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Space Syntax Theory: Multigenerational Dwelling as a Residential Building Typology in the Philippines

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Abstract: The study explores multigenerational dwellings (MGDs) as a residential building typology in the Philippines. Driven by limited research and design focus despite rising demand, this paper examines MGDs by defining their architectural form, addressing their issues, and delineating their design considerations. Space Syntax Analysis through Convex Space Analysis and Visual Graph Analysis was carried out to analyze the data gathered by case studies of various MGDs in the country, then corroborated with related studies to form design considerations. Results show that the multigenerational typology stands independently from existing typologies in the country. A new design vocabulary must be developed to fill the gap and accommodate the unique needs of multigenerational households in the Philippines. With these findings, it is enforced that there is a need to introduce MGD as a residential typology in the Philippines.

Key Words: spatial configuration; social pattern; permeability; privacy; adaptability

1. INTRODUCTION

Multigenerational dwellings are inhabited by households consisting of two or more related adult generations that live in a single residential building (Bueno, 2023; Burayidi, 2015; Burgess & Muir, 2019; Dufty-Jones & Rogers, 2015; Easthope et al., 2016; Easthope et al., 2015; Farrelly, 2014; Fry & Passel, 2014; Guro, 2018).

A problem often brought about by multigenerational living is the lack of privacy (Burgess & Muir, 2019; Chen et al., 2015; Dove, 2020; Easthope et al., 2015; Easthope & Liu, 2017; Judd, 2017). Altman's theory of privacy, which defined privacy as a 'selective control of access to the self or one's group,' has also pointed out the importance of personal space, implying that a person should have time to be alone and time to socialize (Judd, 2017). Privacy has a direct correlation in multigenerational households, and the imbalance between private and public spaces inside the house (Brandon, 2021) compromises the sense of privacy of an individual inside the home (Lee, 2017). This issue amplifies the significance of having a dedicated space for individuals inside the dwelling, in which they have exclusive control (Easthope et al., 2015).

Establishing privacy also involves creating interior spaces secluded from guests and analyzing the spatial layout for effective connections within the household (Ravari et al., 2022). This concept aligns with variables affecting privacy, namely connectivity, which measures the relationship and amount of connected spaces with the space around it (Hillier & Hanson, 1984, 103; Klarqvist, 1993, 11), and accessibility, which is the degree to which a space is reachable, indicating the relative nearness of spaces with each other (Ravari et al., 2022). Combined, it shows permeability, which involves the relationships between adjacent spaces and the ability to access each spatial unit within a building (Ravari, 2022). Additionally, visibility characterizes a particular space to determine how much visual information a person gathers around the surrounding spaces and their layout, affecting the movement patterns inside (Mclane, 2013; Ravari et al., 2022).

The spatial configuration of residential spaces

can show how dwellers move within the environment (Golshan et al., 2023). Space syntax can aid in providing a quantified language to further understand the spatial arrangement of spaces (Farshidi et al., 2023). Hillier et al. (1993) note a strong correlation between spatial integration and observed movements of people, indicating its potential relevance in understanding human spatial behavior within residential spaces. Considering the findings of Farshidi et al. (2023), integrating behavioral patterns of residents with space syntax analysis could lead to a more comprehensive understanding of a dwelling's spatial configuration.

The complex interplay of these numerous aspects has contributed to the continuous growth of multigenerational living (Generations United, 2021). Despite this increasing demand, multigenerational dwellings remain a largely understudied subject (Lee, 2017). It has only been studied from an economic and cultural perspective but seldom through an architectural outlook (Lee, 2017). In the Philippines, significant discussions have only been made regarding its relation to family structure, psychological well-being, and financial context, as depicted in the study of Chen et al. (2015). This lack of knowledge further emphasizes the need for a new housing typology to cater to multigenerational living conditions and problems such as privacy (Dove, 2020; Easthope & Liu, 2017; Judd, 2017; Farrelly, 2014). Further research on these dwellings' spatial configuration and social pattern is required to precisely define the elements that constitute the typology and cultivate a new design vocabulary that aligns more effectively with the essence of multigenerational living (Gerards et al., 2015).

