to security, psychological, and socio-cultural aspects of society.

g. Territory
Territory is a human being determining the demands and limits of an area to achieve physical, emotional, and cultural needs. Regarding emotional needs, the concept of territory relates to private and public space. About cultural aspects, the concept of territory relates to scalar and profane spaces.

According to Altman (1980), territories are divided into three categories, namely [11]:
• Primary Territory, which is an area that is owned and used exclusively, is aware of others, is permanently controlled, and becomes a major part of daily life.
• Secondary territory, which is an area that is not used exclusively, has a relatively large coverage area, controlled periodically.
• Public Territory, which is an area that can be used by anyone, but must comply with the norms and rules that apply in the area.

h. Personal Space and Crowding
Personal space can be an imaginary boundary to one's solitude, which others do not want to enter. If this personal space does not materialize, it will cause chaos. This personal space is related to individual distance, psychological aspects, culture, and physical density.

According to Loo (1997), the determinants of clutter can be divided into three, namely [12]:
• Environmental *factors*, divided into physical and social factors. Physical factors concern the dimensions of the place, density, and atmosphere of a room or place (color, arrangement of furniture, etc.). Social factors concern the characteristics of relationships between individuals, and the duration and intensity of contact.
• Situational factors, namely situations where relationships between different people in the place are intimate, know each other, and the length of the relationship.
• Intrapersonal factors, including characteristics of a person, among others: age, *sex,* education, experience, and attitude.

i. Environmental Pressures, Stress and Coping Strategy
Environmental pressures are physical, social, and economic factors that cause feelings of discomfort. If this continues, it can cause excessive stress. Large environmental pressures can cause interactions between humans and the environment to run poorly and less optimally and cause unnatural behavior.
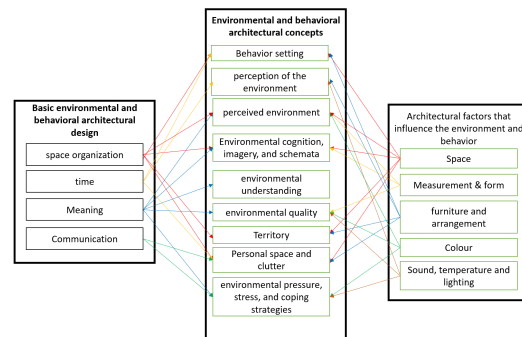

Figure 1. Basic Relationships of Design, Environmental and Behavioral Architectural Factors and Concepts
Source: (Author, 2023)

2.4. Methods

In the preparation of this study, the research method used is a descriptive qualitative method. The following is a scheme of the stages of research carried out:
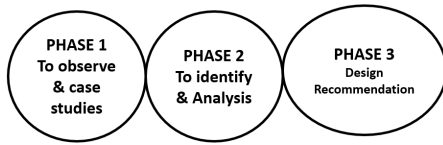
Figure 2. Stages in the Application of
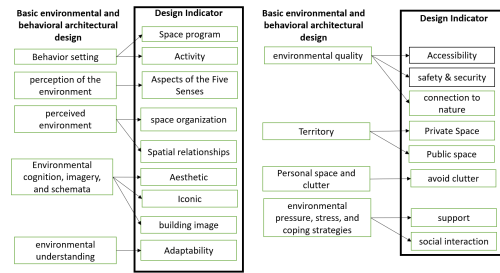Methodology
Source: (Author, 2023)

Figure 3. Design Indicator Scheme
Source: (Author, 2023)

Below are

- Phase 1 (Observation and Case Study)
  Observing Senior Living which is the object of the case study, namely Rukun Senior Living. Determine case studies in appropriate senior living typologies, namely Park Well State Hamadayama and De Hogewey Dementia Village. This stage is carried out to see the activities and facilities for the elderly at the Senior Living.
- Phase 2 (Identification and Analysis)
  Identify and analyze based on design criteria indicators in three *Senior Living* case studies. The design criteria indicators result from a blend of *Senior Living theory and* environmental architecture and behavior.
- Phase 3 (Design Recommendations)
  Produce recommendations for Senior Living design criteria based on identification and analysis performed. Thus, it can be applied to the design of *Senior Living*.

