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[Tran Van-Duc](#) *

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Article

Designing Sustainable Residential Environments for Aging-in-Place: Conceptual Integration and Operationalization of the EREEM Matrix

Tran Van-Duc

Department of Architecture, Faculty of Civil Engineering, Ton Duc Thang University, Ho Chi Minh City, Viet Nam; tranvanduc@tdtu.edu.vn

Abstract

Population ageing is creating increasing demand for residential environments that support safety, independence, and well-being for older adults. However, existing design guidelines remain fragmented and often lack measurable spatial indicators applicable in architectural evaluation. This study proposes the Elderly Residential Environment Evaluation Matrix (EREEM), an integrated framework based on six environmental design principles: safety, accessibility, autonomy, privacy, social interaction, and adaptability. An expert survey involving 36 specialists was conducted to evaluate an initial set of 54 spatial indicators, showing high reliability (Cronbach's $\alpha = 0.978$). The indicators were subsequently refined into 24 operational indicators and applied in field assessments of four residential environments in Vietnam. The results confirm the reliability and applicability of the EREEM framework, highlighting safety and accessibility as foundational conditions for age-friendly residential environments. The study provides a systematic evaluation tool bridging environmental gerontology and architectural design, supporting sustainable and age-friendly residential development in ageing societies.

Keywords: sustainable built environment; aging-in-place; universal design; environmental gerontology; Elderly residential design; social sustainability; sustainability

1. Introduction

Population ageing is becoming one of the most profound demographic transformations of the twenty-first century and is occurring at an unprecedented pace [1]. The increase in average life expectancy, together with rapid urbanization, has altered residential structures and the organization of living environments, particularly for older adults [2]. In this context, residential space—especially the interior living environment—is increasingly playing a central role in maintaining their functioning, health, and quality of life [3]. Housing is considered the environment that determines the ability to meet basic needs, mobility requirements, and the maintenance of relationships for older adults [4].

Studies on *aging-in-place* show that the housing environment has a direct influence on the ability to maintain independence and the perception of personal competence among very old adults [5,6]. However, when the environment fails to ensure accessibility, safety, and adaptability, it may become a factor that increases dependency and risk [7]. This confirms that the design of residential space for older adults should be understood as a mechanism regulating the relationship between individual competence and environmental demands. In other words, environment-behavior studies affirm that the architectural environment directly affects human behavior, emotions, and the structure of social interaction [8].

In Southeast Asia, the ageing trend is also occurring rapidly, while the traditional family context is weakening due to labor migration and changes in family structure [9]. In Malaysia, the proportion of older adults is expected to reach 12% by 2030 [10], and many studies have shown that

characteristics of the built environment directly affect how older adults perceive and use living space. In Thailand, although various housing types exist - including low-rise housing, conserved shophouses, and multi-storey housing - only 7.3% of housing in Bangkok appropriately accommodates older adults, with common deficiencies such as slippery and unsafe materials, level changes, and the absence of handrails, etc,[11]. The built environment may also promote physical activity through supportive environmental design, interdisciplinary planning, or age-friendly infrastructure in Ban Phaeo District [2].

In Vietnam, the significant increase over the past two decades in the proportion of the population aged 65 and above has occurred within a highly collectivist cultural context, in which older adults traditionally live in multigenerational households and occupy a central role in family structure [12]. At the same time, the system of elderly care facilities is developing rapidly but lacks a unified design guideline framework [13], while the classification system and standards for elderly care facilities also remain inconsistent [14].

While many design guidelines [15,16] and studies on Universal Design in elderly care facilities in South Korea have proposed specific recommendations [17,18], the principles remain dispersed across different fields depending on the research orientation of each scholar. The absence of an interdisciplinary integrative framework has limited the possibility of coherent application in urban planning and architectural design.

Although many guidelines address elderly-friendly housing design, most remain conceptual or regulatory in nature and lack measurable spatial indicators that can be systematically applied in architectural evaluation. This study aims to systematize the principles of physical environmental design for older adults, identify core principles that recur consistently across previous studies, and discuss their applicability within the Vietnamese context.

2. Theoretical Foundations and the Development of the Principle System

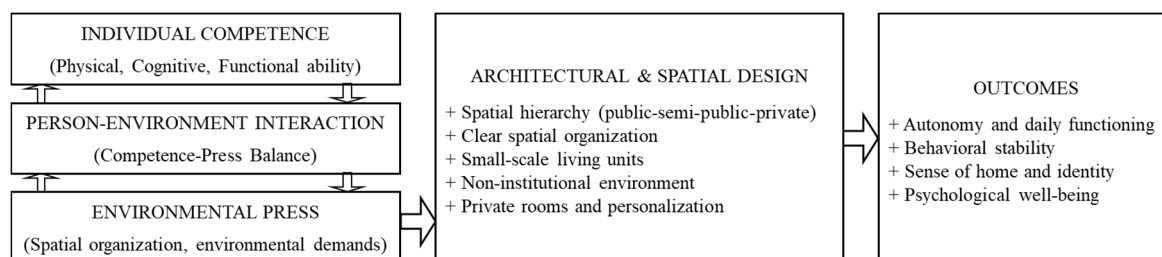
The design of residential environments for older adults is grounded in an interdisciplinary foundation that includes environmental gerontology, environment-behavior studies, therapeutic design, and Universal Design. These approaches all agree that the physical environment is not a passive factor; rather, it has the capacity to regulate human behavior, emotions, and the degree of autonomy.

2.1. Competence-Press Model in Environment Gerontology

Environmental gerontology emphasizes the compatibility between individual competence and environmental demands. A suitably organized environment can maintain or support functioning, whereas an unsuitable environment may increase “environmental press” and lead to functional decline [19]. Environment-behavior research shows that spatial structure affects perceptions of territory, privacy, and environmental control [8]. The hierarchy of public - semi-public - private space has therefore become a basic organizational principle in many architectural design guidelines [15]. Therapeutic design for people with dementia is regarded as a non-pharmacological intervention. Studies indicate that small-group scale, a non-institutional character, and clear spatial organization help improve behavior and daily functioning [20]. At the same time, the concept of “sense of home” emphasizes that architecture can reinforce personal identity and residents’ dignity through private rooms and opportunities for personalization [21].

Thus, individual competence and person-environment interaction mutually influence one another in the Competence-Press Model: individual competence affects the capacity to adapt to the environment, while the environment can either increase or reduce pressure on the individual. Accordingly, the balance between these two factors determines the level of adaptation of the user. At the same time, architectural design plays an intermediary role, showing that environmental press is not a fixed determinant and that architecture can regulate environmental press through clear spatial organization, a public-semi-public-private hierarchy, residential unit scale, and a homelike environment. These architectural strategies lead to behavioral and psychological outcomes for older

adults, including the maintenance of daily functioning, behavioral stability, an increased sense of home, and improved mental well-being (see Figure 1).



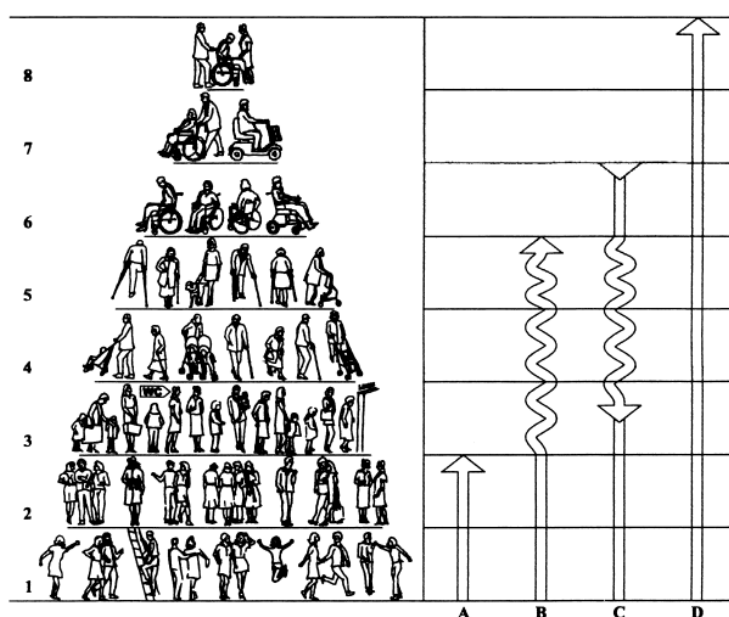
Note: This diagram illustrates the dynamic interaction between individual competence and environmental press in the field of environmental gerontology. Architectural design can mediate environmental demands through spatial organization, hierarchical zoning, and homelike settings, thereby supporting autonomy, behavioral stability, and psychological well-being among older adults.