Simpson (2015) highlights the necessity for government policies and codes tailored to support multigenerational living and address its challenges. Based on the laws and policies in the Philippines, specifically in Rule 7 of the Implementing Rules and Regulations (IRR) of the National Building Code of the Philippines (2018), Batas Pambansa Bilang 220 (2008), The Fire Code of the Philippines (2019), IRR of PD 957 (2009), there are no mentions and information records available for “multigenerational dwellings” and “multigenerational families.” Notably, in the Philippine Statistics Authority (2020), there is no record available for "multigenerational dwellings'' in their housing unit characteristics census. Taking into account the aforementioned laws and statistics, it is evident that there is a deficiency of policies and legal basis addressing multigenerational dwellings and families in the Philippines.

There are, however, established and existing multigenerational dwelling typologies in other countries, which include courtyard housing, garden suites, side-by-side units, leveling suites (up and down units), and accessory apartments (Arasteh, 2009), which are based on the Iran Ministry of Housing and Urban Development research in 2002. Gerards et al. (2015) also listed horizontal and vertical organizations as spatial configurations for multigenerational dwellings. Considering the interior spaces used in terms of flexibility, Alkhansari (2018) defines flexible spaces as plans to have multi-functional capacities to accommodate multiple activities without changes or reorganization of physical spaces.

The problem revolves around the limited research and architectural focus on multigenerational dwellings, which lack a well-defined typology and design language despite rising demand, highlighting the need for further investigation to develop and introduce a suitable residential building typology for multigenerational living.

This study aims to introduce the multigenerational dwelling typology in the Philippines by defining its architectural form, addressing its inherent issues, and delineating its design considerations. With these existing research gaps and problems regarding the design of multigenerational dwellings, the study intends to identify the predominant typologies of multigenerational dwellings in the Philippines, the relationship of their spatial configuration and social patterns with regard to permeability (connectivity and accessibility), and privacy, and identify the considerations in designing multigenerational dwellings.

2. METHODOLOGY

The focus is specifically directed toward multigenerational dwellings in the Philippines and must have undergone a discernible process of evolution over time. A qualitative research approach will be employed to analyze multigenerational dwellings in the Philippines. Additionally, qualitative research further explores and comprehends quantitative data (Tenny, 2022). These factors encompass connectivity, accessibility, and visibility, and their influence on living arrangements pertinent to multigenerational dwellings in the Philippines.

The initial phase involves confirming the absence of specific typologies for multigenerational dwellings in the Philippines by examining relevant regulations and policies. Following this, a case study

will be conducted with ten (10) selected families and their residential dwellings, labeled as dwellings 1-10 (Ravari et al., 2022). The selection process will be randomized, a method often used in research with small sample sizes to enhance the study's significance (Ravari et al., 2022). Selection criteria include: a) the families must share a common bloodline and include at least two generations living together, and b) the dwellings should be existing residential structures that have been adapted over time for multigenerational households.

Data collection will involve on-site visits, and documenting the dwelling's structure and layout through photo documentation and sketches. Informal interviews will provide insights into the families' choice for multigenerational living.

For examining permeability, including connectivity and accessibility, Convex Space Analysis will identify primary spaces and their connections within a plan to interpret privacy levels in each dwelling's spatial configuration.

The depth from the root quantifies the number of steps required to establish spatial separation from a point to a reference point. This plays a key role in determining the privacy attributes of a residential layout. The mean depth (M.D.) is a node's average degree of depth in a justified plan. A room depth higher than the M.D. is more isolated than a room depth lower than the mean depth. Relative asymmetry (R.A.) represents a key aspect of the shape of a graph from that space. Zero indicates maximum integration, no depth, and high functional efficiency. whereas One indicates maximum segregation, maximum depth, and low functional efficiency. Real relative asymmetry (R.R.A) revolves around the number (1). In spatial layouts, lower R.R.A values imply more segregation, control, and less efficient function. In contrast, higher R.R.A values suggest greater control over movement, increased social hierarchy, and heightened privacy. The Integration Value (Rn) gives the degree to which a node is integrated or segregated from the system (Ostwald, 2011; Wu and Guo, 2014). The area situated farthest in the justified graph, requiring access through the highest number of intervening units, is considered the least integrated.

In Convex Space Analysis, spaces are labeled numerically to represent different points, known as "nodes" (Ravari et al., 2022). These nodes are organized horizontally in a justified graph according to their depth values or accessibility levels (Ravari et al., 2022). Figure 1 visualizes this arrangement, with the viewer's point or "carrier" placed at the base of the graph. From this starting point, nodes branch out vertically and horizontally, showing the depths of permeability (Ravari et al., 2022). Lines between nodes indicate connectivity links, demonstrating interrelationships among them.