3. Results and Discussions

Based on the explanation in the Concept of Environmental and Behavioral Architecture in the theoretical study section, produce keywords as design indicators that are used as a benchmark in identifying and analyzing objects of observation and case studies. The resulting analysis knife diagram is as follows:

A. Case Study Profile

1. Rukun *Senior Living* - Bogor

Figure 4. Rukun Senior Living
(Source: Rukun Senior Living, 2023)

- Architect   : PT. Darmaland Selindo Abadi
- Location   : Sentul, Bogor
- Project Year   : 2012

Rukun Senior Living is an elderly-friendly area offering a variety of facilities in one integrated senior residential area, with continuous services (Continuing Care Retirement Community). Thus, residents and their families can always adjust the services received based on changes in residents' lifestyles. Various housing and service options are available to suit the needs of seniors. From the choice to stay at home alone / family and only participate in activities at the Senior Club (Club elderly), or the choice to stay in the RUKUN Senior Living area by buying a villa or renting an apartment or room short to long-term [13].

2. Park Well State Hamadayama - Japan

Figure 5. Park Well State Hamadayama
(Source: World Architecture Festival)

- Architect : Nikken Housing System Ltd
- Location : Tokyo, Japan
- Project Year : 2019
- Luas Area : 5,328 m2

Park Well State Hamadayama is a serviced apartment building for the elderly located close to central Tokyo in a residential area. This building carries the concept of "Mountain Residence in The City", to realize the Japanese architectural ideology that a building and a garden must be integrated together to create a beautiful harmony between the two. This building has 70 residential units, namely 62 general units and 8 maintenance units [14].

B. Case Study Identification and Analysis

3. De Hogewey Dementia Village - Netherlands
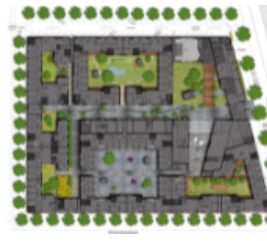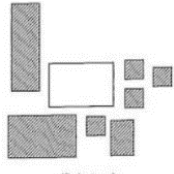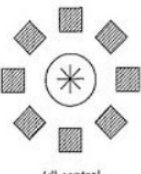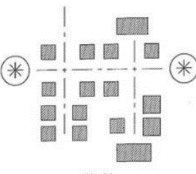
Figure 6. De Hogeway Dementia Village
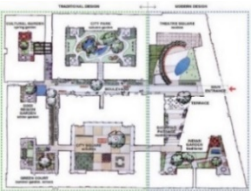(Source: Living for the Elderly, 2nd Edition)
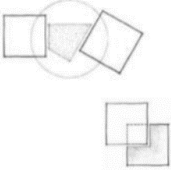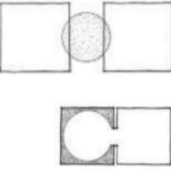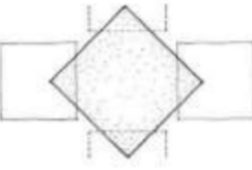
- Architect : Molenaar & Bol & VanDillen architecten
- Location : Weesp, Netherlands
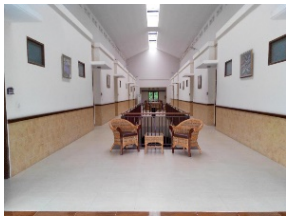- Project Year : 2009
- Luas Area : 15.000 m2
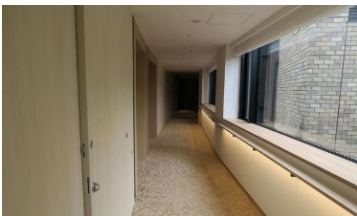
De Hogeweyk is designed as an ordinary residential area, so that residents feel normal life, daily life [15]. They go shopping in supermarkets, gather with family and friends in cafes and restaurants, and they participate in clubs. De Hogeweyk provides care to patients with severe dementia [16].