Figure 1. Competence-Press model and spatial design implications for elderly residential environments (Source: author).

In the context of designing residential environments for older adults, this two-way relationship indicates that architectural design can regulate environmental press by providing clear spatial organization, establishing a public - semi-public - private hierarchy, creating small-scale and easily legible environments, and maintaining the non-institutional character of residential space. These strategies help reduce environmental press and thereby support the maintenance of daily functioning, behavioral stability, and a sense of home for older adults.

2.2. Universal Design and the Shift from “Barrier-free” to “Design for all”

Universal Design (UD) developed from the concept of barrier-free design in American society during the 1950s following the Second World War [22,23] and was later expanded into the concept of design for all in Europe [24]. The design principles of UD have moved beyond specialized design and have become increasingly inclusive (Figure 2).



Note:

Levels represent building users: 1–2 able-bodied adults; 3 women and users affected by inadequate facilities; 4 older adults and pushchair users; 5 ambulant disabled persons; 6 independent wheelchair users; 7 wheelchair users needing assistance; 8 users needing two-person assistance.

A conventional design; B expanded universal design (bottom-up); C accessibility standards focusing on wheelchair users (top-down); D ideal universal design accommodating the widest range of users.

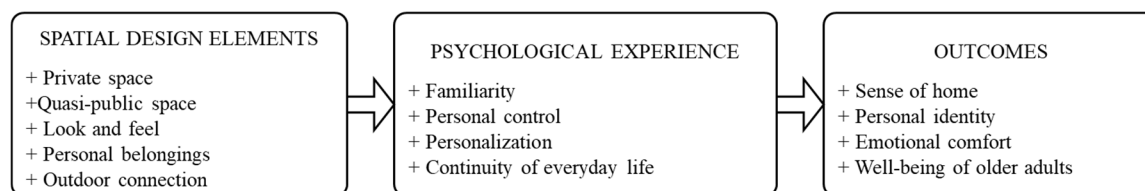
Figure 2. Universal Design pyramid illustrating levels of user accommodation and design strategies from conventional design to inclusive universal design (Source: [23]).

Research comparing elderly care facilities in Vietnam and South Korea shows that UD principles are used as an official evaluation framework, including Equitable Use, Flexibility in Use, Simple and Intuitive Use, Perceptible Information, Tolerance for Error, Low Physical Effort, and Appropriate Size and Space [13]. In current practice, elderly care facilities in Vietnam still lack many specific amenities necessary to serve older users.

In this study, Design for All provides the theoretical basis for viewing residential environments for older adults as an inclusive and life-course-adaptive system, and it serves as the foundation for developing the EREEM evaluation framework.

2.3. Sense of Home and Environments of Personal Identity

In long-term care facilities, a major challenge is how to maintain a sense of home or homelikeness. Spatial and psychological components - including private space, quasi-public space, look and feel, personal belongings, and outdoor connection - directly influence the sense of home. For example, private space allows room for displaying personal memorabilia [25], while gardens or views toward green landscapes can improve comfort and reduce psychological stress in older adults [21,26]. These elements contribute to maintaining personal identity, autonomy, and continuity with previous life habits. In addition, maintaining a sense of home plays an important role in the quality of life of older adults. Research has shown that this feeling is formed through the interaction between spatial factors and psychological experience, thereby expanding the concept of design from functional requirements to emotional and cognitive dimensions [27]. These components contribute to familiarity, attachment to place, and the ability to maintain personal identity among residents [28,29]. (Figure 3)



Note: This illustration shows how spatial design elements influence psychological experience and contribute to personal identity and well-being in older adults

Figure 3. Conceptual framework of sense of home in elderly care environments (Source: author).

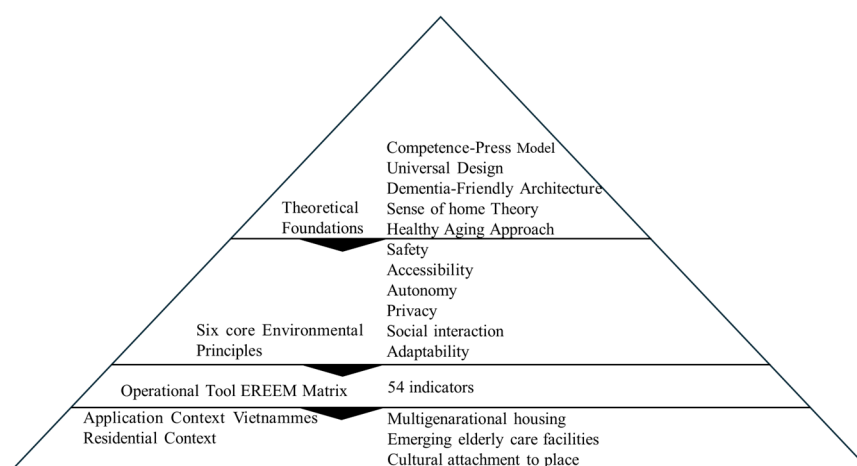
2.4. Dementia-Friendly Architecture

In the context of the increasing prevalence of dementia, dementia-friendly architecture has become a major area of research [30]. Literature reviews show that the built environment can directly influence levels of anxiety, disorientation behavior, and the ability to function independently among people with dementia [31]. The main design principles include clear wayfinding systems, stable natural lighting, loop circulation spaces, avoidance of dead-end corridors, and the reduction of

overstimulating sensory input [32]. These principles correspond directly to the logic of the Competence-Press Model, in which the environment is adjusted to reduce cognitive pressure and enhance adaptive capacity.

2.5. Principles of Communal Dwelling Spatial Organization

In addition to individual factors, the organization of communal space plays an important role in maintaining social interaction and the structure of collective life. Research on communal housing design emphasizes hierarchical spatial structure, social spines, and spatial joints that foster interaction [33]. This type of organization helps create conditions for natural interaction while still maintaining the ability to control the level of social participation - an important factor in elderly care for reducing social isolation and the mental ageing-related challenges experienced by older adults.



Note:

This figure illustrates the hierarchical integration of theoretical foundations - including the Competence-Press Model, Universal Design, dementia-friendly architecture, and the theory of sense of home - into six core environmental principles. These principles are operationalized through the EREEM matrix and situated within the Vietnamese residential context to support sustainable aging-in-place strategies.

Figure 4. Conceptual integration of theoretical foundations and operationalization pathway toward the EREEM evaluation framework (Source: author).

Over nearly four decades, although scholars have approached the subject from different perspectives, factors such as safety, environmental control, spatial hierarchy, small-group scale, and continuous accessibility have repeatedly appeared (Figure 5) and have been reaffirmed by many influential researchers over time [34]. This repetition reflects a stable theoretical foundation and forms the basis for synthesizing the six core principles presented below.