Fig 1. Types of Social Structure from left to right; (a) bush-like or shallow tree, (b) enfilade or deep tree, and (c) lattice-like or shallow ring.

The justified graph reveals a dwelling's social structure by representing its spatial configuration (Dawes & Ostwald, 2021). Dawes and Ostwald (2021) describe three types of social structures observable from the justified graph. The ‘bush-like’ or ‘tree-like’ configuration features dense branching, with further areas of the plan accessible only through a small number of controlling spaces like hallways. The ‘lattice-like’ configuration includes loops or rings with extensive interconnections of spaces, offering flexibility in user navigation. Finally, the ‘enfilade’ configuration is the most controlled structure, guiding user movement along a linear path. These structures are categorized into "shallow tree," "shallow ring," and "deep tree" models.

Regulating privacy within a dwelling influences the social behavior of its inhabitants. Contemporary sociologists identify five types of social interaction: exchange, competition, conflict, cooperation, and accommodation (Gabunia, 2022). These patterns stem from how spatial configuration manages privacy. For example, high privacy levels with limited communal spaces reduce conflict and competition but also hinder exchange and cooperation, and vice versa. The architectural layout, including factors affecting privacy, plays a crucial role in determining how individuals manage and regulate their accessibility.

As for the factor of visibility, Visual Graph Analysis (VGA) in DepthmapX will be utilized. DepthMapX will map the visibility relationship between different points in a space. To assess the level of visibility access within a space, the inter-visibility of the center of each space is calculated (McLane, 2013). A visibility graph is generated using DepthMapX through the depiction of different colorations that correspond to the number of other locations seen from each point (McLane, 2013). The result of the graph shows how visually accessible areas are with each other, which is represented by different colorations as seen in Figure 2.

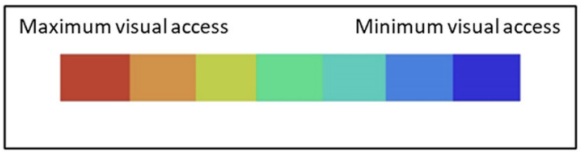

Fig 2. Scale of measurement of visual accessibility graph (McLane, 2013)

The generated visual accessibility map of the plan of the dwelling gives an immediate idea of how visually private a space is. This reveals how the inhabitants use a space according to the level of privacy, implying how they can also move in the environment (Alitajer & Nojoumi, 2016).

3. RESULTS AND DISCUSSION

The 10 case studies have an average of three generations. Dwellings 3 and 8 stand out highest at four generations, whereas Dwellings 5 and 6 exhibit the lowest at two generations. In relation to household members, the average is 11, with Dwelling 8 having the highest count at 40 members and Dwelling 6 having the lowest at six members.

3.1 Spatial Configuration

The study has identified bush-like and enfilade configurations as prominent in dwelling layouts, with no instances of the lattice layout observed. Bush-like layouts start from communal areas and progress towards private spaces, while enfilade layouts lack a clear sequence and feature random zoning. The absence of the lattice layout suggests greater movement restrictions for residents of these dwellings.

In some cases in the observed dwellings, some achieve enhanced privacy within enfilade layouts by starting with communal spaces and ending with private rooms resembling bush-like configurations. This adaptation is feasible due to available spatial options. However, certain dwellings face limitations like restricted space division capacity, forcing compromises on privacy to accommodate more family members.

3.2 Social Pattern

The case studies revealed that the most common social patterns observed in multigenerational households are exchange, cooperation, and conflict, while competition and accommodation are rarely seen. These social patterns are shown through mutual care, division of household chores and bills, and disagreements. The spatial configuration of the dwelling is interrelated with the observed social patterns, indicating that the form shaped by the spaces can regulate privacy.

3.3 Computation & Privacy-Identified Social Patterns

Regarding the Mean Depth, communal areas, such as the living area and kitchen, sit below the average, indicating high accessibility and communal living. The top social patterns in these spaces are cooperation and exchange, depicted through the execution of household chores, mutual care, and companionship among the inhabitants. The private areas are shown to be the least accessible since they are above the average Mean Depth of the dwellings. These areas are where conflicts mostly arise due to conflicts of sleep schedules and noise disturbances from other inhabitants. The presence of a central space in the dwellings allows these social patterns to occur in these specific areas, which also depends on the family dynamic of the household. However, it is important to note that not all of the dwellings in the case study exemplify these traits. This highlights the importance of considering individual preferences and unique spatial layouts.

