Research Inventy: International Journal of Engineering and Science
Vol.16, Issue 7 (July 2026), PP 98-105
Issn (e): 2278-4721, Issn (p):2319-6483, www.researchinventy.com

Application of Behavioral Architecture in the Rear Living Spaces of Permanent Housing at Tondo 1, Palu City

Auliasyah Bayunikarsa[1*], Zaenal Siradjuddin[2], Ahda Mulyati[3], Muhammad Bakri[4]

**1Master's Program in Architecture, Faculty of Engineering, Tadulako University*
2Master's Program in Architecture, Faculty of Engineering, Tadulako University
3Master's Program in Architecture, Faculty of Engineering, Tadulako University
4Master's Program in Architecture, Faculty of Engineering, Tadulako University
**Corresponding Author*

Abstract:*This study examines the application of behavioral architecture in the rear living spaces of the Permanent Housing (Huntap) Tondo 1 in Palu City, a post-disaster relocation area following the 2018 earthquake, tsunami, and liquefaction. Behavioral architecture is grounded in the reciprocal relationship between human behavior and the built environment, wherein the activities, habits, and needs of occupants directly shape and transform the configuration of living spaces. The research employs a descriptive qualitative approach through field observations, interviews, and documentation of 16 housing units, supplemented by Space Syntax analysis (Visibility Graph Analysis/VGA) using DepthmapX software. The findings reveal that all rear yards have undergone transformation from service zones into multifunctional zones through occupant behavioral adaptation processes. These transformations are classified into six multifunctional typologies, with Type C (Service + Semi-Public + Private) emerging as the dominant pattern (37.50%). The primary drivers of change include the need for more adequate kitchen facilities (62.5%), demand for family gathering spaces (56.25%), increasing household size (43.75%), spatial constraints of the original building (37.5%), economic necessities and privacy requirements (31.25% each), and occupant habits (12.5%). Space Syntax analysis confirms that behavioral spatial modifications enhance connectivity and visual integration values, positioning the rear yard as a new spatial core within the housing configuration.*

Keywords: *behavioral architecture, rear yard, post-disaster housing, multifunctional space, Space Syntaxci*

Date of Submission: 09-07-2026 Date of Acceptance: 20-07-2026

I. INTRODUCTION

The natural disaster that struck Palu City on September 28, 2018—comprising an earthquake, tsunami, and liquefaction—resulted in massive destruction of thousands of residential units. As a governmental response to post-disaster housing recovery, the Tondo 1 Permanent Housing (Huntap) was established in Tondo Subdistrict, Mantikulore District, Palu City. This area encompasses 1,532 to 1,563 housing units built on approximately 30 hectares of land, managed by various organizations including the Buddha Tzu Chi Foundation and the AHA Center.

The Tondo 1 Permanent Housing was constructed with a standard design of 36 m² floor area on approximately 150 m² plots. Although designed to meet basic needs, this uniform design fails to adequately accommodate the diverse requirements, habits, and activity patterns of occupants originating from various socioeconomic and cultural backgrounds.

Within the behavioral architecture perspective, residential space is not merely a static container but rather an entity that continuously evolves in response to the behaviors, activities, and needs of its inhabitants. Rapoport (1969) asserts that spatial organization develops following the activities, culture, and needs of its occupants; the house is understood as a dynamic environment wherein the form and function of space transform as occupant activities change. This concept serves as the foundational framework for understanding how Tondo 1 Huntap residents respond to the limitations of the initial housing design.

The rear yard, initially designed as an open service zone, has become the area most intensively transformed due to behavioral pressures from occupants. All 16 housing units constituting the research sample exhibit modifications to the rear yard, with varying forms and levels of complexity. This transformation reflects the spatial behavioral patterns of occupants in adapting to spatial constraints through physical building modifications.

This research aims to: (1) identify the forms of behavioral architecture application in the Tondo 1 Huntap rear yards; (2) analyze the behavioral factors driving spatial functional transformations; (3) map the

multifunctional typologies emerging from occupant behavioral adaptation; and (4) evaluate the impact of spatial behavioral changes on housing spatial configuration through the Space Syntax approach.