Table 1. Identify Design Criteria Indicators in Case Studies

Indicators	Rukun Senior Living	Park Well State Hamadayama	De Hogewey Dementia Village
Masterplan			
Space Organization	Clustered space organization oriented towards Senior Club House	Organization-oriented space centered on the atrium	Organization of mass space with axis surrounded by gardens

Indicators	Rukun Senior Living	Park Well State Hamadayama	De Hogewey Dementia Village
Spatial Relationships	 Relations between masses are separated by outdoor facilities	 There is a space in the middle of the masses that can be used as a third space to interact	 The spatial relationship between the masses of low-rise apartment buildings is connected by a garden
Space Program	Restaurant, Café, Game Room, Activity Room, Art Room, *Gym*, Swimming Pool, Fishing Lake, Garden, *Gazebo,* Jogging Track, *Occupant Unit, Staff Room*	Nursing clinics, restaurants, public baths, gardens, auditoriums, beauty studios, learning courses, mahjong rooms, billiard rooms, fitness centers, resident units, staff rooms.	Maintenance clinics, restaurants, commercial areas, hobby rooms, parks, theaters, offices, cafes, beauty salons, function areas, post offices, resident units, and staff rooms.
Activity	 Doing hobbies, studying, gymnastics, cooking, grooming, seminars, fishing, swimming, sports.	 Doing hobbies, studying, grooming, seminars, exercising.	 Doing hobbies, studying, grooming, seminars, working, shopping, exhibitions.
Aspects of the Five Senses	 There are swimming pool and lake areas close to each other. There is a garden and a wide walkway connected to the housing.	 In the outdoor area, there is a garden that has fountains, ponds, various plants, and rocks with the concept of zen garden. Serves as a functioning area for walking, relaxing, and recreation	 In the outdoor area, there are different theme parks, adapted to the atmosphere and plants that are typical of the theme. The park features a pond and greenery, as walking, relaxing, and recreational areas
Aesthetic	 Using natural and natural colors in indoor and outdoor areas.	 Using natural and natural colors on the exterior and interior, giving the impression of being close to nature	 Using natural and natural colors on the exterior. Using contrasting colors in interior furniture

Indicators	Rukun Senior Living	Park Well State Hamadayama	De Hogewey Dementia Village
Iconic	Close to the lake, there is a gazebo.	Zen garden concept	There are different theme parks.
Building Imagery	Solidarity	Relaxing	Diversity
Adaptability	Provide various facilities so that the elderly do not feel bored and stressed.	Lodging units and furnishings in the unit are designed to resemble the atmosphere of a home	Use a key plan. Using parks and different paved areas as zoning markers, to make it easier for the elderly to reach the intended place
Accessibility	Located in a residential area so it is easily accessible by families	Strategic location and easy to reach, because it is in the center of Tokyo, close to housing, and other supporting facilities.	It is in a residential area, so it is easily accessible by families
Safety and Security	The use of railings in some areas is designed as an aesthetic element. Using anti-slip flooring material	The use of railings in some areas. Using anti-slip flooring material	Using anti-slip flooring material

Indicators	Rukun Senior Living	Park Well State Hamadayama	De Hogewey Dementia Village
Connection to Nature	 Outdoor views can be seen from the residents' rooms	 Outdoor views can be seen from the occupants' rooms, as well as from several facilities areas	 Outdoor views can be seen from the residents' rooms
Private Room	 Room units are divided into several types, namely Ideal Suite, Deluxe Suite, Supreme Suite A, and Supreme Suite D.	 Room units for 1-2 elderly residents so that they get *personal space*, and are arranged to be able to receive guests and visits from family. Room units are designed to get a view of the garden	 Six residents in each unit with the same lifestyle, so residents do not get personal *space*. Room units are designed to get a view of the garden
Public Space	 Restaurant, Café, Game Room, Activity Room, Art Room, Gym, Swimming Pool, Fishing Lake, Garden, Gazebo	 Treatment clinics, restaurants, public baths, gardens, auditoriums, beauty studios, learning courses, mahjong rooms, billiard rooms and fitness centers	 Treatment clinics, restaurants, commercial areas, hobby rooms, parks, theaters, offices, cafes, beauty salons, function areas
Clutter	 Provide parks, social spaces, and spacious hobby spaces with specific quotas and hours	 Provide a garden and spacious social space	 To avoid chaos, the garden area as a socialization area is divided into several areas
Backing	There is a separate staff room provided	There is a staff room located close to 8 treatment units	Each unit (6 rooms) has 1 staff room

Indicators	Rukun Senior Living	Park Well State Hamadayama	De Hogewey Dementia Village
Social Interaction	Socialize between the elderly and between generations. Inter-generational interaction through seminars and *family gatherings*	Socialize between the elderly and between generations. Inter-generational interaction through outdoor parks, seminars, and restaurant courses.	Socialize between the elderly and between generations. Inter-generational interaction with the garden

C. Design recommendations based on analysis

The design applied to the case study has similarities and differences in meeting the indicators of design criteria. These similarities and differences are summed up in Senior Living's design recommendations.