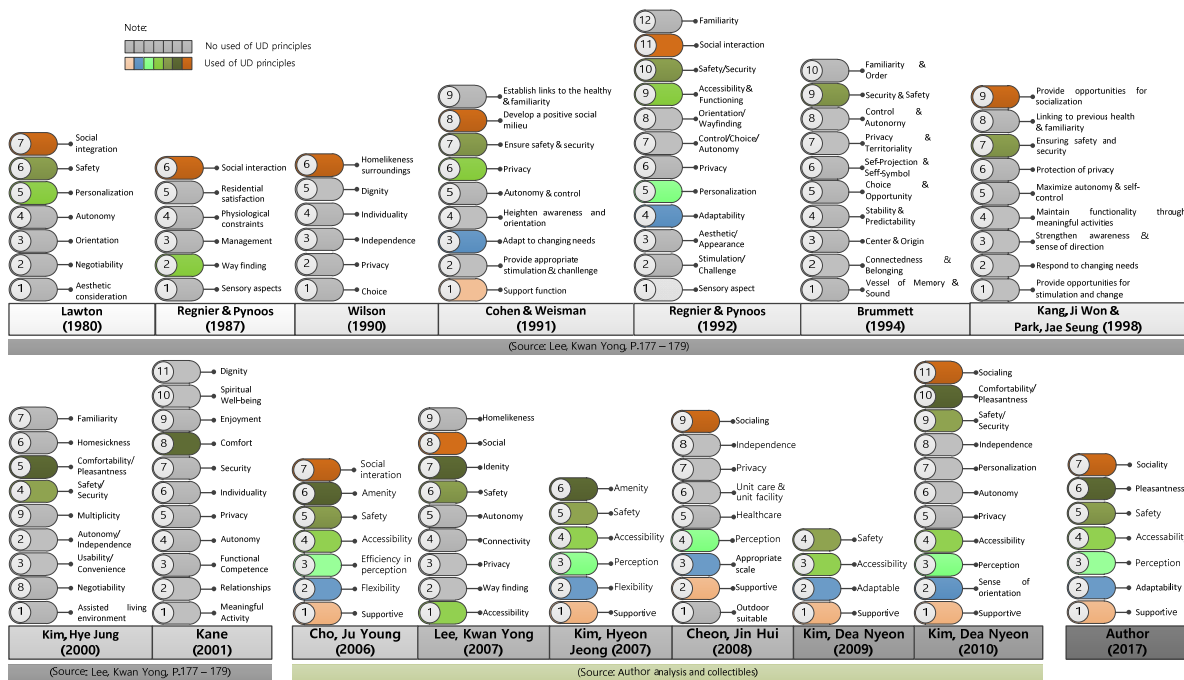


Figure 5. Evolution of environmental design principles in elderly residential architecture across major studies (1980–2017), showing the convergence toward six core environmental principles (Source: author 2017, [34]).

3. Core Principles and Research Framework

Based on the synthesis of the theoretical foundations outlined above, six environmental principles that recur systematically can be identified. Rather than functioning as isolated criteria, these principles form a layered ecological structure in which different environmental dimensions interact to support well-being in later life: safety and accessibility constitute the foundational survival layer and the basic environmental layer; autonomy and privacy form the layer of personal control and dignity; social interaction represents the relational layer of the living environment; and adaptability functions as the temporal layer that allows long-term environmental response as personal competence changes.

Based on the theoretical integration illustrated in Figure 4, the recurring environmental dimensions were synthesized into six core design principles structured as a hierarchical ecological system (Figure 6).

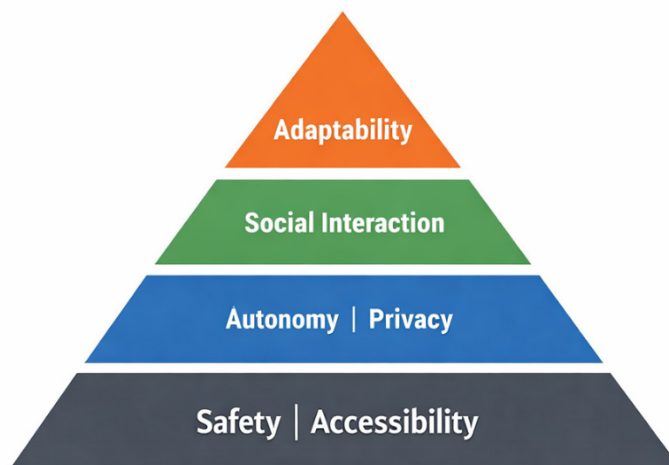


Figure 6. Ecological framework of six core principles for elderly residential design (Source: author).

3.1. Identification of the Six Core Principles

1) Safety

Safety should be understood as a comprehensive ecological structure aimed at minimizing environmental stress rather than merely a collection of isolated technical solutions. Small residential unit size, clear spatial organization, and the control of sensory stimuli can reduce agitated behavior and improve daily functioning [20]. At the same time, safety systems should be integrated within a homelike environment so as to avoid creating an institutional atmosphere [15]. Clearly organized environments, small group scale, and reduced overstimulation help limit agitation and reduce emotional disturbance in older adults with dementia [20,35].

2) Accessibility

Accessibility includes both physical accessibility and cognitive accessibility. Spaces must meet circulation standards for wheelchairs and assistive devices. Accessibility includes both ease of physical movement and cognitive legibility. Adequate lighting, color contrast, and reasonable maneuvering space have been identified as high-priority factors [24]. At the same time, corridor structure and residential unit organization affect wayfinding ability and reduce spatial confusion [35].

Research in Malaysia highlights the role of landmarks in helping older adults construct cognitive maps [36]. This indicates that accessibility should be designed at both the micro-detail level and the overall spatial structure level.

3) Autonomy

Autonomy reflects the ability to maintain control over the personal environment and participate in everyday life. Private rooms and opportunities for personalizing space reinforce a sense of home and personal dignity [21]. Small-scale unit structure helps residents maintain social roles and reduces the institutional character of the environment [20]. The environment should allow individuals to control private space and engage in daily activities. Residential units of 6-12 people and private bedrooms have been shown to help maintain a family-like atmosphere and autonomy [37]. Therefore, autonomy is not merely a characteristic of the bedroom but of the organizational structure of the entire residential unit.

4) Privacy

Privacy is a condition for maintaining psychological balance and environmental control. A clear hierarchy between public, semi-public, and private spaces helps establish territorial boundaries and increases the sense of safety for older users [38]. In the Vietnamese context, private space for family visits is especially meaningful because family ties directly influence quality of life and intergenerational interaction [12].

5) Social Interaction

Semi-public spaces serve as an intermediary layer between the individual and the community. Spatial structure can either promote or constrain social interaction [38]. The design of widened corridors and common rooms has been shown to enhance interaction and reduce social isolation among older adults [39] while common rooms and shared kitchens are places where shared activities with a relatively high level of member interaction frequently occur [37].

6) Adaptability

Adaptive design must ensure that the environment can change along with the ageing process and changing levels of care required by older adults. Flexible design and the capacity to upgrade assistive equipment make it possible to respond to functional decline in both physical and mental terms [15,40].

3.2. Operationalization of Core Principles: Development of the EREEM Matrix

Although the six core principles synthesized above provide a coherent theoretical structure, their practical applicability requires systematic operationalization. To narrow the gap between theoretical synthesis and spatial evaluation practice, this study proposes the Elderly Residential Environment Evaluation Matrix (EREEM).

EREEM translates the six principles - Safety, Accessibility, Autonomy, Privacy, Social Interaction, and Adaptability - into measurable spatial indicators derived from recurring factors identified in environmental gerontology, Universal Design theory, dementia-friendly architecture, and research on sense of home (for example, competence-press theory, person-centered care, and evidence-based design).

Unlike traditional technical checklists, EREEM is not merely a list of design requirements but: (i) a tool for measuring the degree of reduction in environmental press; (ii) a framework for evaluating the capacity to maintain functioning and dignity; and (iii) a bridge between environment-behavior theory and design practice. According to the logic of the Competence-Press Model [15], the environment is viewed as a moderator between declining individual competence and the level of adaptation. Therefore, EREEM makes it possible to quantify this moderating role through spatial structure.

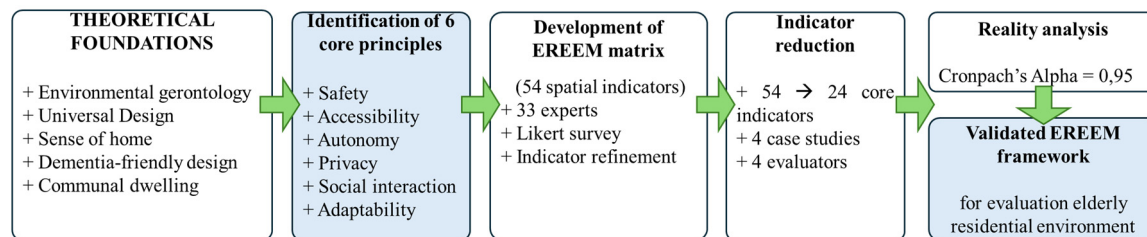


Figure 7. Exploratory application process of the EREEM framework (Source: author). Note: This evaluation framework was developed through a multi-stage process integrating theoretical synthesis, expert validation, and architectural field assessment. The resulting set of 24 spatial indicators demonstrated high internal consistency (Cronbach's $\alpha = 0.951$), confirming the reliability of the EREEM matrix as an environmental assessment tool for residential settings for older adults.