II. RESEARCH METHODOLOGY

This study employs a descriptive qualitative approach utilizing field observations, in-depth interviews, and photographic documentation of 16 housing units in Tondo 1 Huntap. Sample selection was conducted purposively based on the diversity of occupant characteristics, including variations in length of occupancy, household size, occupation type, and regional origin of respondents.

Primary data were obtained through:

1.1 **Direct observation**

Direct observation was conducted at each sampled housing unit to obtain an overview of the actual condition of the rear yard. Observation activities included identification of emergent spatial functions, forms of physical building modifications, types of materials used, and the relationships between original spaces and developed spaces.

1.2 **Structured interviews**

Interviews were conducted with occupants using systematically prepared questionnaires. The interview objectives were to explore information regarding the reasons for modifications, evolving spatial needs, daily activities, family socioeconomic conditions, and the decision-making processes in developing the rear yard.

1.3 **Field measurement**

Field measurements were conducted at each housing unit to obtain actual building dimensions, including all spatial additions undertaken by occupants. Measurement results were used to accurately redraw existing floor plans for comparison with the standard initial design. These actual plans served as the basis for spatial configuration analysis and modeling in DepthmapX software.

1.4**Space syntax analysis**

Space Syntax analysis was conducted using the Visibility Graph Analysis (VGA) method in DepthmapX software version 0.8.0. The analyzed parameters were Connectivity and Visual Integration, compared between the initial standard floor plan and the actual condition of each dwelling. This analysis aimed to quantitatively measure the impact of spatial behavioral changes on housing spatial configuration.

Data analysis proceeded through three stages: (1) identification of spatial function and zoning changes; (2) classification of multifunctional typologies based on the combination of zones formed; and (3) analysis of behavioral factors causing changes, integrated with Space Syntax analysis results to build a comprehensive understanding of behavioral architecture application.

III. RESULTS AND DISCUSSION

3.1 Occupant characteristics as determinants of spatial behavior

Understanding the application of behavioral architecture in Tondo 1 Huntap cannot be separated from occupant characteristics as the subjects whose behaviors shape spatial change. Among the 16 respondent families (R-01 through R-16), all have occupied their dwellings for 5 to 6 years.

In terms of regional origin, respondents came from 7 disaster-affected locations, with a predominance from Petobo (7 families), followed by Balaroa (3 families), and other locations. This diversity of origins indicates varied cultural backgrounds and living habits brought into the new housing. Within the behavioral architecture perspective, these habits and cultural backgrounds constitute predisposing factors that influence how occupants use and modify space.

Household size varies from 2 to 10 individuals, with an average of 5.06 persons per family. This variation is significant in behavioral architecture because spatial demand pressure increases proportionally with household size. Families with 10 members (R-03 and R-12) face considerably higher spatial pressure than families with 2 members (R-01), resulting in markedly different spatial modification patterns.

Regarding employment, 12 families (75%) work in the informal sector (entrepreneurs, self-employed individuals, traders, daily laborers). This characteristic is highly relevant to behavioral architecture, as informal sector workers tend to integrate economic activities into living spaces, driving spatial adaptations that accommodate productive functions within or around the house.

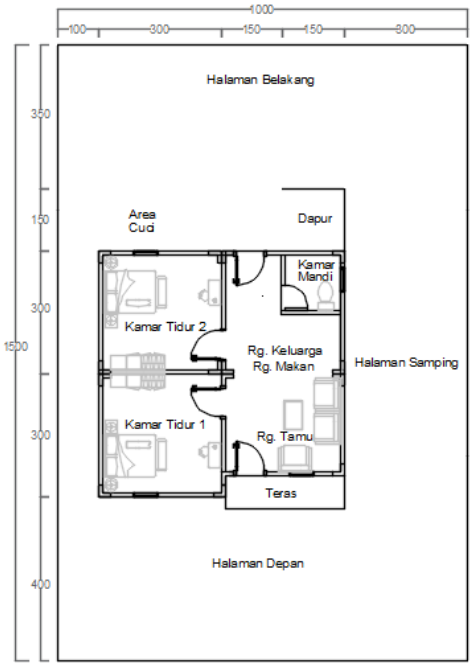
Table 1. Characteristics of tondo 1 huntap residents, palu city

