Space syntax analysis of low-income housing in progressive urban settlements: case of Davao City, Philippines

Isidoro Malaque III
University of the Philippines Mindanao, Davao City, Philippines
irmalaqueiii@up.edu.ph

Abstract: The incremental construction of low-income housing, in progressive urban settlements in Davao City, Philippines, was observed being directly related to the improvement on the degree of security of tenure. Housing as material expression of the status of its inhabitants, there is a need to further explore on the spatial configuration of low-income housing classified in five contiguous categories from formal to informal housing types. Space syntax analysis is used by architects to examine spatial configuration of houses as reflection of social and environmental outcomes of human movement and social interaction. Thus, the aim of this paper is to use space syntax analysis technique to explore spatial morphology of low-income housing cases from a simple shack in informal settlement to becoming more formal housing types; illustrate interior spatial pattern; and, interpret interior spatial configuration. Space syntax analysis of houses in progressive urban settlements is compared with a housing unit in a planned and completed socialised housing subdivision. This paper maintains a claim that housing, in low-income settlement in developing country, is socially constructed as demonstrated by the valuable contribution of the people, who shape, and whose behaviour is shaped by, the built environment.

Keywords: Space syntax analysis; low-income housing; progressive urban settlements; Davao City.

1. INTRODUCTION

Half of the world’s population now lives in urban areas and its rapid increase is found in major cities of developing countries. In 2015, the United Nations declared that 54% of the world’s population lives in urban areas. While it is estimated that the figure will reach 66% by 2050, nearly 90% of this increase will be in Asia and Africa (United Nations, 2015). In this context of unprecedented urbanisation coupled with widespread urban poverty, higher density of spontaneous low-income settlements is observed in major cities of developing countries like in the Philippines. UN-HABITAT (2003, p. 4) claimed that from the point of view of the urban poor, formal planning was far from reality, instead, their existence and their precarious informal settlements were almost ignored. However, urbanisation as one of the global transformative trends in the twenty-first century, cities are now viewed as source of solutions instead of being the avenue of environmental and social problems. In 2015, the United Nations Member States adopted a comprehensive Development Agenda. To address emerging concerns, it focuses on the root causes of poverty and inequality that undermines full human potential to achieve harmony with a healthy environment. The Agenda 2030 for Sustainable Development, which is aimed to end poverty, protect the planet and ensure prosperity for all, stresses the point that everyone do their part, with among other key actors, putting the people at the centre. In recognition of the spatial dimension of development, the aim is clearly translated in the incorporation of Sustainable Development Goal 11 (SDG11) ‘Make cities and human settlement inclusive, safe, resilient and sustainable’ (UN-HABITAT, 2017). With around a billion people live in slums and squatter settlements today and higher density is evident in major cities of developing countries, it is timely for architectural science to pay attention to this clear and present urban challenges in the twenty-first century. Thus, the need to study the social construction of housing and urban settlements demonstrated by the valuable contribution of the people, specifically by the urban poor who shape, and whose behaviour is shaped by, the spontaneous built environment in developing countries.

2. BACKGROUND TO THE STUDY

2.1 Low-income housing: classifications, incremental construction and evolution

This paper maintains to focus on the phenomenon of low-income housing in progressive urban settlements. Informed by rigorous fieldwork and data analysis, low-income housing in Davao City, Philippines were classified into five different contiguous categories, and their incremental construction and evolution were modelled (Malaque III et al., 2014; 2015; 2016). Firstly, in a comprehensive study of 74 households in 11 settlements, urban households were classified into five different types in a range of contiguous categories from formal (Type I) to informal (Type V) housing. Furthermore, it was observed that householders moved from one type to another until they became owners of formal housing, which was characterised as multi-step transition process (Malaque III et al., 2014). Secondly, focusing on housing cases in progressive
urban settlements, it was observed that the incremental construction of housing units resulted directly from improvement of householder’s security of tenure. This was exemplified how informal housing unit was upgraded with better materials and standard methods of construction as the inhabitant’s security of tenure improved. The physical condition of the house could deteriorate over time while the inhabitants focused on payment for land, however, the house was further refurbished to become a formal structure upon achievement of legal land ownership (Malaque III et al., 2015). Thirdly, connecting the incremental constructions of housing cases representing the range of housing types from informal to formal, the evolution of a house was modelled. This was demonstrated how a simple shack in a squatter settlement evolved to become permanent piece of formal architecture (which could be one- or two-storey residential building) within the city (Malaque III et al., 2016). Parallel to these observations on incremental construction and evolution of housing units, this paper explores on the spatial configuration of houses using space syntax analysis as the third point of view to further observe an architectural phenomenon of low-income housing in progressive urban settlements.