3.3. Survey Design and Data Collection

To validate the proposed EREEM matrix, the study conducted a questionnaire survey with a group of experts. Direct surveys of older adults were not conducted due to research ethics considerations and possible cognitive limitations that could affect the reliability of responses. Therefore, the study employed expert evaluation combined with architectural field assessment, a method commonly used in environmental gerontology research.

The expert survey was conducted using purposive sampling, in which experts were selected based on professional reputation and relevant expertise in elderly residential environments, including architecture, urban planning, and healthcare. Participants evaluated the relevance and importance of design principles and indicators using a five-point Likert scale. Based on the collected results, the indicator set was reduced for field evaluation at four projects by four assessors (three architects and one interior design graduate). To minimize evaluation bias, all field investigators were trained to use the same assessment procedure before data collection.

The field survey was conducted in four representative residential environments in Vietnam, including a state nursing home (Case 1), a private nursing home (Case 2), a religious shelter (Case 3), and a Multi-generational house (Case 4).

The mean score for each indicator was calculated as follows:

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$
 where x_i is the score given by respondent i , and n is the total number of respondents.

The mean values were interpreted using interval interpolation as follows: 1.00-1.80 (very low), 1.81-2.60 (low), 2.61-3.40 (medium), 3.41-4.20 (high), and 4.21-5.00 (very high). The reliability of the questionnaire was assessed using Cronbach's alpha (1951):

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum \sigma_i^2}{\sigma_T^2} \right); \text{ A value above 0.7 indicates acceptable internal consistency.}$$

4. Survey Results and Validation of the EREEM Framework by Experts

4.1. Profile of the Experts Participating in the Survey

The expert survey obtained 36 valid responses from specialists with experience related to residential environments for older adults. Because the questionnaire allowed the selection of multiple professional roles, some participants belonged to more than one field; therefore, the total proportion may exceed 100%.

Among them, architects represented the largest proportion, with 29 selections (80.6%), followed by urban planning specialists with 6 selections (16.7%). There were also gerontology specialists (2 selections, 5.60%), managers of elderly care facilities (1 selection, 2.80%), and an "other" group (4 selections, 11.4%), mainly including a musculoskeletal physician (1 selection, 2.80%), a nurse (1 selection, 2.80%), and others directly involved in elderly care settings.

In terms of years of experience, the group with fewer than 5 years accounted for the largest proportion (41.7%), while the group with more than 20 years also represented a substantial share (30.6%). Experts with 10-20 years of experience accounted for 16.7%, and those with 5-10 years accounted for 8.3%. This structure indicates that the sample combined both contemporary practical perspectives and long-term accumulated experience.

The survey sample structure reflects the interdisciplinary nature of the field of residential environments for older adults, combining perspectives from spatial design, urban planning, and healthcare experience. Although the architecture group dominated because the research focuses on evaluating the architectural environment, the participation of healthcare professionals enhances the practical relevance of the design principle evaluation process. The experts had an appropriate background to evaluate the EREEM framework in both family housing and long-term care facilities.

4.2. Reliability, Internal Consistency, and Applicability of the Expert Indicator Set

The reliability of the set of 54 indicators was tested using Cronbach's alpha to assess the internal consistency of the scale. The results showed an overall Cronbach's alpha of 0.978, reflecting a very high level of internal consistency. Although a high Cronbach's alpha indicates strong internal consistency, it may also partly reflect conceptual overlap among some indicators.

At the level of each principle group (Table 1), the Cronbach's alpha values were all good to very good: Safety = 0.91; Accessibility = 0.92; Autonomy = 0.93; Privacy = 0.92; Social Interaction = 0.94; Adaptability = 0.96. All values exceeded the threshold of 0.70, confirming that the six core principles possess methodological stability and form a consistent evaluation system within a conceptual structure. In addition, the questionnaire included a separate item asking experts to assess the relevance and applicability of each principle in Vietnam, with results ranging from high to very high (3.97 to 4.44).

Table 1. Reliability and perceived importance of the six environmental design principles.

| Principles | Mean | Cronbach's alpha | Mean importance |
|---------------|-------|------------------|-----------------|
| Safety | 4.287 | 0.906 | 4.444 |
| Accessibility | 4.238 | 0.915 | 4.333 |

| | | | |
|--------------------|-------|-------|-------|
| Social interaction | 4.096 | 0.934 | 4.111 |
| Autonomy | 4.059 | 0.916 | 4.057 |
| Adaptability | 3.904 | 0.937 | 4.029 |
| Privacy | 3.892 | 0.962 | 3.972 |

Overall, the experts did not view these six principles as independent criteria but as interconnected components within an integrated residential environmental system.

4.3. Importance and Cross-Comparison of the Six Core Design Principles

The survey results in Table 1 show that all six principles were rated from high to very high. Specifically, Safety received the highest mean score (Mean = 4.29), followed by Accessibility (4.24), Social Interaction (4.10), Autonomy (4.10), Adaptability (3.90), and Privacy (3.89). This ranking indicates that experts clearly prioritized foundational conditions related to circulation safety, fall prevention, barrier-free design, and spatial accessibility. At the same time, it is notable that Social Interaction scored higher than both Adaptability and Privacy, reflecting the communal cultural characteristics of Vietnamese society, where family and community ties play an important role in the lives of older adults.

To further investigate the relationships among the six principles, a correlation analysis was conducted based on the expert survey results (Table 2). The correlation matrix shows several strong relationships among the principles, providing empirical support for the hierarchical structure of the proposed ecological framework.

Table 2. Correlation matrix of the six environmental design principles.

| Principles | Safety | Accessibility | Autonomy | Privacy | Social interaction | Adaptability |
|--------------------|--------|---------------|----------|---------|--------------------|--------------|
| Safety | 1.000 | 0.909 | 0.742 | 0.701 | 0.726 | 0.688 |
| Accessibility | 0.909 | 1.000 | 0.758 | 0.721 | 0.739 | 0.702 |
| Autonomy | 0.742 | 0.758 | 1.000 | 0.812 | 0.784 | 0.756 |
| Privacy | 0.701 | 0.721 | 0.812 | 1.000 | 0.898 | 0.863 |
| Social interaction | 0.726 | 0.739 | 0.784 | 0.898 | 1.000 | 0.882 |
| Adaptability | 0.688 | 0.702 | 0.756 | 0.863 | 0.882 | 1.000 |

From a structural perspective, these results reinforce the argument that the six principles should not be viewed as separate criteria but as a layered design ecosystem in which Safety and Accessibility play the most important foundational role.

4.4. Detailed Analysis of the Indicators and the Basis for Reduction from 54 to 24 Indicators

At the indicator level, the highest-scoring factors were concentrated mainly in the Safety and Accessibility groups. In particular, according to Table 3, the indicators with the highest ratings clearly reflect expert priorities regarding factors that reduce the risk of falls, support safe mobility, and maintain independent use. This is consistent with the theoretical foundations presented in Section 2, especially the Competence-Press Model, Universal Design, and studies on design for aging in place. In contrast, the relatively lowest-scoring indicators were concentrated in the Privacy and Adaptability groups. However, it should be emphasized that these values still fall within the range of 3.41-4.20 according to the interpolation method described in Section 3.3, meaning that they were still rated as high, indicating that they remain important but are more difficult to apply due to constraints of area, investment cost, and existing housing structure.

Table 3. Ranking of the highest-rated and lowest-rated indicators.

| Top highest-rated | Bottom lowest-rated |
|---|---|
| Non-slip bathroom design (4.75) | Personal space is separated (3.50) |
| Handrails on stairs (4.53) | Arrange space for personal activities (3.67) |
| Elevator placement in multi-story building (4.42) | Spaces that can be repurposed (3.70) |
| The restroom is easy to use (4.42) | The structural system allows for changes in layout (3.72) |
| Handrails along corridors (4.39) | The ability to control individual lighting (3.78) |

From these results, the theoretical set of 54 indicators was reduced to 24 core indicators based on three criteria: (1) higher expert ratings; (2) representativeness of the six principles; and (3) direct observability in architectural field surveys.