Code	Length of Occupancy	Area of Origin	Household Size	Occupation	Size of Previous House
R-01	6 years	Tanjung Tada	2 persons	Entrepreneur	Same type 36
R-02	5 years	Petobo	3 persons	Civil Servant	Above type 36
R-03	5 years	Balaroa	10 persons	Homemaker	Above type 36
R-04	6 years	Duyu	4 persons	Trader	Above type 36
R-05	6 years	Petobo	4 persons	Trader	Same type 36
R-06	5 years	Petobo	4 persons	Police Officer	Above type 36
R-07	6 years	Petobo	4 persons	Entrepreneur	Same type 36
R-08	5 years	Petobo	7 persons	Entrepreneur	Above type 36
R-09	6 years	Pantoloan	5 persons	Homemaker	Above type 36
R-10	6 years	Petobo	5 persons	Entrepreneur	Above type 36
R-11	5 years	Tondo	5 persons	Self-employed	Same type 36
R-12	5 years	Panau/Taweli	10 persons	Self-employed	Above type 36
R-13	5 years	Petobo	4 persons	Civil Servant	Above type 36
R-14	5 years	Balaroa	4 persons	Trader	Same type 36
R-15	5 years	Balaroa	4 persons	Self-employed	Above type 36
R-16	5 years	Petobo	3 persons	Daily Laborer	Above type 36

3.2 Initial housing condition: the starting point of behavioral adaptation

The Tondo 1 Permanent Housing was designed as a standard type of 36 m² on plots of approximately 150 m². The initial design comprised a front porch (public zone), living/family room (semi-public zone), two bedrooms (private zone), a bathroom, and a rear yard classified as a service zone. The rear yard was originally an open area without permanent structures, planned only as a service space for washing, drying, and air circulation. (Figure 1)

Figure 1. Initial standard floor plan of the dwelling



From the behavioral architecture perspective, this initial condition creates significant "behavioral pressure": the uniform and limited design fails to accommodate the diversity of behaviors and activity needs of occupants. The absence of a permanent kitchen, for instance, directly drives occupants to create cooking spaces in the rear yard as a behavioral response to basic household needs.

Table 2. Initial zoning of tondo 1 permanent housing

Zone	Space	Initial Function
Public	Front Porch	Reception area and transitional space between rooms
Semi-Public	Living/Family Room	Shared activities and receiving guests
Private	Bedrooms 1 & 2	Rest and private activities of occupants
Service	Bathroom + Rear Yard	Sanitation and open service space for household activities

3.3 Patterns of spatial function transformation

The application of behavioral architecture in the rear yard is reflected in the diverse new functions emerging as responses to occupant activity needs. The most dominant functions are kitchen and washing areas, each found in 15 of 16 respondents (93.75%). The high frequency of these functions reflects the most fundamental behavioral pressure: the need for cooking facilities that remain unaccommodated in the initial housing design.

3.3.1 Patterns of spatial function transformation

The application of behavioral architecture in the rear yard is reflected in the diverse new functions emerging as responses to occupant activity needs. The most dominant functions are kitchen and washing areas, each found in 15 of 16 respondents (93.75%). The high frequency of these functions reflects the most fundamental behavioral pressure: the need for cooking facilities that remain unaccommodated in the initial housing design.

Table 3. Summary of rear yard function transformations

New Function	Number of Respondents	Percentage	Behavioral Driver
Kitchen	15	93.75%	Daily cooking requirements
Washing area	15	93.75%	Household hygiene activities
Dining room	14	87.50%	Family dining together habits
Family/gathering room	8	50.00%	Family social interaction needs
Additional bedroom	7	43.75%	Increasing household size
Business space	5	31.25%	Productive economic needs
Drying area	4	25.00%	Basic domestic activities
Additional bathroom	4	25.00%	Sanitation needs of large families
Storage room	1	6.25%	Storage needs
Chicken coop	1	6.25%	Subsistence household activities
Vertical floor addition	1	6.25%	Limited horizontal land

The emergence of dining rooms in 14 respondents (87.50%) reflects the social behavior of occupants requiring spaces for family interaction during meals. This is not merely a functional addition but represents an expression of occupants' socio-cultural values manifesting in physical spacethe core of behavioral architecture.