2.2 Space syntax analysis of the architecture of houses

Space syntax is ‘a research program that investigates the relationship between human societies and space from the perspective of a general theory of the structure of inhabited space in all its diverse forms: buildings, settlements, cities, or even landscapes’ (Bafna, 2003, p. 17). Furthermore, Bafna (2003, p. 18) explained that it is aimed to develop strategies of description for inhabited space to understand configured space itself, particularly its formative process and social meaning. Space syntax was originally developed by Bill Hillier and colleagues at the University College London, acknowledged by Vrusho and Yunnitsyna (2016); Mustafa et al. (2010); Bafna (2003); Dawson (2002); Monteiro (1997); among others. It ‘has been used by architects to examine the influence of the spatial layout of buildings and cities upon the economic, social, and environmental outcomes of human movement and social interaction’ (Dawson, 2002, p. 465).

In terms of its application to the study of architecture and spatial configuration of houses, space syntax analysis was applied in the following researches. Firstly, Vrusho and Yunnitsyna (2016) used space syntax method to interpret interior spatial configurations and impact of culture. Results implied that Albanian dwellings are organised under social hierarchy and context, mechanical reasons and practical use of space. Secondly, Mustafa et al. (2010) used space syntax analysis in a comparative study to detect privacy between traditional and modern house layouts in Ebril City, Iraq. Results showed that better design solution in terms of privacy is offered in traditional house layouts compared with modern house layouts. Thirdly, Dawson (2002) used space syntax to examine spatial morphology of snow houses built by three Central Inuit groups in the Canadian Arctic, based on ethnohistoric and ethnographic accounts. Results demonstrated that variation in family structure and behavioural directives present in Inuit kinship systems are reflected in spatial configurations of snow house architecture. Fourthly, in the study of Monteiro (1997) on activity analysis in houses of Recife, Brazil, instead of analysing the pattern of space which is common in space syntax, what was analysed was the spatial pattern of activity in the home. Based on analysis of structure and arrangement of houses, spatial pattern of domestic activities of different social groups were compared.

A house, aside from a place for living, cooking, eating, sleeping and others, ‘from the architectural point of view, it is an expression of how householders have accommodated their everyday activities through time’ (Vrusho and Yunnitsyna, 2016, p. 95). In the previous papers (Malaque III et al., 2015; 2016), the incremental construction and evolution of low-income housing were viewed as the material expression of status of the urban poor from living in informal settlements to becoming owners of more formal housing units during development, in relation to the degree and improvement of security of tenure. In this paper, to further explore the socio-spatial processes in progressive low-income settlements, space syntax is used to analyse interior spatial organisation of dwelling spaces provided and inhabited by the urban poor themselves through self-help housing.

3. AIMS AND OBJECTIVES

The main aim of this paper is to demonstrate that housing, in low-income settlement in a developing country like the Philippines, is socially constructed as exemplified by the valuable contribution of the urban poor in housing provision through self-help. Hence, an understanding on the underlying social factors behind the formation of the built environment is hoped to lead towards sustainable inclusive cities and human settlement. Specifically, this study used space syntax analysis technique to explore spatial morphology of low-income housing cases from a simple shack in informal settlement to becoming more formal housing types; illustrate interior spatial pattern; and, interpret interior spatial configuration. Moreover, space syntax analysis of houses in progressive urban settlements is compared with a housing case in a planned and completed socialised housing subdivision incrementally developed in three phases.
4. METHODOLOGY

4.1 Case study area and selection of housing cases

This paper utilised fieldwork data from comprehensive study conducted in Davao City, Philippines presented in previous papers (Malaque III et al., 2014; 2015; 2016). Davao City has a population of 1.63 million based on the 2015 census (Philippine Statistics Authority, 2016). Located a thousand kilometres south of Manila, it is the only city outside the National Capital Region (also known as Metro Manila) that has a population of more than one million. Like other major cities in the country, Davao City is populated by impoverished rural immigrants who have settled in precarious informal settlements. Having the same pattern throughout the developing world, this prompts the need for this continued scholarship in housing research.

The data was collected between February and April 2014, in accordance with fieldwork protocols approved by The University of Adelaide Human Research Ethics Committee (January 2014), described in the previous papers (Malaque III et al., 2014; 2015; 2016). This paper focused to explore on the spatial configuration of a representative sub-set of nine of the 74 housing cases examined in the larger research project. The nine housing cases presented in Table 1 were selected from progressive urban settlements to represent the range of respective housing types identified in the previous papers. For comparative syntax analysis, a housing case located in a planned and completed socialised housing subdivision was included and presented in the results and discussion sections.

