



Adaptation Values of Elderly Housing within the Universal Design Framework

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| Received February 25th 2026 | Accepted May 12th 2026 | Published September 30th 2026 |

| DOI <https://doi.org/10.32315/jlbi.v15i3.688> |

Abstract

This study aims to identify the adaptive values of elderly housing based on physical and socio-spiritual competencies and to map these values against the seven principles of Universal Design (UD). The research employs a qualitative case study approach involving eight elderly housing units in the Banyumanik Housing Estate, Semarang. Data were collected through spatial observation, floor plan documentation, and in-depth interviews, and were analyzed using an interpretative approach based on Rapoport's framework of meaning in the built environment. The results indicate that housing adaptation not only embodies physical values such as order, compactness, orientation, and multifunctionality that align with Universal Design principles, but also encompasses non-physical values, including privacy, tranquility, security, closeness, freedom, and connectedness, which are influenced by the socio-spiritual activities of the elderly. The mapping results show that physical values primarily align with the principles of Perceptible Information and Low Physical Effort, particularly by strengthening sensory dimensions (visual and auditory) in the relationship between indoor and outdoor spaces. These findings emphasize that the implementation of Universal Design in elderly housing should be understood contextually by considering the continuity of the elderly's socio-spiritual roles in the aging-in-place process.

Keywords: elderly competency, home adaptation, elderly-friendly housing design, Universal Design, socio-spiritual dimension

Nilai Adaptasi Perumahan Lansia dalam Kerangka Desain Universal

Abstrak

Penelitian ini bertujuan untuk mengidentifikasi nilai-nilai adaptif perumahan lansia berdasarkan kompetensi fisik dan sosio-spiritual, serta memetakan nilai-nilai tersebut dengan tujuh prinsip Desain Universal (UD). Penelitian ini menggunakan pendekatan studi kasus kualitatif yang melibatkan delapan unit perumahan lansia di Perumahan Banyumanik, Semarang. Data dikumpulkan melalui observasi spasial, dokumentasi denah lantai, dan wawancara mendalam, serta dianalisis menggunakan pendekatan interpretatif berdasarkan framework makna Rapoport dalam lingkungan binaan. Hasil penelitian menunjukkan bahwa adaptasi perumahan tidak hanya mewujudkan nilai-nilai fisik seperti keteraturan, kekompakan, orientasi, dan multifungsi yang selaras dengan prinsip-prinsip Desain Universal, tetapi juga mencakup nilai-nilai non-fisik, termasuk privasi, ketenangan, keamanan, kedekatan, kebebasan, dan keterhubungan, yang dipengaruhi oleh aktivitas sosial-spiritual para lansia. Hasil pemetaan menunjukkan bahwa nilai-nilai fisik terutama selaras dengan prinsip Informasi yang Dapat Dirasakan dan Upaya Fisik yang Rendah, terutama dengan memperkuat dimensi sensorik (visual dan auditori) dalam hubungan antara ruang dalam dan luar. Temuan ini menekankan bahwa penerapan Desain Universal dalam perumahan lansia harus dipahami secara kontekstual dengan mempertimbangkan kelanjutan peran sosio-spiritual lansia dalam proses penuaan di tempat tinggal.

Kata-kunci: kompetensi lansia, penyesuaian rumah, desain rumah ramah lansia, Desain Universal, dimensi sosial-spiritual

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Introduction

In the 21st century, the increase in life expectancy among the elderly has contributed to the growing elderly population in both developed and developing countries, including Indonesia [1], [2]. The increase in life expectancy has led to a rising number of older adults who require special attention in various aspects of life, including housing. Older adults tend to prefer spending their time in their own homes due to comfort, emotional attachment, and independence [3], [4]. This preference necessitates a balance between the declining personal capacities of older adults and the conditions of their residential environment. When the competence of older adults declines while environmental demands remain constant or even increase, a mismatch may occur, potentially hindering daily activities, threatening safety, and increasing dependence on others.

Developed countries have housing policies that can accommodate the needs of older adults, supported by comprehensive facilities and services. These countries also implement policies that support older adults who prefer to remain in their own homes or age at home, encompassing micro-scale (housing), meso-scale (the surrounding residential environment), and macro-scale environments [5]-[7]. One such policy involves housing adaptation programs funded by grants from institutions concerned with elderly welfare. These adaptations are based on the physical competencies of older adults and are implemented using a Universal Design approach [8]. This approach facilitates easier access to spaces and environments for older adults. In Indonesia, the Universal Design policy is accommodated through the Decree of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 14/PRT/M/2017. However, this regulation does not directly address aging in place, as it primarily focuses on buildings that provide easier access for persons with disabilities. Therefore, it is important to conduct studies on aging at home and its relationship to spatial suitability for older adults, whose findings may inform the development of policies for elderly-friendly housing.

Lawton's ecological model theory serves as the primary foundation for understanding the relationship between older adults and their environment. The Person-Environment Fit (PE-Fit) theory explains that the behavior and well-being of older adults are functions of the interaction between individual competence and environmental press. Elderly

competence encompasses an individual's intrinsic capacities related to socio-cultural background, somatic and physical health, cognitive abilities, and physical functioning [9]. According to this theory, individuals with high competence can cope with high environmental pressures. Conversely, as competence declines with aging, the same environmental pressures may become excessively burdensome. Under such conditions, the environment must be adapted so that the resulting pressures correspond to the remaining capacities of older adults. The compatibility between competence and environment will subsequently produce adaptive behavior, life satisfaction, and psychological well-being.