The transformation into family/gathering spaces in 8 respondents (50.00%) signifies a more substantial shift: the rear yard evolves from a service area into a social interaction space. This demonstrates that occupants' social behavior (the habit of gathering with family) actively creates new spatial typologies absent from the initial design.

3.3.2 Physical and material changes as behavioral expressions

Behavioral changes in space usage produce measurable physical transformations. Materials used reflect occupant behavioral strategies in optimizing available resources. Lightweight steel dominates as roofing material due to its lightweight nature, economic feasibility, and ease of installationreflecting adaptive occupant behavior with limited economic capacity who nonetheless strive to meet spatial needs.

Table 4. Physical and material changes as behavioral expressions

Material	Type of Change	Respondents	Behavioral Significance
Lightweight steel	Semi-permanent/permanent roofing	Majority	Economic strategy, incremental, and adaptive
Concrete block + concrete	Permanent walls	R-04, R-05, R-07, R-08, R-11, R-12, R-14	Long-term commitment to new functions
Gypsum	Semi-permanent partitions	R-02, R-06, R-09, R-13, R-16	Flexibility and middle-level economic capacity
Wood	Lightweight structure/fencing	R-03, R-10	Utilization of available and affordable materials
Red brick + concrete	Full permanent construction	R-03, R-15	Need for high-quality construction spaces

3.4Zoning change analysis: spatial behavioral restructuring

From the behavioral architecture perspective, zoning changes represent the clearest indicator of how occupant behavior restructures spatial organization. Analysis of zoning changes across the 16 housing units demonstrates that all respondents have shifted from a single service zone toward more complex zone combinations.

Table 5. Analysis of rear yard zoning changes

Respondent	Initial Zone	Actual Zone	Primary Behavioral Driver
R-01	Service	Service + Semi-Public	Need for family gathering space
R-02	Service	Service + Semi-Public	Comfort in domestic activities
R-03	Service	Service + Semi-Public + Economic	Productive economic needs
R-04	Service	Semi-Public + Private + Economic	Spatial constraints + economic needs
R-05	Service	Service + Semi-Public + Economic	Grocery kiosk business
R-06	Service	Service + Semi-Public + Private	Increasing household size
R-07	Service	Service + Semi-Public	Gathering habits + subsistence activities
R-08	Service	Service + Semi-Public + Private	Large family (7 members)
R-09	Service	Service + Semi-Public + Private	Increasing household size
R-10	Service	Service	Improvement of service function quality
R-11	Service	Service + Semi-Public	Family gathering habits
R-12	Service	Service + Semi-Public + Private	Large family (10 members)
R-13	Service	Service + Semi-Public + Private	Privacy needs
R-14	Service	Service + Semi-Public + Private + Economic	Business + spatial needs
R-15	Service	Service + Semi-Public + Economic	Production kitchen + family space
R-16	Service	Service + Semi-Public + Private	Increasing household size

The summary of zoning changes indicates that the dominant pattern is Service + Semi-Public + Private (6 respondents, 37.50%), followed by Service + Semi-Public (4 respondents, 25.00%), and Service + Semi-Public + Economic (3 respondents, 18.75%). Only 1 respondent (6.25%) still maintains the rear yard as a pure service zone. This data empirically demonstrates that occupant behavioral pressures consistently drive the expansion and complexification of spatial zones.

Notably, R-04 represents the most extreme case of behavioral architecture application: the rear yard transformed into a combination of Semi-Public + Private + Economic zones without retaining any service character whatsoever. The vertical development (second-floor addition) undertaken by R-04 reflects innovative adaptive behavior when spatial demand pressure is extremely high but horizontal land is insufficient.