<table>
<thead>
<tr>
<th>Case number</th>
<th>Household name</th>
<th>Settlement location</th>
<th>Housing type</th>
</tr>
</thead>
<tbody>
<tr>
<td>D42</td>
<td>Rafales</td>
<td>Matina Aplaya Shanghai Village</td>
<td>Type I – ‘formal’ housing</td>
</tr>
<tr>
<td>E43</td>
<td>Amad</td>
<td>Toril II settlement</td>
<td>Type II – ‘almost formal’ housing</td>
</tr>
<tr>
<td>D40</td>
<td>Domingo</td>
<td>Matina Aplaya Shanghai Village</td>
<td>Type III – ‘semi-formal’ housing</td>
</tr>
<tr>
<td>F47</td>
<td>Albios</td>
<td>Piapi I settlement</td>
<td>Type III – ‘semi-formal’ housing</td>
</tr>
<tr>
<td>A01</td>
<td>Abarquez</td>
<td>Arroyo Compound</td>
<td>Type IV – ‘in-transition informal’ housing</td>
</tr>
<tr>
<td>B27</td>
<td>Rabara</td>
<td>Kobbler settlement</td>
<td>Type IV – ‘in-transition informal’ housing</td>
</tr>
<tr>
<td>B30</td>
<td>Wagas</td>
<td>Kobbler settlement</td>
<td>Type IV – ‘in-transition informal’ housing</td>
</tr>
<tr>
<td>A19</td>
<td>Truya</td>
<td>Arroyo Compound</td>
<td>Type V – ‘informal’ housing</td>
</tr>
<tr>
<td>B24</td>
<td>Lamanilao</td>
<td>Kobbler settlement</td>
<td>Type V – ‘informal’ housing</td>
</tr>
</tbody>
</table>

4.2 Space syntax procedure of analysis

This paper adopted space syntax analysis technique explained by Bafna (2003) and used in the analyses of houses demonstrated in the works of Vrusho and Yunnitsyna (2016); Mustafa et al. (2010); Dawson (2002); and, Monteiro (1997). Initially, the first procedure was to draw justified graphs of each sample house, based from sketches of floor plans used in the previous paper (Malaque III et al., 2016), considering the main entrance of the house as the root. Spatial hierarchy was mapped considering the different levels of privacy inside the house used by Mustafa et al., (2010) in analysing privacy in house layouts in Erbil City, Iraq (Figure 1). Finally, space syntax analysis was carried out by measuring scale, integration, mean depth and relative asymmetry, such as demonstrated by Dawson (2002) in the analysis of Central Inuit snow houses. Measurements of mean depth and relative asymmetry were also demonstrated by Vrusho and Yunnitsyna (2016) in the analysis of Albanian dwellings.

Figure 1: The layers of space within the house and between the house and the street. (Adopted from Mustafa et al., 2010)

Properties of spatial configuration comprising scale and integration are illustrated in Figure 2. Scale is the total number of nodes or bounded spaces contained in the configuration, which indicates the size and space requirements of the housing unit. Integration encompasses the number of rings and the number of communal spaces. Rings occur when spaces are connected into circuits that allow a single space to be accessed by more than one route. Communal spaces integrate other
spaces by connecting them in ways that create opportunities for social encounters. This means that well-integrated houses are those with greater numbers of rings and communal spaces.

![Diagram of spatial configuration](image)

Figure 2: Properties of spatial configuration comprising scale and integration. (Adopted from Dawson, 2002)

Other parameters of spatial configuration considered are mean depth and relative asymmetry. Depth between two spaces, defined by Klarqvist (1993, p. 11), is the least number of syntactic steps in a graph that are needed to reach one from the other. Depth of one space in the house from the root (in the case of this research, the main entrance) is directly measured by counting the number of intervening spaces between the two spaces. Asymmetry is a spatial configuration property based on depth. The mean depth (MD) is calculated first by assigning depth value of a space in the house from the main entrance. The depth values are then summed and divided by the total number of spaces in the house (k) less one that is the main entrance as the root. Relative asymmetry (RA), demonstrated by Dawson (2002), is then calculated as follows:

\[
RA = \frac{2(MD - 1)}{(k - 2)}
\]

Furthermore, comparative analysis based on the measurements of spatial configuration was conducted between the houses in progressive urban settlements and a case in a planned and completed socialised housing subdivision.