Housing adaptation has become a key strategy for achieving such compatibility. Housing adaptation refers to efforts to positively modify the physical home environment in order to enhance the independence, health, and well-being of older adults [10], [11]. In practice, housing adaptation for older adults generally adopts the Universal Design (UD) approach. Developed by The Center for Universal Design (1997), this approach aims to accommodate the needs of diverse human conditions without requiring specialized adjustments. The seven principles of UD—equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and appropriate size and space for approach and use—are grounded in users' physical and cognitive competencies.

Universal Design is the primary approach in housing adaptation for older adults. This approach can support successful aging, which includes a lower probability of disease and disability, higher levels of physical and cognitive functioning, and active engagement in life. Through the application of Universal Design, spaces become more accessible and usable for a broad spectrum of users without requiring special adaptations [12]. In South Korea, Universal Design has become the foundation of building regulations that guide the design and development of housing for older adults [13]. By implementing a Universal Design approach in housing adaptation, the safety of older adults within their homes can be improved while they perform daily activities [14].

Although the Universal Design (UD) approach has been widely implemented, several researchers have identified its limitations. According to Mustaqim (2015), more operational terms are needed to

measure and relate the principles of Universal Design in facilitating improvements in the quality of life of older adults. Carr et al. (2013) also emphasized that UD should not only accommodate physical aspects but should also promote social equality for older adults in their daily lives.

A more fundamental critique emerges from studies examining Lawton's PE-Fit theory. Most studies on older adults and their environments have focused primarily on health and physical aspects [7]. Social aspects such as social support, socio-demographic position, and family living arrangements of older adults have received relatively limited attention. In fact, within the context of Indonesia, older adults interact not only with the physical environment but also with a social environment deeply embedded with communal and spiritual values. Previous research conducted in Banyumanik Housing revealed that housing adaptation was carried out independently by older adults and the community, without external assistance [15]. These adaptations were driven not only by physical competence but also by socio-spiritual competence, namely the ability of older adults to function within their families and communities through social and religious activities. These findings indicate that, within the context of independent adaptation, older adults do not merely respond to physical decline but also consider socio-spiritual values embedded in their daily lives, which have not yet been explicitly integrated into the Universal Design framework.

The conceptual gap identified in this study is that existing UD approaches to housing adaptation have primarily addressed physical and mental aspects, whereas socio-spiritual aspects—which have been shown to influence how older adults independently adapt their homes—have not been explicitly integrated into the UD framework. The absence of such integration has implications for the lack of elderly-friendly housing design guidelines that not only ensure physical accessibility and safety but also support the continuity of socio-spiritual activities among older adults. If this gap remains unaddressed, housing adaptation practices risk neglecting important dimensions that constitute significant sources of meaning and quality of life for older adults.

This study is a continuation of the work by Wijayanti et al. (2018), which previously focused solely on socio-spiritual competence in relation to housing adaptation typology. The present study is directed toward

identifying the values of housing adaptation emerging from elderly activities, based on both physical and socio-spiritual competencies, and subsequently juxtaposing them with the seven principles of Universal Design. The research question posed is: "To what extent are housing adaptation values based on physical and socio-spiritual competencies aligned with, or even exceed, the principles of Universal Design?" This evaluative question aims to determine whether additional values derived from socio-spiritual competence may enrich or complement existing UD principles. Based on this research question, the objective of this study is to identify housing adaptation values based on physical, mental, and socio-spiritual competencies and to examine them alongside Universal Design principles in a balanced manner, as well as to identify additional values that may enrich these principles in order to refine elderly-friendly housing design guidelines.

The findings of this study are expected to provide theoretical contributions to the development of a more contextual and holistic Universal Design framework, as well as practical input for the formulation of policies and design guidelines for elderly-friendly housing in Indonesia, which to date have largely remained oriented toward disability aspects and have not specifically accommodated the phenomenon of aging at home.

Method

This study employed a qualitative approach using a case study strategy. The research site was located in Banyumanik Housing in Semarang, selected because it is an established residential area inhabited by older adults who have independently adapted their homes over a long period. This process was conducted using an interpretive investigation approach similar to that employed by Amos Rapoport in his research on the meaning of the built environment [16]. Rapoport argued that changes in the built environment reflect efforts to interpret it.

The unit of analysis in this study consisted of 8 (eight) elderly housing units. Each house was occupied by one older adult who simultaneously served as the primary informant. The socio-spiritual activities undertaken by the older adults were analyzed as the contextual background underlying spatial adaptation; however, the primary object of analysis remained the house and its spatial transformations. Eight house floor plans were used as instruments for spatial

analysis to identify spatial zoning (public, semi-private, private), circulation configurations, and the location of elderly-preferred spaces. These floor plans were analyzed to examine the relationship between socio-spiritual activities and the forms of physical adaptation that occurred.

Research Focus

This study focused on forms of spatial adaptation carried out by older adults within their residential homes. The research focus encompassed four main aspects: forms of spatial adaptation within the house, spatial and furniture arrangement, orientation and modification of the house's physical elements, and adaptation values emerging from the socio-spiritual activities of older adults. In this study, socio-spiritual aspects are understood as the abilities and competencies of older adults to conduct religious activities, establish social interactions, and perform daily practices that carry religious and communal meanings within the home environment.