3.5Multifunctional typologies: mapping spatial behavioral patterns

The classification of multifunctional typologies represents an effort to systematize occupant spatial behavioral patterns. The six identified types describe the adaptation spectrum from the simplest (maintaining service functions) to the most complex (full integration of service, semi-public, private, and economic functions).

Table 6. Classification of rear yard multifunctional typologies

Type	Zone Combination	Respondents	N	%
A	Service	R-10	1	6.25%
B	Service + Semi-Public	R-01, R-02, R-07, R-11	4	25.00%
C	Service + Semi-Public + Private	R-06, R-08, R-09, R-12, R-13, R-16	6	37.50%
D	Service + Semi-Public + Economic	R-03, R-05, R-15	3	18.75%
E	Service + Semi-Public + Private + Economic	R-14	1	6.25%
F	Semi-Public + Private + Economic	R-04	1	6.25%
Total			**16**	**100%**

Type C as the dominant typology (37.50%) reflects occupant behavior that requires not only domestic and social spaces but also additional private space due to increasing household size. This demonstrates that demographic pressure (household growth) constitutes one of the strongest behavioral drivers in spatial transformation.

Type B (25.00%) reflects occupants whose primary needs are adequate domestic space and social interaction space. This type is generally found in families with stable household size and adequate income. Type D (18.75%) indicates that economic pressure drives some occupants to integrate productive functions into living spacesa distinctive form of economic behavioral architecture characteristic of lowtomiddleincome communities.

.

3.6 Behavioral Factors Driving Change

Identifying the factors driving change lies at the core of behavioral architecture analysis, as these factors explain "why" occupant behavior produces specific spatial changes. Based on observation and interview results, seven primary behavioral factors were identified.

Table 7. Behavioral Factors Driving Rear Yard Changes

Behavioral Factor	Number of Respondents	Percentage	Category
Need for more adequate kitchen	10	62.50%	Domestic Behavior
Need for family/gathering space	9	56.25%	Social Behavior
Increasing household size	7	43.75%	Demographic Behavior
Spatial constraints of original building	6	37.50%	Spatial Pressure
Economic needs (business/kiosk/production kitchen)	5	31.25%	Economic Behavior
Privacy needs	5	31.25%	Private Behavior
Occupant habits	2	12.50%	Cultural Behavior

The dominant behavioral factor is the need for a more adequate kitchen (62.50%), reflecting a critical functional void in the initial design. The absence of a permanent kitchen represents a fundamental mismatch between housing design and basic occupant behaviora situation that almost inevitably drives spatial adaptation. This confirms the behavioral architecture proposition that design-behavior mismatch generates spatial modification.

The need for family space (56.25%) reflects the social behavior of occupants requiring interaction spaces. In Indonesian culture, particularly among communities originating from areas such as Petobo and Balaroa, family gathering activities hold high social value and require adequate spatial accommodation.

Increasing household size (43.75%) constitutes a demographic factor that directly intensifies spatial demand pressure. With an average of 5.06 members per family and some families with 10 members, this pressure is significant given the original building area of only 36 m².

The economic needs factor (31.25%) reflects an interesting phenomenon in behavioral architecture: when family economy is under pressure, living spaces are optimized for income generation. R-04, R-05, R-14, R-15, and partially R-03 demonstrate how economic pressure drives the transformation of rear yards into productive spaces.

3.7 Space syntax analysis: quantitative confirmation of behavioral architecture

3.7.1 Connectivity changes

Visibility Graph Analysis (VGA) using DepthmapX provides quantitative confirmation that occupant behavioral modifications successfully transform spatial configuration in measurable terms. In the initial standard floor plan, Connectivity values showed Max=145, Min=4, and Average=103.042. Following occupant spatial behavioral adaptation, these values increased significantly across nearly all units.

Table 8. Summary of connectivity statistics for actual conditions by typology

Typology	Transformation Characteristic	Repr.	Max	Min	Average
Standard	Initial plan (baseline)	–	145	4	103.042
I	Simple domestic	R-02	291	8	156.618
II	Domestic + Social	R-01	433	12	252.974
III	Domestic + Residential	R-12	370	4	200.404
IV	Domestic + Economic	R-15	516	4	322.982
V	Full Multifunctional	R-08	263	4	124.515

The increase in average Connectivity values from 103.042 (initial standard) to 156.618 through 322.982 across various typologies indicates that occupant behavioral adaptation not only physically adds space but also strengthens the circulation network within the dwelling. The new spaces added by occupants as expressions of their behavior become integrated into the existing spatial system and enhance overall connectivity.