5. RESULTS

5.1 Space syntax analysis of houses in progressive urban settlements

Type I – ‘formal’ housing units are built in accordance to the building code and located in settlements with secured land tenure. Type II – ‘almost formal’ housing units, on the other hand, are also built on land with secured land tenure, however, the houses require further improvements to comply with the building code standards (Malaque III et al., 2014). In the case of the Rafales house (Type I – ‘formal’ housing), and of the Amad house (Type II – ‘almost formal’ housing), which are in progressive urban settlements, these houses went through multi-step transition process from informal housing to become more formal housing units during development. Figure 3 presents the space syntax analyses of samples of Type I – ‘formal’ housing and Type II – ‘almost formal’ housing units.

![Diagram of space syntax analysis](image)

Figure 3: Space syntax analysis of Type I – ‘formal’ housing (a); and, Type II – ‘almost formal’ housing (b).
Type III – ‘semi-formal’ housing units are located in settlements with secured land tenure, however, the houses are not built in accordance with the building code or they have become dilapidated over time (Malaque III et al., 2014). In both cases, the Domingo and Albios houses presented in Figure 4, their settlements were once informal but the inhabitants availed land tenure assistance programmes from the government. Despite there was incremental construction of houses with better building materials parallel to improvement of security of tenure, the inhabitants in the time being are focusing for payments for the land, thus the apparent dilapidation of houses characterised as slum. Figure 4 presents the space syntax analyses of samples of Type III – ‘semi-formal’ housing units.

![Figure 4: Space syntax analysis of Type III – ‘semi-formal’ housing.](image)

Type IV – ‘in-transition informal’ housing units are located in informal settlements. However, the inhabitants of this housing type are in the process of upgrading their status towards more formal type by organising themselves to negotiate the purchase of their squatter land from the legal owners, or to avail government programmes for the improvement of security of tenure and development of site and services (Malaque III et al., 2014). Figure 5 presents the space syntax analyses of samples of Type IV – ‘in-transition informal’ housing units.

![Figure 5: Space syntax analysis of Type IV – ‘in-transition informal’ housing.](image)

Type V – ‘informal’ housing units are self-built by the inhabitants not in accordance with the building code and illegally occupying squatter land with undeveloped site and lack of services (Malaque III et al., 2014). The incremental construction of an informal housing unit from a simple shack, exemplified by the case of Truya house, is shown in Figure 6 (a). Figure 6 presents the space syntax analyses of samples of Type V – ‘informal’ housing units.

![Figure 6: Space syntax analysis of Type V – ‘informal’ housing.](image)
5.2 Space syntax analysis of a house in completed socialized housing subdivision

Low-income housing units in a planned and completed socialized housing subdivisions were delivered either through government housing programme, through private developer’s investment, or through joint ventures of both the government and the private sector. These housing units were basically classified as Type I – ‘formal’ housing for being built in accordance to the building code with secured land tenure (Malaque III et al., 2014). The chosen housing case (Gomez house) presented in Figure 7 was initially provided as a core house. Upon occupancy, the inhabitants installed the wall partitions, and later, the house was expanded by the addition of rooms.

5.3 Comparative space syntax analysis of houses in progressive urban settlements and in completed socialized housing subdivision

<table>
<thead>
<tr>
<th>Housing type:</th>
<th>Scale: # Nodes</th>
<th>Integration: # Rings</th>
<th># Communal spaces</th>
<th>Mean depth: (MD)</th>
<th>Relative asymmetry: (RA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple shack:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truya house</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>1.000</td>
<td>0.0000</td>
</tr>
<tr>
<td>Type V – ‘informal’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lamanilao house</td>
<td>7</td>
<td>1</td>
<td>3</td>
<td>1.833</td>
<td>0.3332</td>
</tr>
<tr>
<td>Truya house</td>
<td>8</td>
<td>3</td>
<td>6</td>
<td>1.428</td>
<td>0.1427</td>
</tr>
<tr>
<td>Type IV – ‘in-transition informal’:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wagas house</td>
<td>8</td>
<td>1</td>
<td>4</td>
<td>1.857</td>
<td>0.2857</td>
</tr>
<tr>
<td>Rabara house</td>
<td>7</td>
<td>1</td>
<td>3</td>
<td>1.667</td>
<td>0.2668</td>
</tr>
<tr>
<td>Abarquez house</td>
<td>10</td>
<td>0</td>
<td>3</td>
<td>2.670</td>
<td>0.4175</td>
</tr>
<tr>
<td>Type III – ‘semi-formal’:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albios house</td>
<td>9</td>
<td>1</td>
<td>3</td>
<td>3.375</td>
<td>0.6786</td>
</tr>
<tr>
<td>Domingo house</td>
<td>8</td>
<td>1</td>
<td>4</td>
<td>1.714</td>
<td>0.2380</td>
</tr>
<tr>
<td>Type II – ‘almost formal’:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amad house</td>
<td>7</td>
<td>2</td>
<td>4</td>
<td>1.500</td>
<td>0.2000</td>
</tr>
<tr>
<td>Type I – ‘formal’:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rafales house</td>
<td>10</td>
<td>2</td>
<td>6</td>
<td>2.000</td>
<td>0.2500</td>
</tr>
</tbody>
</table>