Data Collection Methods

Data collection was conducted using several techniques: direct observation of the house's spatial conditions, visual documentation through photographs and spatial sketches, and in-depth, semi-structured interviews with the homeowners. Observations were conducted to identify changes in spatial layout, furniture usage, and modifications of physical elements related to elderly activities. Visual documentation was used to record spatial conditions and adapted physical elements, while in-depth interviews aimed to explore the experiences, motivations, and meanings underlying the spatial adaptations undertaken by elderly occupants. The data collection process involved repeated visits to the research site to obtain a more comprehensive understanding of the relationship between older adults' daily activities and the spatial transformations occurring within the home. This approach enabled the researcher to observe the dynamics of spatial use more thoroughly and to confirm information obtained from interviews and observations. Case units were selected purposively based on several criteria: older adults aged at least 60 years, having lived in the house for at least 10 years, having independently carried out spatial adaptations without professional design intervention, and remaining actively engaged in social and spiritual activities within the home environment. These criteria were used to ensure that the selected

cases had spatial adaptation experiences relevant to the study's objectives.

Data Analysis Process

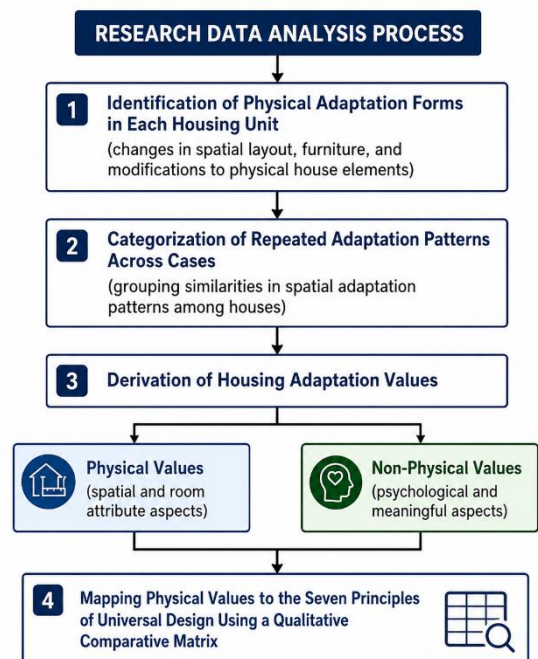


Figure 1. Stages of the Spatial Adaptation Analysis of Elderly Housing

In the interpretation process shown in Figure 1, this study employed Amos Rapoport's approach to the meaning of the built environment [16]. Rapoport distinguished three levels of interpretation:

Table 1. Levels of Interpretation of Built Environment Meaning according to Rapoport (1990)

Level of Interpretation	Description
Low-Level Interpretation	Focuses on the activities performed and the physical attributes present within the space or built environment.
Medium-Level Interpretation	Describes spatial values and the organization of attributes that shape the meaning of the activities taking place.
High-Level Interpretation	Interprets transcendental values related to culture, beliefs, and symbolic meanings within space.

This study focuses on the intermediate level of interpretation, namely spatial adaptation values that can be physically observed, as it is at this level that the principles of Universal Design can be analyzed most relevantly. Non-physical values were also identified through interviews; however, they were not directly compared with Universal Design principles because they are abstract and psychological in nature. These

values were understood as contextual aspects accompanying the physical values present in housing adaptation.

Universal Design as an Analytical Framework

Universal Design was employed as the analytical framework to understand the extent to which the identified physical adaptation values align with the seven principles of Universal Design [17], namely:

1. Equitable Use
2. Flexibility in Use
3. Simple and Intuitive Use
4. Perceptible Information
5. Tolerance for Error
6. Low Physical Effort
7. Size and Space for Approach and Use

In this study, these principles were not used as normative instruments for assessing socio-spiritual competence, but rather as conceptual mapping tools for the physical adaptation values identified in the field.

Results and Discussion

Spatial Configuration of the Eight Housing Units

Analysis of the eight housing floor plans shown in Figure 2 revealed a relatively consistent pattern of spatial configuration: a linear organization with a dominant orientation toward the front area (terrace). In all units, the terrace serves as a transitional space between the private interior and the external environment and as the house's primary orientation point. This condition indicates that the boundary between interior and exterior spaces is not entirely enclosed, but rather visually and auditorily semi-permeable.

The living room is generally located within the semi-public zone at the front of the house and directly connected to the terrace. This configuration enables social interaction to occur without requiring entry into the private domain. Meanwhile, bedrooms are positioned in deeper zones (middle or rear areas), forming a clear spatial hierarchy between social and personal spaces. This pattern demonstrates the regulation of accessibility and privacy levels to support both communal and individual socio-spiritual activities.



Figure 2. Floor Plans of the 8 Elderly Housing Units (Micro Scale)



Figure 2. (Continued) Floor Plans of the 8 Elderly Housing Units (Micro Scale)

Two housing units (House 2 and House 8) feature vertical spatial divisions with two floors. In both cases, the upper floor tends to function as an additional private zone, reinforcing the differentiation between social and personal activities. In addition, one housing unit provides a dedicated prayer room, indicating a more spatially articulated intensity of spiritual practice. However, in other units, worship activities do not always require a dedicated space; they are instead integrated into bedrooms or family rooms, demonstrating spatial flexibility in supporting daily spiritual practices.