Typology IV (Domestic + Economic) exhibits the highest average Connectivity value (322.982), indicating that the integration of economic functions creates the most intensive spatial connections. This is logical because economic activities (kiosks, production kitchens) generate more numerous and diverse movements within the dwelling.

3.7.2 Visual integration changes

Visual Integration analysis confirms the transformation of the rear yard's role within the housing spatial system. The average Visual Integration value in the initial standard plan was 31.83, which increased dramatically in actual conditions.

Table 9. Summary of visual integration statistics by typology

Typology	Transformation Characteristic	Repr.	Max	Min	Average
Standard	Initial plan (baseline)	–	676.18	10.47	31.83
I	Simple domestic	R-02	827.3	8.44	70.70
II	Domestic + Residential	R-16	2427.4	604.3	309.9
III	Domestic + Social	R-01	2654.82	-1	311.453
IV	Multifunctional + Economic	R-15	3335.58	8.61	359.36
V	Economic + Vertical	R-04	2647.77	-1	335.706

The dramatic increase in average Visual Integration values from 31.83 to 70.70–359.36 across various typologies constitutes strong quantitative evidence that occupant behavioral adaptation has transformed the position of the rear yard within the housing spatial system. The rear yard, originally in a peripheral position with low integration, has become a highly integrated area—reflecting its new role as a center of activity.

Typology IV has the highest average Visual Integration value (359.36), indicating that the integration of multifunctional uses (domestic + social + economic) creates the most spatially integrated configuration. This confirms that as more behaviors/activities are accommodated within a single area, that area increasingly becomes the gravitational center of the dwelling's spatial configuration.

It is noteworthy that some respondents exhibit negative minimum values (-1), indicating the presence of additional spaces with very limited visual connectivity. This is a consequence of the development process undertaken by occupants without formal planning, where new space additions sometimes create "dead spaces" that lack visual connection to other spaces.

3.8 Synthesis: application of behavioral architecture in tondo 1 permanent housing

Based on the above findings, the application of behavioral architecture in the rear living spaces of Tondo 1 Huntap can be synthesized into four main propositions.

First, the rear yard constitutes an open behavioral zone most susceptible to adaptive pressure. Its position as an open area without primary function in the initial condition makes it a blank canvas for the expression of occupant behavior. Not a single one of the 16 units was left in its original condition; this finding affirms the universality of behavioral pressure experienced by occupants. This condition aligns with Rapoport's view that living spaces continuously undergo change following the needs, culture, and activities of their inhabitants [1], [2]. Similar phenomena are widely observed in post-disaster housing across various countries, where occupants gradually modify spaces according to daily living needs [3], [4].

Second, behavioral pressure is hierarchical. Basic domestic needs, such as cooking and washing, constitute the primary drivers of change, followed by social needs for family gathering spaces, demographic needs through the addition of bedrooms, and finally economic needs through the provision of business spaces. This sequence indicates that spatial change does not occur randomly but develops according to occupant priority needs in sustaining life and improving quality of life. This finding reinforces the concept of Housing by People, which positions occupants as the primary actors in the incremental development of housing according to their capacities and needs [5]. In the context of mass housing, Habraken also asserts that housing should be viewed as a system open to modification by its occupants, not as a final product [6].

Third, behavioral adaptation produces new spatial typologies absent from the initial design. The six identified multifunctional space types represent collective products of adaptive occupant behavior from different social, economic, and family composition backgrounds. This demonstrates that behavioral architecture does not produce a single form but rather a spectrum of responses reflecting the diversity of human behavior in utilizing space[1], [2]. The findings also reinforce the work of Marcillia and Ohno on post-disaster housing transformation in Yogyakarta, which demonstrated that spatial modification constitutes a form of occupant adaptation to daily living needs [7].