In other words, the 24 indicators represent the transition from a theoretical indicator set to an operational indicator set, suitable for evaluating actual projects while still retaining the original conceptual structure of EREEM. See more survey's result in Appendix C.

4.5. Reliability of the 24 Indicators in the Field Survey

After the 24 core indicators were used to evaluate four case-study projects, their reliability was again tested using Cronbach's alpha. The results showed that $\alpha_{24indicators} = 0.951$, indicating a very high level of internal consistency. This value is important in two respects. First, it confirms that the reduction from 54 to 24 indicators did not diminish the reliability of the evaluation tool. Second, it shows that the reduced indicator set is not only theoretically appropriate but also sufficiently stable for application in actual architectural evaluation. Thus, EREEM is not only a theoretical synthesis framework but also a highly reliable spatial evaluation tool.


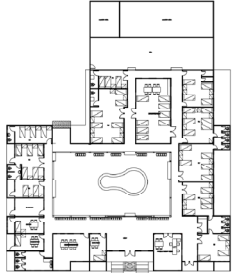
Table 4. Mean values of the field survey across four case studies.

| Principles | Case 1 | Case 2 | Case 3 | Case 4 |
|------------|--------|--------|--------|--------|
| Safety | 1.38 | 2.50 | 1.88 | 0.94 |

| | | | | |
|--------------------|------|------|------|------|
| Accessibility | 1.00 | 1.75 | 1.44 | 0.88 |
| Autonomy | 1.50 | 2.25 | 1.31 | 1.75 |
| Privacy | 1.75 | 2.19 | 1.13 | 1.56 |
| Social interaction | 1.44 | 2.44 | 1.19 | 1.50 |
| Adaptability | 1.31 | 2.25 | 1.00 | 1.19 |
| Overall mean | 1.40 | 2.23 | 1.32 | 1.30 |

4.6. Cross-Comparison of the Four Surveyed Projects

To facilitate visual comparison among the four residential environments, Figure 8 presents the representative spatial configurations and architectural conditions observed in the field survey. The study proposes four real-world case studies that serve as experimental trials to verify the theoretical framework.

| Case | Type | Image | Plan |
|--------|--------------------|---|---|
| Case 1 | State nursing home |  |  |


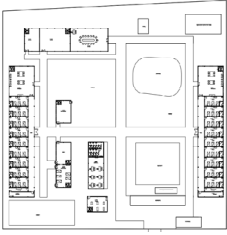

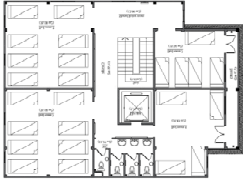
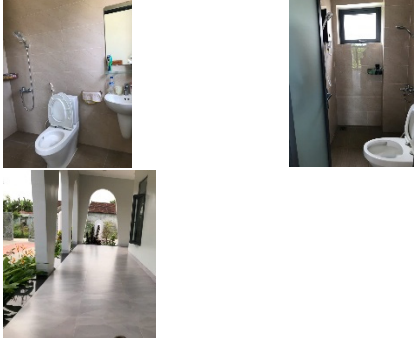
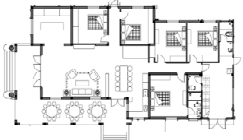
| | | | |
|--------|--------------------------|--|---|
| Case 2 | Private nursing home |  |  |
| Case 3 | Religious shelter |  |  |
| Case 4 | Multi-generational house |  |  |

Figure 8. Overview of the four residential environments surveyed in Vietnam (Source: Author).

The field assessment was conducted in four projects representing different types of residential environments for older adults in Vietnam: Case 1 - State nursing home; Case 2 - Private nursing home; Case 3 - Religious shelter in a pagoda; and Case 4 - Multi-generational house. The overall project scores show a clear difference among projects with different levels of systematic investment (Figure 9).

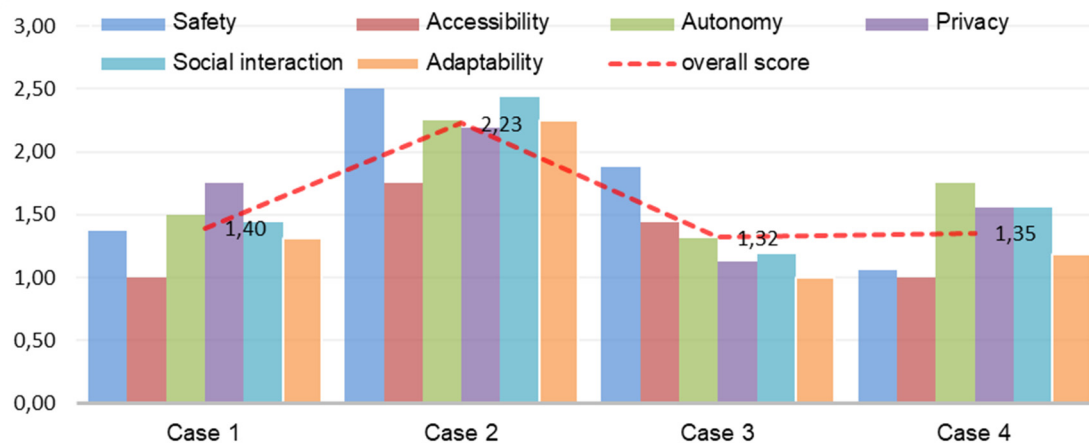


Figure 9. Principles summary result and overall score of case site visited (Source: Author).

Case 2 achieved the highest mean score (2.23 (on a 3-point scale)), significantly exceeding Case 1 (1.40), Case 3 (1.32), and Case 4 (1.35). This result indicates that a care environment that is intentionally designed and relatively well invested can better satisfy the principles of EREEM.

In terms of individual principles, Case 2 scored highest in most groups: Safety = 2.50; Accessibility = 1.75; Autonomy = 2.25; Privacy = 2.19; Social Interaction = 2.44; Adaptability = 2.25. This was the only project that showed a relatively balanced level across the foundational layer (safety - accessibility), the personal control layer (autonomy - privacy), the relational layer (social interaction), and the temporal layer (adaptability).

Case 1 achieved a lower overall score, with particular limitations in Accessibility (1.00) and Adaptability (1.31), indicating that this facility only partially meets basic environmental conditions and is not yet sufficiently flexible to support long-term change during the ageing process.

Case 3 - achieved a relatively good score in Safety (1.88) due to the presence of handrails along walls, stairs, and anti-slip flooring, but scored low in Privacy (1.13), Social Interaction (1.19), and Adaptability (1.00) because the space is cramped and the number of older residents is too large relative to the scale of the building. This shows that a self-organized care model may maintain some minimum conditions of safety but lacks a specialized spatial structure capable of adequately supporting psychological, social, and long-term adaptive needs.

Case 4 - represents a highly characteristic and common model in Vietnam. This project achieved relatively good scores in Autonomy (1.75) and Privacy (1.56) due to the suitable interior architectural space and ease of toilet use, reflecting the advantages of a familiar environment and family support. However, its Safety (0.94) and Accessibility (0.88) scores were the lowest among the projects because of the absence of handrails along corridors and bathrooms, the lack of an elevator, and difficulty in using door handles. This indicates that traditional housing has not yet been designed according to Universal Design principles and may become risky when the physical competence of older adults declines with age.

4.7. Consistency Between the Expert Survey and the Field Survey

An important finding of the study is the relatively high correspondence between expert evaluations and actual project performance in the field. In the expert survey, Safety and Accessibility were the two highest-rated principles (4.29 and 4.24) and were also the two principles experts considered most applicable in Vietnam (4.44 and 4.33). In the field survey, Case 2 - the project with the highest overall score (mean: 2.23) - also achieved the highest scores in these two principles (2.50 and 1.75). Conversely, environments with low scores in Safety and Accessibility also tended to score lower in higher-level principles such as Autonomy, Social Interaction, and Adaptability. This suggests that the foundational principles do not merely play a technical role but also exert a cascading influence on the overall quality of the residential environment.