Majority of the dwellings manifest a balance of being integrated and segregated according to their values of Relative Asymmetry (R.A.) and Real Relative Asymmetry (R.R.A.). A greater part of the dwellings exhibit higher integration and better functional efficiency for R.A.. However, the majority are also characterized as having lower integration and higher segregation with concern to R.R.A. The values may contradict each other, but this simply means that the communal and private spaces are clearly segregated in the layout of the home but are integrated together by the presence of a central hub or space (Ravari, 2021), usually the living room for most dwellings. Even so, there are still some dwellings in the case study which does not manifest the balance.

For the predominant typology, the study revealed that the horizontal extended family house is common among multigenerational dwellings. As long as there is enough lot space, horizontal extensions are done on the ground floor levels to address the need for space in the household. Conversely, the vertical extension of the dwelling, characterized by the leveling

suites typology (Arasteh, 2009), is necessary if the horizontal ground floor space is not feasible. If the extension of space is not available either horizontally or vertically, then it is necessary for a flexible spatial use of spaces (Alkhansari, 2018).

The study also looks into the spatial configuration of multigenerational dwellings as it directly relates to the level of permeability and privacy of the dwellings. In the study, the entryway's number and strategic placement dictate the permeability level of private spaces. This relatively coincides with the creation of separate adjacent functioning spaces with separate entrances (Arasteh, 2009), which is found in most dwellings in the study. Ravari (2021) also stated this in his study, where he found that the location of entry contributes to the effective visual privacy of a dwelling. Notably, the majority of the dwellings have their entrance far from the private zones. This spatial arrangement is evident in the depth level of these dwellings, where private areas such as bedrooms and bathrooms are consistently positioned at the highest depth level. Notably, this pattern is not observed in the design of two specific dwellings in the case study, wherein they feature a storage area and dirty kitchen in their highest depth level.

Table 1

Summary of Convex Space Analysis Values

Convex Space Analysis - Syntactic Property Values							
	n	T.D.	M.D.	R.A.	*D*	R.R.A	Rn
Dwelling 1	8	20	2.86	0.62	0.328	1.89	0.53
Dwelling 2	13	28	2.33	0.24	0.276	0.87	1.15
Dwelling 3	23	83	3.77	0.26	0.209	1.24	0.81
Dwelling 4	12	27	2.45	0.29	0.285	1.02	0.98
Dwelling 5	14	37	2.85	0.31	0.267	1.16	0.86
Dwelling 6	10	23	2.56	0.39	0.306	1.27	0.79
Dwelling 7	18	74	4.35	0.42	0.237	1.77	0.56
Dwelling 8	22	45	2.14	0.11	0.214	0.51	1.96
Dwelling 9	12	35	3.18	0.44	0.285	1.54	0.65
Dwelling 10	16	42	2.8	0.26	0.251	1.04	0.96
MEAN	14.8	41.4	2.929	0.334	0.265	1.231	0.925

As evident in the results from the case studies, the layout of the spaces inside a dwelling impacts the level of privacy through connectivity and accessibility. For instance, the dwelling with the highest Rn (Dwelling 8) is the most integrated, which can be observed in the position of nodes in the justified graph. Eight nodes with different zoning requirements are on the same level of depth, resulting from the dwelling's separated units and entrances. This separation resulted in a lower depth level, enabling the private spaces to be easily accessible from the carrier and reducing privacy. In contrast, the dwelling with the lowest Rn has its nodes positioned on different depth levels, with the private spaces (bedrooms) located at the highest level. One design quality that contributes to the separation of private to communal spaces is the incorporation of hallways. This feature is present in Dwelling 1, serving as an intermediate node linking various spaces within the dwelling. It is observed that among the ten dwellings, seven have incorporated the inclusion of hallways to establish connections between different spaces. This architectural element facilitates a distinct separation of different space zoning, enhancing privacy.

In the context of multigenerational dwelling, the number of kitchens and entrances in dwellings plays a crucial role in influencing privacy. Within the observed residences, the kitchen configurations vary, with Dwelling 8 notably featuring the highest number of kitchens at six, contrasting with the common range of one or two kitchens in most dwellings. Furthermore, regarding entrances, Dwelling 8 stands out with the highest count at eight, surpassing the average two entrances observed in most dwellings.