Overall, the spatial configuration of the eight housing units demonstrates a hierarchical structure consisting of three primary zones: (1) the external-semi-public zone (terrace), (2) the internal social zone (living room/family room), and (3) the personal private zone (bedroom or prayer room). This structure not only reflects the physical organization of space but also represents how older adults manage the relationships among privacy, social connectedness, and spiritual tranquility in the context of aging at home. This pattern forms the basis for understanding how housing adaptation values emerge from the

interaction between older adults' physical and socio-spiritual competencies.

1. Activities within Elderly Housing

In this study, socio-spiritual competence is the primary factor influencing the activity patterns of older adults at home. Daily activities are determined not only by physical conditions but also by the need to maintain social roles, sustain religious practices, and seek inner tranquility during the aging-at-home process.

Based on observations conducted across the eight housing units, elderly activities can be classified into two main categories, both of which are spatially related to the house floor plan configuration. These activities include:

- a. Individual activities with a social orientation, namely, when older adults pray directly to God. These prayers contain wishes for goodness and blessings for themselves, their families, and the surrounding community. Physical and recreational activities are also conducted to maintain physical and spiritual well-being. These activities include, but are not limited to, light exercise using exercise

equipment, listening to music, and enjoying the surrounding views.

- b. Collective activities with a social orientation, namely manifestations of horizontal worship involving family members, friends, or neighbors from the same social and religious community. Older adults believe that, as human beings, they have responsibilities to uphold religious rules and values. Furthermore, these activities are regarded as expressions of their faith in God.

2. Adaptation Values within the Home

In this study, adaptation is understood as the process of adjusting spaces, physical elements, and furniture to align with the socio-spiritual activities and physical competencies of older adults. Adaptation does not always involve major renovations, but more frequently consists of rearranging positions, orientations, and spatial relationships.

Based on the eight analyzed units, the following forms of adaptation demonstrate direct relationships with floor plan configurations and socio-spiritual activities. In this paper, these adaptations remain consistent with findings from previous research [15], namely:

a. Arrangement of Objects

Attributes required by older adults (objects and furniture) are organized neatly so they can easily remember where items are placed and locate the objects they need, such as holy scriptures, religious books, and nostalgic cassette tapes. As a result, they can perform activities around the room and retrieve necessary objects with ease. Spatially, because the house configuration tends to be linear and compact, the placement of attributes follows the primary circulation path, thereby supporting ease of use.

b. Furniture Arrangement

The orientation of furniture across the eight housing units is not random, but rather directed toward terrace openings, the source of the call to prayer (adhan), outdoor views, or religious symbols. Since the living room is typically directly connected to the terrace, older adults can receive visual and auditory stimuli without leaving the house. This orientation strengthens social connectedness, creates spiritual tranquility, and provides visual control, fostering a sense of security. Thus, the relationship between interior and exterior spaces in the floor plan becomes a spatial

strategy for maintaining the socio-spiritual balance of older adults.

c. Furniture Orientation

Furniture orientation within the eight housing units is intentionally oriented toward meaningful elements such as terrace openings, sources of the adhan, views of the external environment, or particular religious symbols. Since nearly all living rooms in the floor plans are directly connected to the terrace, older adults can continue receiving visual and auditory stimuli from the surrounding environment without leaving the house. This orientation carries socio-spiritual significance because it allows older adults to feel that they remain part of the community; the sound of the adhan and outdoor activities create a sense of connectedness, while visual control over the surrounding environment provides a sense of security. Consequently, the relationship between interior and exterior spaces in the floor plan is not merely an architectural decision, but also a spatial strategy for maintaining the socio-spiritual balance of older adults.

d. Spatial Modification

Spatial modifications within the eight housing units were carried out by opening or maintaining visual access to the terrace, using transparent partitions, optimizing the living room as a multifunctional space, and, in one unit, providing a dedicated prayer room. The floor plan configuration, which positions the terrace at the front and the living room as a semi-public zone, facilitates visual and auditory relationships between interior and exterior spaces. For older adults, this relationship fosters a sense of non-isolation, enables social proximity without extensive movement, and provides inner tranquility through connection with the surrounding environment. Therefore, spatial modification functions not only to improve physical aspects but also to maintain the socio-spiritual roles of older adults within their communities.

Adaptation Values

1. Physical Values

Within these values, the house and its interior spaces are adapted to accommodate older adults' socio-spiritual competencies. Adaptation occurs naturally in response to the physical conditions of

elderly occupants. However, several Universal Design values were identified across the eight cases studied. These physical values include:

a. Orderliness

Orderliness concerns the arrangement of furniture, equipment, and both religious and personal items so that they are easily visible, accessible, and memorable. Items such as holy scriptures, worship equipment, medications, and nostalgic objects are placed in fixed positions that follow the daily routines of older adults. Within relatively linear and compact floor plan configurations, this orderliness enables older adults to access their necessities without moving long distances or performing excessive physical movements. This value aligns with the principles of Perceptible Information, Tolerance for Error, and Low Physical Effort, as spatial information becomes clearer and the risk of error is minimized.

b. Compactness and Ease of Mobility

This value is reflected in furniture arrangements that prioritize smooth circulation and flexibility of spatial use. Living rooms and family rooms, which are generally located in semi-public zones of the floor plan, are arranged to allow furniture to be moved during communal activities such as religious gatherings (*pengajian*) or family meetings. Spatial compactness facilitates movement, while furniture flexibility enables changes in spatial functions without structural intervention. This value is associated with the principles of Flexibility in Use, Size and Space for Approach and Use, and Low Physical Effort.

c. Orientation and Clarity

This value relates to attention toward the presence of specific objects, such as sound sources (in this case, the call to prayer or *adhan*), particular views, or other individuals that can be easily accessed through hearing and vision. With this value, older adults do not need to be physically close to these objects to enjoy or perceive them. Orientation is accompanied by clarity. Clarity refers to having clear access to the primary orientation object. Objects serving as orientation points must be clearly audible or visible from a distance. Thus, the values of orientation and clarity inherently involve sensory dimensions, particularly visual and auditory, which serve as bridges between the private spaces of older adults and the socio-

spiritual environment beyond them. These spaces may take the form of open spaces or enclosed yet transparent spaces with perceivable boundaries.