Figure 7: Space syntax analysis of Type I – ‘formal’ housing in completed socialised housing subdivision.
Tables 2 and 3 present the measurements of spatial configuration of houses in progressive urban settlements and a house in planned and completed socialised housing subdivision, respectively. Housing cases in progressive urban settlements include a simple shack and representative sub-set of nine cases to represent the range of respective housing types from informal to formal. On the other hand, a housing case in planned and completed socialised housing subdivision, though classified as Type I – ‘formal’ housing, went through phases of incremental construction from a core house to the present floor plan with wall partitions and further addition of rooms.

6. DISCUSSION AND CONCLUSION

John Turner’s reinterpretation of ‘simple shacks in squatter settlements as the first stage in an incremental process of construction’ was acknowledged by Kellet and Napier (1995, p. 8). With the same observation in low-income progressive urban settlements, this research further provides a comparison with the incremental construction of a formal housing unit initially delivered as a core house. The simple shack of Truya house (Figure 6(a)) located in informal settlement and the core house of Gomez house (Figure 7) delivered in the regular housing market have the same spatial composition to include a core living space and toilet and bath. Despite with the same scale, considering the main entrance as the root, their respective relative asymmetry values are extremely opposite, presented in Tables 2 and 3. This is due to the location of the toilet and bath. In the Truya house, the makeshift toilet and bath was located outside for hygiene reason. During incremental construction process of a house in progressive urban settlement, toilet and bath will become an integral part of the entire house. In the Gomez house, on the other hand, the toilet and bath was built with the core house as its sanitary and plumbing lines were installed based on standards.

In the multi-step transition process, when simple shack incrementally developed or evolved towards more formal housing types, measurements of spatial configuration of houses in progressive urban settlements have almost the same values with a formal housing unit installed with wall partitions upon occupancy and with the addition of rooms during expansion. Higher values of mean depth and relative asymmetry are only observed in two-storey structures such as the cases of Albios (Type III – ‘semi-formal’) and Abarquez (Type IV – ‘in-transition informal) houses. In most of the one-storey structures, mean depth values of two or below implies that private and intimate spaces within the house are closely accessible from the main entrance. The permeability or accessibility of interior spaces inside the house is also mapped through justified graphs of lines and circles, shown in Figures 3 to 7.

The provision of living spaces in low-income housing, by the inhabitants through self-help, is progressive over the course of its development. A house, aside from being a material expression of the status of its inhabitants, from the architectural point of view, it is also an expression of how it accommodated the everyday activities of its inhabitants through time. Parallel to the incremental construction and evolution of low-income housing, this paper used space syntax to analyse how the urban poor provided their own living spaces from inhabiting in informal housing towards improving their housing status to more formal types. The incremental construction of low-income housing was observed as direct result of the improvement of householder’s security of tenure (Malaque III et al., 2015). The results of this study demonstrate that the spatial configuration of low-income housing units in progressive urban settlements is almost the same with those in planned and completed housing subdivisions, revealed through space syntax analysis indicated by scale, integration, mean depth and relative asymmetry values. Thus, this implies that the lack of security of tenure and the inability to afford housing structures conforming to the building code are not the hindrances for the urban poor to provide their own living spaces to suit their needs.

This paper further demonstrates that low-income housing, in progressive urban settlement in developing country, is socially constructed. Moreover, this suggests that its architecture should not be viewed purely as an object. Despite spontaneous in nature, spatial configuration of low-income housing reflects direct human intervention by the inhabitants who shape it, and whose movement is influenced, and behaviour is shaped by it. Furthermore, this paper concludes the valuable contribution of the people towards sustainable urban development, especially in developing countries which are rich in human resources. Putting the people at the centre of urban development, finally, this paper recommends that the spatial configuration of low-income housing in progressive urban settlements, examined through space syntax, are to be considered in the design, planning and policy interventions pertaining to sustainable housing provision feasible in developing country condition.
References