Fourth, Space Syntax analysis confirms that behavioral changes produce more integrated spatial configurations. The rear yard, which in the initial design occupied a peripheral position with low integration, transforms into a new activity center with higher integration levels. This transformation reflects how occupant behavior effectively reconfigures the housing spatial system through unplanned adaptation processes that nevertheless carry strong spatial meaning. This finding aligns with the theory of The Social Logic of Space, which states that patterns of social activity shape spatial configuration, and conversely, spatial configuration influences human behavior [8]. In the post-disaster housing context, these spatial configuration changes also demonstrate the process of recovery and occupant adaptation to new environments as described by Davis [3] and the development of post-occupancy housing transformation elaborated by Wagemann [4]. This phenomenon is particularly relevant in the context of Tondo 1 Permanent Housing, constructed as part of the rehabilitation and reconstruction program following the 2018 Central Sulawesi earthquake, tsunami, and liquefaction.

IV CONCLUSION

This research demonstrates that the rear yards of Tondo 1 Permanent Housing, Palu City, represent the most significant arena for behavioral architecture application within the overall housing spatial system. Behavioral pressures originating from domestic, social, demographic, economic, and cultural needs consistently drive spatial transformation from single-function service zones into complex multifunctional zones.

All 16 housing units studied exhibit changes to the rear yard, with six identified multifunctional typologies. Type C (Service + Semi-Public + Private) emerges as the dominant pattern (37.50%), while the need for more adequate kitchen facilities (62.50%) and the need for family space (56.25%) constitute the primary behavioral drivers. Space Syntax analysis quantitatively confirms that behavioral adaptation significantly enhances Connectivity and Visual Integration values, transforming the rear yard into a new spatial core within the housing spatial system.

These findings carry important implications for future post-disaster housing design: designs that fail to accommodate occupant behavioral diversity will inevitably undergo informal modification. Therefore, a behavioral architecture approach that considers occupant activities, habits, economic needs, and socio-cultural characteristics from the planning stage can produce housing that is more responsive, sustainable, and capable of evolving alongside occupant needs.

This research recommends that future post-disaster permanent housing design adopt: (1) flexible space principles that enable adaptation to behavioral diversity; (2) planning of rear yards as semi-structured spaces ready for development; (3) provision of adequate kitchen facilities from the outset to reduce adaptive pressure; and (4) consideration of productive economic needs in the design of housing service zones..

Conflict of Interest

No conflicts of interest to declare.

ACKNOWLEDGMENTS

The authors express their gratitude to the “Master's Program in Architecture, Faculty of Engineering, Tadulako University".

REFERENSI

[1] A. Rapoport, *House form and culture*. Englewood Cliffs, N.J, 1969.

[2] A. Rapoport, *Human aspects of urban form : towards a man-environment approach to urban form and design*. Oxford ; New York : Pergamon Press, 1977.

[3] Ian. Davis, Paul. Thompson, and Frederick. Krimgold, *Shelter after disaster*. International Federation of Red Cross and Red Crescent Societies, 2015.

[4] E. Wagemann and R. Moris, “Transitional habitability: Solutions for post-catastrophe in Chile,” *International Journal of Disaster Risk Reduction*, vol. 31, pp. 514–525, Oct. 2018, doi: 10.1016/j.ijdrr.2018.06.007.

[5] J. F. C. . Turner, *Housing by people : towards autonomy in building environments*. Marion Boyars, 1976.

[6] N. J. . Habraken, *Supports, an alternative to mass housing [by] N.J. Habraken; translated from the Dutch by B. Valkenburg*. Architectural Press, 1972.

[7] S. R. Marcillia and R. Ohno, “Importance of Social Space in Self-built and Donated Post-disaster Housing after Java earthquake 2006,” *Asian Journal of Environment-Behaviour Studies*, vol. 3, no. 6, pp. 111–119, Jan. 2018, doi: 10.21834/aje-bs.v3i6.241.

[8] Bill. Hillier and Julienne. Hanson, *The social logic of space*. Cambridge University Press, 1984.