These findings indicate that the value of orientation is not merely physical-spatial but also sensory, as it strongly depends on the quality of visual and auditory stimuli older adults can perceive within their homes.

2. Non-Physical Values

Non-physical values in this context refer to values that emerge simultaneously with physical values when older adults engage in daily activities. These non-physical values are associated with aspects perceived and experienced by older adults and may influence their psychological conditions while performing activities. The non-physical values include:

a. Privacy and Tranquility

Physically, several private spaces are provided to ensure privacy and tranquility for older adults during activities. Activities related to religion or worship inherently require calm environments. Private zones within the floor plan, particularly bedrooms or prayer rooms, provide conditions that support contemplative activities and worship practices. Spatial tranquility becomes an important factor in maintaining the spiritual balance of older adults.

b. Security and Proximity

Spaces with well-organized attributes are necessary to ensure that older adults feel secure while engaging in activities. Spaces must also enable them to experience a sense of closeness with others outside the home so that they do not feel alone. This condition is facilitated by creating access to the external environment through open spaces or enclosed yet transparent spaces. Organized spatial arrangements and visual access to terraces or the surrounding environment generate a sense of security and social proximity. Older adults can observe outdoor activities without needing to move far, thereby preventing feelings of isolation.

c. Freedom

Freedom refers to older adults' ability to choose positions and ways of engaging in activities according to their comfort. Compact and flexible spatial configurations enable older adults to enjoy the surrounding environment

from both open spaces and transparent interior spaces.

d. Connectedness

Connectedness reflects the emotional and social relationships that older adults have with their spaces, objects, and surrounding environments. Through visual and auditory cues embedded in the floor plan, older adults continue to feel part of the community and social life outside the home.

3. Theoretical Discussion: The Integration of Housing Adaptation Values and Universal Design

a. The Meaning of Adaptation in the Context of Older Adults: Between Physical, Social, and Spiritual Dimensions

For older adults, housing designed through a Universal Design approach is expected not only to function as a residence that provides comfort and physical security, but more profoundly as an environment that feels home-like. Housing should serve as a center through which older adults obtain meaningful life experiences, as the home represents the center of one's personal world [18].

The findings of this study demonstrate that housing adaptation among older adults in Banyumanik Housing is not merely a response to declining physical function, but also a manifestation of efforts to maintain the continuity of social and spiritual roles. This finding aligns with the concept of "aging in place" proposed by Sixsmith and Sixsmith [19], which emphasizes that the home for older adults is not simply a place of shelter, but also a center of meaning, identity, and social connectedness. However, this study extends the concept by demonstrating that, within religious societies such as Indonesia, "aging in place" also encompasses spiritual dimensions that are spatially articulated, either through dedicated worship spaces or through the integration of spiritual practices into everyday spaces.

These findings also reinforce the argument proposed by Percival [20] that older adults tend to engage in "environmental proactivity," namely actively reorganizing their living environments to accommodate changing needs and capacities. In the Banyumanik cases, this

proactivity is manifested through the arrangement of objects, furniture orientation, and spatial modifications that consider not only functional aspects but also socio-spiritual values, such as connectedness with the community through visual and auditory access to the external environment.

Interestingly, the findings regarding the flexibility of worship spaces—where spiritual activities may occur within bedrooms or family rooms without requiring dedicated spaces—indicate adaptation patterns that differ from findings in Western contexts. Whereas studies in Europe and North America tend to emphasize physical modifications through assistive technologies, adaptation within the Banyumanik context is more socio-spiritual and grounded in simple yet meaningful everyday practices. This difference highlights the importance of considering cultural and religious factors in designing contextual elderly housing policies.

Accordingly, the evaluation of Universal Design principles was not conducted normatively but rather by mapping adaptation values derived from observed field practices. Of the eight units analyzed, seven demonstrated relatively good physical condition and remained actively engaged in social and spiritual activities within the home. These activities stimulated the arrangement of spaces and attributes, generating physical values such as orderliness, compactness, orientation, clarity, and multifunctionality.

b. Universal Design Principles in Practice: Between Normativity and Intuition

Orderliness encompasses values related to *Perceptible Information*, grounded in older adults' awareness of their declining memory capacity. Consequently, they independently organize frequently used items in orderly positions aligned with their daily routines. This arrangement reduces the likelihood of errors, corresponding to the principle of *Tolerance for Error*. These efforts also facilitate easier use of required objects, thereby reflecting the principles of *Simple and Intuitive Use* and *Low Physical Effort*. Furthermore, the arrangement of objects is adjusted to the available space, indicating consideration of the *Size and Space*

for Approach and Use principle. These findings demonstrate that UD principles have been applied intuitively by older adults, not through formal regulations, but through everyday lived experience.