3.4 Discussion on Visibility

The visibility graph analyses through DepthMapX have uncovered several commonalities regarding visibility between the spatial configurations of the ten (10) multigenerational dwellings. Most dwellings show that the transitional space, such as a hallway, between communal and semi-private areas tends to have higher visual access. In this study, the general category of spaces revealed to have high visual access are communal spaces and semi-private spaces like kitchens and service areas. Public spaces are preferred to have high visual access to maintain visual privacy in a residence (Ravari et al., 2021).

The majority of the private spaces of these dwellings, such as the bedrooms and bathrooms, are more inclined to have lower visual access. These spaces have low visual connectivity, indicating higher visual privacy. The amount of visual accessibility should gradually diminish as the functionality of the space requires more privacy (Ravari et al., 2021). However, it is observed that some of the private spaces, like bedrooms, of half of the dwellings are partially exposed, having slightly more visual access

than the ideal. It is also noticed that these areas are directly connected to either a transitional space or a communal area. According to Ravari et al. (2021), private areas directly connected to a public area can be inefficient since they allow direct visibility to private areas like bedrooms and bathrooms.

3.5 Summary of Discussions

The results from the case studies using the space syntax techniques reveal the direct influence of spatial configurations on the privacy and social patterns per multigenerational dwelling. From the convex space analysis, privacy can be achieved through the layout of spaces, from communal to private, which also resonates with the coloration revealed in the visual graph analysis. However, there is a discrepancy between the intended use of a space, with its level of visual privacy, such as kitchens and living areas. This difference emphasizes the connection between the visual representation and the intended function of a space, highlighting how the spatial configuration of a dwelling impacts social patterns.

With regards to the results of the computations, it highlights the balance between the integration and segregation of spaces in terms of spatial configuration. This corresponds to the majority of the coloration from the visual graph analysis, as some communal spaces can be shown to be somewhat visually private, while some private areas are visually accessible. However, it is also notable that social patterns can still affect how these spaces are used, where the repurposing of what is initially communal to be a private space and vice versa can sometimes be observed. The results from the visual graph underline the connection between how spaces are visually shown and how they are used, which is linked to the results from the convex space analysis, where spatial layouts can affect how people interact in a space.

31 design considerations were categorized based on their general guidelines and identified zoning under communal, private, semi-private, and auxiliary spaces (Judd, 2017). The design parameters were then totaled according to their recurrence from the filtered related literature. The top three (3) design considerations are: (1) Separate or private entrances should be provided for the different occupants and units of the dwelling to provide privacy; (2) Open and spacious communal and shared spaces such as kitchens, dining areas, and living areas should be provided; (3) Rooms and spaces should be adaptable and flexible to accommodate the evolving family structures and dynamics.

4. CONCLUSIONS

The results show an innate connection between spatial configuration and privacy, which creates social patterns. The convex space analysis revealed that household dynamics alter the spatial configuration of the house depending on the needs of the evolving family structure. This predominant physical alteration on the dwellings regulates the level of privacy of spaces and, in turn, affects the social pattern and user behavior inside the house. Consequently, the visual graph analysis shows that the spatial configuration of multigenerational dwellings also contributes to the level of visual privacy of spaces, affecting their utilization. A notable finding is that some communal spaces are not utilized well as gathering spaces due to their low level of visual access. A content analysis on related literature, collating different considerations for designing multigenerational dwellings to present solutions that regulate privacy in the dwelling through spatial layout.

To further reinforce the significance, the researchers compared the data from the case studies to a multifamily house through the same space syntax techniques. The ten case studies of multigenerational dwellings demonstrate how multigenerational families modify their homes. On the contrary, a multifamily dwelling might not achieve this type of future development since units often lack space flexibility due to the units being pre-planned. Regarding convex space analysis, the data from MGDs and the multifamily dwelling present the same spatial configuration and issue it causes regarding its relationship to regulating privacy. However, there is a stark difference regarding their visual graph analysis, where almost the entirety of its plan is revealed to be private regardless of what zone it is. With these findings, the social dynamic of multigenerational households requires different design considerations that will fit their unique needs.

Therefore, the multigenerational typology stands independently and can be introduced as a new building typology in the Philippines. In order to fill the gap and accommodate the unique needs of multigenerational households in the Philippines, a new design vocabulary must be developed.

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