Correlation analysis among the six principles in the expert survey also supports this interpretation. The strongest relationship was found between Safety and Accessibility ($r = 0.88$), while the cluster of Privacy - Social Interaction - Adaptability also showed high correlation ($r = 0.86-0.898$). These results indicate that the six principles form an interconnected design system rather than a set of independent criteria.

Thus, the field survey not only illustrates differences among residential environment types but also serves as empirical validation for the structural logic of EREEM established from the expert survey.

In summary, the results of both the expert survey and the field survey show that EREEM possesses both methodological reliability and practical applicability. The original set of 54 indicators achieved very high internal consistency (Cronbach's $\alpha = 0.978$), while the reduced set of 24 indicators maintained strong reliability in field assessment (0.951). The correspondence between expert priorities and the actual spatial performance of the surveyed projects reinforces the validity of EREEM as an evaluation framework for residential environments for older adults in the Vietnamese context.

5. Discussion

5.1. Consistency Between Expert Evaluation and Field Evaluation

The results of the architectural field assessment show a strong similarity to the expert survey results previously conducted in this study. Experts rated all six principles highly, with safety and accessibility receiving the highest priority, both achieving mean scores above 4.17 on the Likert scale.

The case study analysis confirms this priority: environments that performed better in safety and accessibility - particularly the private nursing home (Case 2) - also achieved higher scores in higher-level principles such as autonomy, social interaction, and adaptability. This pattern supports the proposed ecological hierarchy within the conceptual framework, in which basic environmental conditions influence the effectiveness of higher-order environmental qualities.

5.2. Differences Between Institutional Care Environments and Informal Care Environments

Comparison among the four case studies reveals significant differences in environmental performance. The private nursing home (Case 2) consistently achieved the highest scores across all six principles, indicating that a purposefully designed care environment can provide better spatial support conditions for older adults. In contrast, the pagoda shelter (Case 3) and the multigenerational household (Case 4) demonstrated lower levels of environmental support, particularly in accessibility and adaptability.

These findings reflect the reality of many ageing societies in Southeast Asia, where care environments often emerge informally and were not originally designed specifically for older adults.

5.3. Implications for Aging in Place

Interestingly, the multigenerational household (Case 4) showed a relatively higher autonomy score despite lower levels of safety and accessibility. This suggests that environmental familiarity and strong family relationships may partly compensate for spatial limitations. However, the absence of Universal Design features may increase long-term environmental risks as residents' physical competence declines. This highlights the importance of integrating age-responsive design principles into ordinary housing environments, not only into formal care institutions.

5.4. Reliability and Applicability of the EREEM Framework

The reliability analysis of the 24 spatial indicators produced a Cronbach's α value of 0.951, indicating excellent internal consistency. This result confirms that the reduced indicator set provides a stable and coherent framework for assessing residential environments for older adults. More importantly, the framework narrows the gap between theoretical concepts in environmental

gerontology and practical architectural assessment, enabling designers and planners to systematically evaluate residential environments for older adults.

By supporting older adults in remaining at home and improving their residential environments, this framework contributes to the broader goal of social sustainability in rapidly ageing societies.

5.5. Research limitations

Although the study proposes the EREEM evaluation framework and provides preliminary validation through expert survey and field survey, several limitations should be acknowledged. First, the number of case studies remains limited and should be understood as only an initial empirical validation. Second, the evaluation process relied mainly on expert opinion and architectural field assessment rather than direct surveys of older adults, in order to ensure research ethics and avoid potential bias caused by cognitive limitations. Third, the study was conducted within the specific cultural and housing context of Vietnam; therefore, further studies are needed to test its applicability in other contexts.

1. Contribution to Sustainability

Population ageing is becoming one of the major demographic challenges of the twenty-first century, while multigenerational families remain common in Vietnam. This situation requires appropriate strategies for designing residential environments for older adults. In this context, the study contributes to sustainability in three main respects:

First, from a theoretical perspective, the study proposes the Ecological Framework of Six Core Principles for residential environments for older adults, including *Safety, Accessibility, Autonomy, Privacy, Social Interaction, and Adaptability*. This framework approaches the residential environment as a multidimensional spatial ecosystem, emphasizing the interrelationship among physical, social, and psychological factors in the living environment of older adults.

Second, from a methodological perspective, the study develops and validates the Elderly Residential Environment Evaluation Matrix (EREEM). Through expert survey and statistical reliability testing, the initial set of 54 indicators was reduced to 24 core indicators that can be applied in field assessment while still maintaining high reliability.

Third, from a practical perspective, the field survey results reveal significant differences among types of residential environments for older adults in Vietnam. These findings indicate that integrating age-friendly design principles into existing housing and long-term care facilities is important for improving quality of life and promoting aging in place within the context of population ageing.

Fourth, this policy framework contributes to the Sustainable Development Goals, particularly SDG 3 (Good Health and Well-being), SDG 10 (Reduced Inequalities), and SDG 11 (Sustainable Cities and Communities).

7. Conclusion

Older adults spend most of their time in indoor residential environments, where the physical environment directly affects safety, autonomy, and quality of life in the context of physical, cognitive, and psychological decline associated with ageing. This study aimed to develop and validate an evaluation framework for residential environments for older adults based on an ecological approach. Through theoretical synthesis and expert survey, the study identified six core principles - *Safety, Accessibility, Autonomy, Privacy, Social Interaction, and Adaptability* - as important components of age-friendly residential environments.

The results of the expert survey with 36 participants showed that the 54-indicator system had very high reliability (Cronbach's alpha = 0.978). Based on expert evaluation and field observability, the indicator set was reduced to 24 core indicators, which still maintained strong internal consistency when applied in project surveys (Cronbach's alpha = 0.951). This indicates that the EREEM framework can be used as a reliable evaluation tool for residential environments for older adults.

The results of the field survey across four types of residential environments for older adults in Vietnam show that Safety and Accessibility play a foundational role in improving the quality of the living environment. Environments that scored highly in these two principles also tended to achieve higher scores in other principles such as Autonomy, Social Interaction, and Adaptability, indicating a close interrelationship among the components of the residential environmental ecosystem.

Overall, the study contributes an environmentally based evaluation framework supported by both theoretical grounding and empirical validation, which may assist architects, planners, and facility managers in designing and improving residential environments for older adults. As Vietnam enters a period of rapid population ageing, the application of these design principles may contribute to promoting safer, more inclusive, and more sustainable residential models for older adults - especially in a context where multigenerational households remain common and attachment to familiar living environments remains strong.

Future studies may expand this framework through larger empirical samples, cross-cultural comparison, and the integration of more user-centered evaluation methods.

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Institutional Review Board Statement: Ethical review and approval were not required for this study in accordance with local legislation and institutional requirements, as the research did not involve clinical procedures or direct surveys with vulnerable elderly participants.

Informed Consent Statement: Informed consent was obtained from all experts involved in the questionnaire survey. No direct interviews or questionnaires were conducted with elderly residents.

Data Availability Statement: The data presented in this study are available within the article and its appendices. Additional information may be made available by the author upon reasonable request.

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Conflicts of Interest: The author declares no conflict of interest.