The mapping of physical values onto the seven Universal Design (UD) principles reveals that these principles have been intuitively implemented by older adults, despite their lack of explicit knowledge regarding the UD framework. This finding reinforces the thesis proposed by Connell et al. [21] that UD principles are fundamentally universal because they originate from basic human needs rather than solely from technical regulations. However, this study also demonstrates that such intuitive implementation is not equally distributed across all principles.

Compactness and ease of mobility provide spatial values that facilitate older adults' use of space for various activities through furniture arrangements that can be easily moved or repositioned as needed. Older adults independently organize their spaces and furniture according to the principles of *Flexibility in Use*, *Tolerance for Error*, and *Size and Space for Approach and Use*.

Orientation and clarity encompass values related to how older adults achieve tranquility and security by utilizing physical spaces that provide easy access to clearly visible and audible sources. These sources may generate feelings of peace and safety, including the sound of the *adhan* from the nearest mosque, natural scenery, and the presence of people passing by the house. In addition to the principles of Low Physical Effort and Size and Space for Approach and Use, it is necessary to consider an additional principle not yet explicitly present in Universal Design: a sensory approach related to audiovisual dimensions.

Multifunctionality is a spatial value that describes the flexibility of spatial use, supported by compact spatial organization and open-plan configurations, enabling spaces to accommodate both private and semi-private activities. This value corresponds closely with Universal Design principles related to *Flexibility in Use* and *Size and Space for Approach and Use*.

Living rooms and family rooms simultaneously serve as private, semi-public, and communal worship spaces. This flexibility is enabled by the linear floor plan configuration and the semi-public zones located at the front of the house. However, unlike studies conducted in developed countries, the flexibility identified here is not driven by technological intervention or smart systems, but rather by simple spatial strategies grounded in social experience.

c. Sensory Dimensions as an Extension of the Principle of Perceptible Information

One of the most significant findings of this study is the identification of sensory dimensions—particularly visual and auditory aspects—that expand the operational understanding of the principle of *Perceptible Information*. Within the conventional UD framework, this principle is generally understood as providing information through multiple modalities (visual, verbal, tactile) to accommodate individuals with sensory disabilities [21]. However, in the context of older adults in Banyumanik, sensory dimensions instead function as bridges between private spaces and the socio-spiritual environment beyond the home.

Non-physical values emerge alongside physical values and coexist closely with the seven Universal Design values. The non-physical values identified include privacy and tranquility, security and closeness, freedom, and connectedness. Because these values are more non-physical in nature, they cannot be directly compared with Universal Design values. Nevertheless, since these non-physical values accompany the physical ones, they should be considered complementary dimensions of the existing physical values. This is because older adults possess competencies beyond physical competence, namely, socio-spiritual competence, which influences their experiences of aging at home.

Findings concerning furniture orientation toward the source of the *adhan* and outdoor views demonstrate that older adults utilize sensory stimuli to maintain a sense of connectedness with the community and the natural environment. This finding reinforces the concept of the “sensory environment”

proposed by Robert Gifford [22], which argues that environments are not merely passively perceived but are actively interpreted through sensory experiences. Furthermore, these findings are consistent with the study by Stephen Kaplan [23] on the “restorative environment,” in which natural and social stimuli may produce psychological restorative effects, a point particularly relevant for older adults, who are vulnerable to social isolation.

From the adaptation values discussed above, the physical values encompass all seven Universal Design principles. This is because Universal Design is associated with the concept of physical design that can be physically adapted and understood by users. To systematically summarize how physical values intersect with UD principles and their accompanying sensory dimensions, the mapping is presented in Table 1. Descriptions of the physical and non-physical values are presented in Table 2.

Table 2. Description of Physical and Non-Physical Values

Adaptation Values	1	2	3	4	5	6	7	Sensory Dimension
Orderliness	-	-	✓	✓	✓	✓	✓	Visual
Compactness & Mobility	-	✓	-	-	✓	✓	✓	-
Orientation & Clarity	-	-	✓	✓	-	✓	✓	Visual + Audial
Multifunctionality	✓	✓	-	-	-	✓	✓	-
Privacy & Tranquility (Non-Physical)	-	-	-	-	-	-	-	Visual + Audial
Security & Closeness (Non-Physical)	-	-	-	✓	✓	✓	✓	Visual
Freedom (Non-Physical)	✓	✓	-	-	-	✓	✓	-
Connectedness (Non-Physical)	✓	-	-	✓	-	-	-	Visual + Audial

Description:

1: Equitable Use

2: Flexibility in Use

3: Simple and Intuitive Use

4: Perceptible Information

5: Tolerance for Error

6: Low Physical Effort

7: Size and Space for Approach and Use

Table 1 demonstrates that the physical adaptation values most dominantly intersect with the principles of Perceptible Information and Low Physical Effort. This is evident in the

values of orderliness, orientation, and clarity, which consistently emphasize ease of visual and auditory access without requiring excessive physical movement. The principle of Size and Space for Approach and Use also appears strongly, particularly in the values of compactness and multifunctionality, which relate to circulation efficiency and the flexibility of spatial use. In contrast, the principle of Equitable Use appears more limited, as most adaptations were carried out independently and focused primarily on the personal needs of older adults rather than on broader user diversity. These findings indicate that the implementation of Universal Design principles in elderly housing in Banyumanik tends to evolve intuitively through everyday practices, with particular emphasis on spatial information clarity and physical efficiency as responses to aging.

d. Non-Physical Values as Complements to Universal Design

The presence of non-physical values—privacy and tranquility, security and closeness, freedom, and connectedness—in elderly housing adaptation indicates that housing quality cannot be reduced to the fulfillment of physical principles alone. These findings reinforce critiques of the Universal Design approach as being overly technical and insufficiently attentive to the affective and existential dimensions of spatial experience [24].