Table 2. Design Recommendations

Design Indicators	Recommendations
Space Program	The space program offered must be adjusted to the habits and behaviors of the target elderly so that there is no optimal space program to improve the welfare of the elderly
Activity	The activities offered must be adjusted to the behavior of the elderly and the appropriate duration of time so that activities do not burden the elderly.
Aspects of the Five Senses	In the outdoor area, it is necessary to stimulate the five sensory aspects of the elderly. This is to exercise the cognition of the elderly. This aspect can be the sound of water from the pool, visual and fragrant from greenery, texture on the material, etc. It is also possible to apply to indoor areas.
Space Organization	The organization of the space to be used is better easy and not complex, so as not to confuse the elderly.
Spatial Relationships	Spatial relations between masses or between unit spaces, are needed for relaxation, rest, and socializing.
Aesthetic	The use of natural colors can increase the feeling of being close to nature so as to increase calmness, and the use of contrasting colors can be used as a distinguishing element to avoid confusion.
Iconic	In the building, it has iconic things as an attraction and differentiator from *other Senior*

Design Indicators	Recommendations
	Living. Provide added value so that the elderly are interested in living.
Building Imagery	Have a positive building image for the elderly, which can be seen from the façade and mass shape of the building
Adaptability	Use directions to help seniors reach their destination. A spatial arrangement that is not confusing. Make the atmosphere of the living unit like a comfortable home atmosphere. Providing various facilities so that the elderly do not feel bored and stressed.
Accessibility	The location of Senior Living must be near housing, so that elderly families who want to visit do not experience difficulties. The location of Senior Living is in a strategic place, surrounded by supporting facilities such as hospitals, recreation areas, malls, etc.
Safety and Security	Ensure the safety and security of the elderly by adding a handrail as an aid for the elderly to support their bodies. Using anti-slip material to avoid the risk of falling.
Connection to Nature	We recommend that each unit has a visual view of nature, so as to increase calmness. Facilities that visually face nature also improve the well-being of residents.
Private Room	Has several types of units, so the elderly can choose the space that suits their needs. Units with different furniture, colors, and sizes.
Public Space	Having public spaces that are easily accessible to residents based on the habits and culture of residents.
Clutter	Creating separate outdoor spaces, spacious facility spaces, hobby rooms with quota and schedule provisions.
Backing	Provide staff space close to the occupant unit, so that it can directly help the elderly carry out activities if needed.
Social Interaction	Provide space activities and programs that generate social interaction between the

Design Indicators	Recommendations
	elderly and between generations. Examples such as Seminars to increase knowledge to the lower generation, family gatherings, joint hobby activities.

Source: (Author, 2023)

In designing *Senior Living* which is proven to be able to increase the productivity of the elderly. 17 indicators of design criteria must be considered related to the concept of architecture, environment, and behavior that can be applied to *Senior Living buildings.*

Based on the identification and analysis of the case study will form the application related to the indicators of design criteria with an environmental, architectural, and behavioral approach. Thus, producing design recommendations that can be a benchmark to be applied to the design of Senior living.

5. Conclusion

The research results show that environmental architectural and behavioral indicators have been applied to three senior living case studies. The application of design in the three case studies has several similarities and differences. Similarities can be identified in the design criteria indicators: the five senses in the form of green open space and water elements to provide stimulants to the visual, olfactory, tactile, hearing and taste senses. Apart from that, the design indicator is connectedness to nature, namely the design of a space with a wide open view. As well as the design criteria indicators in the form of social interaction, where there is large space available inside and outside. Meanwhile, differences in application can be seen in the indicators of design criteria for space programs, activities, space organization, etc.
Some recommendations related to design indicators in the environmental architecture approach and Senior Living behavior are the provision of railings in several areas, for the safety and comfort of the elderly in supporting their bodies during activities. Another design indicator is interaction with nature both visually and physically. This can improve the psychological condition of the elderly, making them calmer and more productive.

Based on the research above, further research is expected to be expanded to other elderly housing sectors, so that it can help increase the productivity of the elderly in Indonesia. Further research can also be supported by elderly interviews regarding elderly satisfaction factors with housing.

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