Appendix A

Appendix A. 54 indicators of the six principles and mean scores from the survey of 36 experts

| Principle | | Contents of indicators | Result |
|-----------|------|---|--------|
| Principle | Code | | |
| Safety | S1 | The floor uses anti-slip material | 4.36 |
| | S2 | There are no dangerous elevation differences on the walkway | 4.31 |
| | S3 | Ensure adequate lighting in walkways and staircases | 4.31 |
| | S4 | Handrail system in the hallway | 4.39 |
| | S5 | Handrails on the stairs | 4.53 |
| | S6 | Non-slip bathroom design | 4.75 |
| | S7 | There is an emergency alarm system | 3.92 |
| | S8 | Safe interior design with sharp angles | 4.00 |
| | S9 | Clear visibility in traffic areas | 4.03 |

| | | | |
|--------------------|-----|---|--|
| | | Please assess the appropriateness and necessity of the Safety indicator for evaluating the living environment for the elderly in Vietnam? | 4.44 |
| Accessibility | AC1 | Stepless walkway | 4.11 |
| | AC2 | The building's entrance is easily accessible | 3.94 |
| | AC3 | The corridor is wide enough for wheelchairs | 4.39 |
| | AC4 | The doorway is wide enough | 4.42 |
| | AC5 | The door handle is easy to use | 4.28 |
| | AC6 | Elevator placement in multi-story buildings | 4.42 |
| | AC7 | The walkway surface is flat | 4.25 |
| | AC8 | Install ramps for wheelchair users | 4.33 |
| | AC9 | Convenient connection between functional spaces | 4.14 |
| | | | How would you assess the appropriateness and necessity of this principle indicator (Accessibility) for evaluating the living environment for the elderly in Vietnam? |
| Autonomy | A1 | The space layout is easy to navigate | 4.03 |
| | A2 | Kitchens convenient for the elderly | 3.86 |
| | A3 | The restroom is easy to use | 4.42 |
| | A4 | The control devices are easily accessible | 3.94 |
| | A5 | Suitable interior height | 4.11 |
| | A6 | A space that allows elderly people to live independently | 4.03 |
| | A7 | Design that reduces reliance on assistants | 4.00 |
| | A8 | Easy-to-use household appliances | 3.92 |
| | A9 | The layout of the space supports daily living | 4.00 |
| | | | How do you assess the suitability and necessity of this principle indicator (Autonomy) for evaluating the living environment for the elderly in Vietnam? |
| Privacy | P1 | It has a separate bedroom | 3.83 |
| | P2 | Personal space is separated | 3.50 |
| | P3 | Control visibility from the outside | 4.08 |
| | P4 | Noise control | 4.19 |
| | P5 | There is a quiet resting area | 4.25 |
| | P6 | There is a private outdoor space | 3.81 |
| | P7 | Arrange space for personal activities | 3.67 |
| | P8 | Clearly separate private and shared spaces | 3.92 |
| | P9 | The ability to control individual lighting | 3.78 |
| | | | How do you assess the suitability and necessity of this principle indicator (Privacy) for evaluating the living environment for the elderly in Vietnam? |
| Social interaction | SI1 | There is a common living space | 4.28 |
| | SI2 | There is a reception area | 3.86 |

| | | | |
|--------------|-----|--|--|
| | SI3 | There is outdoor space for socializing | 4.03 |
| | SI4 | There is a community living area | 4.11 |
| | SI5 | A space that encourages communication | 3.89 |
| | SI6 | Place benches along the walkway | 4.25 |
| | SI7 | Convenient access to residential areas | 4.08 |
| | SI8 | Easy access to community amenities | 4.19 |
| | SI9 | Spaces that support social activities | 3.94 |
| | | How do you assess the suitability and necessity of this principle indicator (Social interaction) for evaluating the living environment for the elderly in Vietnam? | 4.11 |
| Adaptability | AD1 | The space is easy to renovate | 3.83 |
| | AD2 | The interior can be flexibly modified | 3.89 |
| | AD3 | Assistive care equipment can be installed | 4.11 |
| | AD4 | Designed to suit various health levels | 4.03 |
| | AD5 | Spaces that can be repurposed | 3.69 |
| | AD6 | The structural system allows for changes in layout | 3.72 |
| | AD7 | It has the potential to expand space | 3.86 |
| | AD8 | Flexible layout to suit needs | 4.03 |
| | AD9 | The design adapts to changes during the aging process | 3.97 |
| | | | How do you assess the suitability and necessity of this principle indicator (Adaptability) for evaluating the living environment for the elderly in Vietnam? |

Appendix B

Appendix B. Reduced set of 24 core EREEM indicators and mean scores obtained from the architectural field assessment of four residential environments

| Principle | | | Indicator content | Result of site visited | | | |
|-----------|---------------|------|--|------------------------|--------|--------|--------|
| No. | Principle | Code | | Case 1 | Case 2 | Case 3 | Case 4 |
| 1 | Safety | S1 | Non-slip bathroom design | 1.75 | 2.50 | 2.00 | 2.00 |
| 2 | Safety | S2 | Handrails on stairs | 1.25 | 2.25 | 2.00 | 0.25 |
| 3 | Safety | S3 | Handrails along corridors | 1.00 | 2.75 | 2.25 | 0.50 |
| 4 | Safety | S4 | Adequate lighting in circulation areas | 1.50 | 2.50 | 1.25 | 1.50 |
| 5 | Accessibility | AC1 | Elevator in multi-story buildings | 0.00 | 0.00 | 2.00 | 0.00 |
| 6 | Accessibility | AC2 | Corridors wide enough for wheelchair users | 2.00 | 3.00 | 1.25 | 2.00 |
| 7 | Accessibility | AC3 | Ramp access for wheelchair movement | 1.00 | 2.00 | 1.00 | 1.00 |
| 8 | Accessibility | AC4 | Easy-to-use door handles | 1.00 | 2.00 | 1.50 | 1.00 |
| 9 | Autonomy | A1 | Easy-to-use bathroom and toilet facilities | 1.00 | 2.25 | 1.25 | 2.00 |

| | | | | | | | |
|----|--------------------|-----|--|------|------|------|------|
| 10 | Autonomy | A2 | Furniture height suitable for older adults | 2.00 | 2.75 | 1.50 | 2.00 |
| 11 | Autonomy | A3 | Clear spatial orientation and circulation | 1.00 | 2.00 | 1.00 | 1.75 |
| 12 | Autonomy | A4 | Design supporting independent daily activities | 2.00 | 2.00 | 1.50 | 1.25 |
| 13 | Privacy | P1 | Quiet resting areas within the dwelling | 2.00 | 2.25 | 1.00 | 2.00 |
| 14 | Privacy | P2 | Acoustic control within living spaces | 1.25 | 2.00 | 1.25 | 1.00 |
| 15 | Privacy | P3 | Visual privacy from outside views | 2.00 | 2.50 | 1.25 | 1.25 |
| 16 | Privacy | P4 | Clear separation between private and shared spaces | 1.75 | 2.00 | 1.00 | 2.00 |
| 17 | Social interaction | SI1 | Shared living spaces for residents | 2.00 | 2.75 | 1.00 | 2.00 |
| 18 | Social interaction | SI2 | Community gathering areas | 1.00 | 2.50 | 1.00 | 2.00 |
| 19 | Social interaction | SI3 | Resting seats along circulation routes | 1.75 | 2.50 | 1.50 | 1.00 |
| 20 | Social interaction | SI4 | Spaces encouraging social interaction | 1.00 | 2.00 | 1.25 | 1.25 |
| 21 | Adaptability | AD1 | Provision for installing assistive devices | 1.00 | 3.00 | 1.00 | 1.00 |
| 22 | Adaptability | AD2 | Flexible spatial layout | 2.00 | 2.00 | 1.00 | 1.25 |
| 23 | Adaptability | AD3 | Design suitable for different health conditions | 1.25 | 2.00 | 1.00 | 1.50 |
| 24 | Adaptability | AD4 | Spatial adaptability to aging-related changes | 1.00 | 2.00 | 1.00 | 1.00 |

Appendix C

Appendix C. Detailed Likert (1–3) scoring matrix of the 24 EREEM indicators used in the field evaluation of the four case-study residential environments





































Note: 0 = Not present
 1 = Present but inadequate
 2 = Adequate
 3 = Well implemented

duc: Tran, Van-Duc (Author, Dr. Architect)
 my: Le, T. Hoa-My (Master student of Interior Design)
 huy: Lam, Gia-Huy (5th-year Architecture student)
 vy: Pham, N. Tuong-Vy (5th-year Architecture student)
 m1, m2, m3, m4: Mean 1 (Case 1), Mean 2 (case 2), Mean 3 (case 3), Mean 4 (case 4)

I: Illustration

My, Huy, and Vy are students the author is supervising on their graduation projects at Ton Duc Thang University, focusing on architecture for the elderly