The values of privacy and tranquility, which emerge alongside the provision of private zones within the floor plan, reflect older adults' need for contemplative spaces. Similar findings were reported in Mary Marshall Chalfont's study [25] on design for older adults with dementia, in which calm spaces were shown to support psychological well-being. However, this study demonstrates that the need for tranquility does not necessarily entail isolation; rather, older adults in Banyumanik continue to desire closeness to the outside world through managed visual and auditory access. This finding indicates a dialectical relationship between privacy and connectedness that should be accommodated in the design of elderly housing.

The values of security and closeness that emerge from visual access to the terraces and the surrounding environment are also noteworthy. These findings are consistent with Jay Appleton's concept of "prospect and refuge," which states that human environmental preferences are influenced by the need to observe (*prospect*) without being observed (*refuge*). For older adults, the terrace serves as a secure refuge, while visual access to the external environment provides a prospect that helps them remain connected to social activities without direct participation. This spatial strategy demonstrates that older adults intuitively apply principles of evolutionary psychology in organizing their living environments.

The values of freedom and connectedness emerging from spatial flexibility and sensory orientation also carry important theoretical implications. These findings reinforce Graham Rowles's argument [26] regarding "insideness," namely, the feeling of being part of an environment through everyday experiences and routines. In the Banyumanik cases, older adults achieve "insideness" not only through direct social interaction but also through sensory connectedness with the external environment, enabling them to feel that they remain part of the community despite increasingly limited physical mobility.

Based on these findings, additional values may emerge and be further juxtaposed with Universal Design principles. Since this study is based on elderly activities that contain socio-spiritual aspects, non-physical values emerge in relation to physical values. However, because the physical and mental conditions of older adults gradually decline, further investigation concerning these aspects remains necessary [27]. From the collected data, 1 out of 8 analysis units experienced difficulty conducting activities at home due to a history of slips caused by differences in floor levels in the family room. This indicates the continued need for further research emphasizing the physical competencies of older adults in relation to housing adaptation.

The values emerging from housing adaptation, both physical and non-physical, include

orientation and clarity, privacy and tranquility, security and closeness, and connectedness. These physical values embody Universal Design principles: Size and Space for Approach and Use, Tolerance for Error, and Low Physical Effort. These findings indicate the existence of sensory dimensions (visual and auditory) that expand the operational understanding of the principles of Perceptible Information and Low Physical Effort within the context of socio-spiritually based elderly housing.

e. Soundscape and Sensory Design for Older Adults

This approach is included within the framework of environmental acoustics. Calm sounds from natural sources, as well as human-generated sounds such as the *adhan*, create a soundscape that provides optimal acoustic comfort in the surrounding environment, enabling older adults to feel calm when hearing them, particularly when noise pollution from human-made sources is reduced [28]. On the other hand, noise may adversely affect health even when it originates from places of worship [29].

The findings regarding older adults' auditory orientation toward the *adhan* reinforce the concept of *the soundscape developed by R. Murray Schafer [30] and later expanded by Jian Kang [31] in the context of urban environments*. This study demonstrates that soundscapes contribute not only to acoustic comfort but also possess spiritual dimensions that reinforce religious identity and older adults' sense of connectedness with their communities. These findings are consistent with the research of Torresin et al. [32] regarding the influence of sound on perceptions of comfort in residential environments, with particular emphasis on the role of religious sounds in highly religious societies.

Accordingly, if there are sound sources outside the home that can serve as elements of the acoustic environment and are comfortably perceived by older adults, these sources should be important considerations in creating soundscapes in residential areas inhabited by older adults. In addition, these sources may serve as audiovisual media by integrating sound and visual displays, which are expected to

benefit older adults. Such audiovisual displays may serve as stimuli for older adults' hearing and vision [33]. These displays should also be designed for urban outdoor spaces, particularly during nighttime conditions. This may affect the comfort and satisfaction of older adults [34]. In the social context, such comfort may also contribute to the well-being of older adults [35].

These findings are important for housing adaptation. The assessment of elderly housing is essential to obtaining adaptations that align with older adults' competencies, both physical and non-physical [36]. Housing adaptation should be understood not only as providing physically adequate housing for older adults but also as creating homes where they can attain spiritual tranquility. Spiritual approaches are therefore important considerations in studies concerning older adults living in residential housing or nursing homes [37]

Conclusion

This study demonstrates that housing adaptation among older adults in Banyumanik Housing is influenced not only by declining physical competence but also by socio-spiritual competencies embedded in their daily activities. Through analysis of eight housing units, two categories of adaptation values were identified: physical and non-physical. Physical values include orderliness, compactness, orientation, clarity, and multifunctionality, while non-physical values include privacy, tranquility, security, closeness, freedom, and connectedness. Mapping these values against the seven Universal Design principles shows that the physical values align most closely with the principles of Perceptible Information, Low Physical Effort, and Size and Space for Approach and Use.

1. The Big Picture of the Findings

The most significant finding of this study is that these physical values, particularly in relation to orientation and clarity, inherently involve sensory dimensions (visual and auditory). These dimensions play a crucial role in connecting older adults to the social and spiritual environments beyond their homes [38], such as through views of the terrace or the reverberation of the *adhan*. This finding indicates that elderly housing adaptation cannot be understood merely as a functional response to declining physical capacities, but also as an existential strategy for maintaining

connectedness with the outside world and giving meaning to the process of aging at home.

More broadly, this study reveals that housing for older adults serves as a nexus linking three dimensions of human existence: physical (comfort and safety), social (interaction and togetherness), and spiritual (tranquility and meaning). The hierarchical spatial configuration, from the semi-public terrace to the social living room and finally to the private bedroom, reflects how older adults negotiate these three dimensions in their everyday lives. Accordingly, housing adaptation should be understood not as a one-time process but as a continuous practice that evolves alongside changes in older adults' capacities and needs.

2. Theoretical Implications

Theoretically, this study contributes significantly to three scholarly domains. First, this study expands understanding of the concept of "aging in place" by integrating socio-spiritual dimensions that have thus far received limited attention in architecture and environmental gerontology. Whereas previous studies have primarily focused on the physical and functional aspects of aging at home [7]–[9], this study demonstrates that within religious societies such as Indonesia, the success of aging in place is also determined by the extent to which housing can accommodate spiritual practices and maintain older adults' sense of social connectedness.

Second, this study identifies sensory dimensions (visual and auditory) as integral components of the principles of *Perceptible Information* and *Low Physical Effort* within the Universal Design framework. These findings enrich the operational understanding of UD principles, which have generally been interpreted in technical-functional terms. By demonstrating that sensory stimuli function as bridges between private spaces and socio-spiritual environments, this study proposes that sensory dimensions should be understood as contextual elaborations that enrich the application of UD principles for elderly housing.

Third, this study introduces the concept of "non-physical values" as complements to Universal Design principles. The presence of values such as privacy, tranquility, security, closeness, freedom, and connectedness demonstrates that the quality of elderly housing cannot be reduced to meeting

physical criteria alone. These findings reinforce critiques of the UD approach as overly technical and insufficiently attentive to the affective and existential aspects of spatial experience [29], [24]. Accordingly, this study contributes to developing a more holistic theoretical framework for understanding the relationship between older adults and their residential environments.

3. Practical Implications

The findings of this study carry important practical implications for architects, designers, housing developers, and policymakers concerned with elderly-friendly housing. Given the growing number of older adults living at home, integrating these adaptation values is essential to developing more responsive elderly housing design guidelines. Based on the findings, the following operational design recommendations may be considered:

- a. **Orderliness and Accessibility:** Design storage systems for personal and religious attributes within the ergonomic reach of older adults (ideally between 60–120 cm from the floor surface) and organize items according to daily activity routines to facilitate memory and retrieval.
- b. **Spatial Flexibility:** Organize spaces using compact floor plans, ensure unobstructed circulation widths (minimum 90 cm), and utilize lightweight or movable furniture to accommodate changes in spatial functions, such as communal gatherings.
- c. **Orientation and Sensory Clarity:** Design the orientation of primary spaces (living/family rooms) to provide clear visual and auditory access to the external environment. This may be achieved by maximizing openings toward positive stimulus sources (e.g., mosques, gardens, social spaces), incorporating transparent façade elements, and minimizing visual and acoustic barriers.
- d. **Private Zones for Contemplation:** Provide quiet private zones separated from social areas to support contemplative activities and individual worship, thereby fulfilling older adults' spiritual needs and inner tranquility.

4. Research Limitations

This study has several limitations that should be acknowledged to provide a balanced perspective when interpreting the findings. First, there are contextual and geographical limitations because

the study was conducted only in eight elderly housing units in Banyumanik Housing, Semarang, so the findings cannot be generalized to other housing typologies, such as vertical housing or rural settlements. Second, there are limitations regarding the diversity of older adults' physical conditions due to the limited exploration of elderly individuals with severe disabilities or chronic conditions. Third, there are temporal limitations because the study employed a cross-sectional approach that could not capture long-term adaptation dynamics. Fourth, there are methodological limitations related to interpretive subjectivity within the qualitative approach employed. Fifth, this study did not examine other contextual factors such as gender differences, health status, or family support, which may influence adaptation patterns.

5. Future Research Directions

Based on these findings and limitations, seven directions for future research may be developed. First, comparative cross-contextual studies comparing various housing typologies and cultural backgrounds are needed to develop a more culturally inclusive Universal Design framework. Second, longitudinal studies are required to observe adaptation processes over time and identify critical points for design intervention. Third, future studies should focus on diverse physical competencies, including older adults with severe disabilities, visual impairments, dementia, and other chronic conditions. Fourth, interdisciplinary studies integrating perspectives from architecture, environmental psychology, acoustics, and religious studies should be developed. Fifth, participatory (co-design) research that actively involves older adults in the design process is recommended. Sixth, further research on soundscapes and sensory environments, examining acoustic quality, sound preferences, and their effects on the well-being of the elderly, is needed. Seventh, studies at meso and macro scales should expand investigations toward neighborhood environments, communities, and age-friendly urban policies, thereby enabling housing adaptation to be understood as part of a more comprehensive age-friendly environmental system.

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