Indicator codes correspond to the EREEM matrix presented in Appendix B

| No. | CONTENTS | | | CASE STUDY | | | | | | | | | | | | | | | | | | | | | | | |
|-----|-----------|--------------------|--|-------------------|----|-----|----|------|---|-----|----|-----|----|--------------------|---|-----|----|-----|---------------------|------|---|-----|----|-----|----|------|---|
| | Indicator | Principle | Description | THI NGHE (case 1) | | | | | BINH MY (case 2) | | | | | DIEU PHAP (case 3) | | | | | QUANG NGAI (case 4) | | | | | | | | |
| | | | | duc | my | huy | vy | m1 | I1 | duc | my | huy | vy | m2 | I2 | duc | my | huy | vy | m3 | I3 | duc | my | huy | vy | m4 | I4 |
| 1 | S1 | Safety | Non-slip bathroom design | 2 | 2 | 1 | 2 | 1,75 |  | 3 | 3 | 2 | 2 | 2,50 |  | 2 | 2 | 2 | 2 | 2,00 |  | 2 | 2 | 2 | 2 | 2,00 |  |
| 2 | S2 | Safety | Handrails on stairs and toilet | 2 | 1 | 1 | 1 | 1,25 |  | 2 | 2 | 3 | 2 | 2,25 |  | 2 | 2 | 2 | 2 | 2,00 |  | 0 | 0 | 1 | 0 | 0,25 |  |
| 3 | S3 | Safety | Handrails along corridors | 1 | 1 | 1 | 1 | 1,00 |  | 3 | 2 | 3 | 3 | 2,75 |  | 2 | 2 | 3 | 2 | 2,25 |  | 2 | 0 | 0 | 0 | 0,50 |  |
| 4 | S4 | Safety | Adequate lighting in circulation areas | 1 | 1 | 2 | 2 | 1,50 |  | 2 | 2 | 3 | 3 | 2,50 |  | 2 | 1 | 1 | 1 | 1,25 |  | 1 | 1 | 2 | 2 | 1,50 |  |
| 5 | AC1 | Accessibility | Elevator in multi-story buildings | 0 | 0 | 0 | 0 | 0,00 |  | 0 | 0 | 0 | 0 | 0,00 |  | 2 | 2 | 2 | 2 | 2,00 |  | 0 | 0 | 0 | 0 | 0,00 |  |
| 6 | AC2 | Accessibility | Corridors wide enough for wheelchair users | 2 | 2 | 2 | 2 | 2,00 |  | 3 | 3 | 3 | 3 | 3,00 |  | 1 | 1 | 2 | 1 | 1,25 |  | 2 | 2 | 2 | 2 | 2,00 |  |
| 7 | AC3 | Accessibility | Ramp access for wheelchair movement | 1 | 1 | 1 | 1 | 1,00 |  | 2 | 2 | 2 | 2 | 2,00 |  | 1 | 1 | 1 | 1 | 1,00 |  | 2 | 0 | 1 | 1 | 1,00 |  |
| 8 | AC4 | Accessibility | Easy-to-use door handles | 1 | 1 | 1 | 1 | 1,00 |  | 2 | 2 | 2 | 2 | 2,00 |  | 2 | 1 | 1 | 2 | 1,50 |  | 1 | 1 | 1 | 1 | 1,00 |  |
| 9 | A1 | Autonomy | Easy-to-use bathroom and toilet facilities | 1 | 1 | 1 | 1 | 1,00 |  | 2 | 2 | 3 | 2 | 2,25 |  | 1 | 1 | 2 | 1 | 1,25 |  | 2 | 2 | 2 | 2 | 2,00 |  |
| 10 | A2 | Autonomy | Furniture height suitable for older adults | 2 | 2 | 2 | 2 | 2,00 | | 3 | 3 | 2 | 3 | 2,75 | | 2 | 2 | 1 | 1 | 1,50 | | 2 | 2 | 2 | 2 | 2,00 | |
| 11 | A3 | Autonomy | Clear spatial orientation and circulation | 1 | 1 | 1 | 1 | 1,00 | | 2 | 2 | 2 | 2 | 2,00 | | 1 | 1 | 1 | 1 | 1,00 | | 1 | 2 | 2 | 2 | 1,75 | |
| 12 | A4 | Autonomy | Design supporting independent daily activities | 2 | 2 | 2 | 2 | 2,00 | | 2 | 2 | 2 | 2 | 2,00 | | 2 | 2 | 1 | 1 | 1,50 | | 1 | 1 | 1 | 2 | 1,25 | |
| 13 | P1 | Privacy | Quiet resting areas within the dwelling | 2 | 2 | 2 | 2 | 2,00 | | 2 | 2 | 3 | 2 | 2,25 | | 1 | 1 | 1 | 1 | 1,00 | | 2 | 2 | 2 | 2 | 2,00 | |
| 14 | P2 | Privacy | Acoustic control within living spaces | 1 | 1 | 2 | 1 | 1,25 | | 2 | 2 | 2 | 2 | 2,00 | | 1 | 1 | 2 | 1 | 1,25 | | 1 | 1 | 1 | 1 | 1,00 | |
| 15 | P3 | Privacy | Visual privacy from outside views | 2 | 2 | 2 | 2 | 2,00 | | 2 | 2 | 3 | 3 | 2,50 | | 1 | 1 | 2 | 1 | 1,25 | | 1 | 1 | 2 | 1 | 1,25 | |
| 16 | P4 | Privacy | Clear separation between private and shared spaces | 2 | 2 | 1 | 2 | 1,75 | | 2 | 2 | 2 | 2 | 2,00 | | 1 | 1 | 1 | 1 | 1,00 | | 2 | 2 | 2 | 2 | 2,00 | |
| 17 | SI1 | Social Interaction | Shared living spaces for residents | 2 | 2 | 2 | 2 | 2,00 | | 3 | 3 | 2 | 3 | 2,75 | | 1 | 1 | 1 | 1 | 1,00 | | 2 | 2 | 2 | 2 | 2,00 | |
| 18 | SI2 | Social Interaction | Community gathering areas | 1 | 1 | 1 | 1 | 1,00 | | 2 | 2 | 3 | 3 | 2,50 | | 1 | 1 | 1 | 1 | 1,00 | | 2 | 2 | 2 | 2 | 2,00 | |
| 19 | SI3 | Social Interaction | Resting seats along circulation routes | 2 | 2 | 2 | 1 | 1,75 | | 2 | 2 | 3 | 3 | 2,50 | | 2 | 1 | 2 | 1 | 1,50 | | 1 | 1 | 1 | 1 | 1,00 | |
| 20 | SI4 | Social Interaction | Spaces encouraging social interaction | 1 | 1 | 1 | 1 | 1,00 | | 2 | 2 | 2 | 2 | 2,00 | | 1 | 1 | 2 | 1 | 1,25 | | 2 | 1 | 1 | 1 | 1,25 | |
| 21 | AD1 | Adaptability | Provision for installing assistive devices | 1 | 1 | 1 | 1 | 1,00 | | 3 | 3 | 3 | 3 | 3,00 | | 1 | 1 | 1 | 1 | 1,00 | | 1 | 1 | 1 | 1 | 1,00 | |
| 22 | AD2 | Adaptability | Flexible spatial layout | 2 | 2 | 2 | 2 | 2,00 | | 2 | 2 | 2 | 2 | 2,00 | | 1 | 1 | 1 | 1 | 1,00 | | 1 | 2 | 1 | 1 | 1,25 | |
| 23 | AD3 | Adaptability | Design suitable for different health conditions | 1 | 1 | 2 | 1 | 1,25 | | 2 | 2 | 2 | 2 | 2,00 | | 1 | 1 | 1 | 1 | 1,00 | | 1 | 1 | 2 | 2 | 1,50 | |
| 24 | AD4 | Adaptability | Spatial adaptability to aging-related changes | 1 | 1 | 1 | 1 | 1,00 | | 2 | 2 | 2 | 2 | 2,00 | | 1 | 1 | 1 | 1 | 1,00 | | 1 | 1 | 1 | 1 | 1,00 | |

The indicator codes correspond to the six core principles of the EREEM framework: Safety (S), Accessibility (AC), Autonomy (A), Privacy (P), Social Interaction (SI), and Adaptability (AD).

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