

Discovering pattern of space layouts from low-income housing: A discussion of the New Normal preparedness after the Covid-19 pandemic

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Abstract. By the end of 2021, it is expected that the coronavirus (COVID-19) will shift from pandemic to endemic phase as the number of vaccinated people is increasing over time. It gives us hope as the endemic phase will allow us to live together with the virus. During the Covid-19 situation, people have become more creative and innovative for familiarising themselves with the New Normal. The next question is how is the existing housing for the low-income group ready to be suited with this situation? Therefore, this study will examine the concept of space design in housing units for the lower income group. The study adopted a case study approach based on housing layout from Kuala Lumpur, Bandung and Buckinghamshire. These housing layouts were analysed using the Space Syntax method for describing the meaning of space layout from a low-income perspective. This study found two consideration points, (1) the willingness of space to accommodate small business activities and to avoid the spread of epidemics in the domestic space, and (2) the willingness of the government to educate the public to cultivate small home entrepreneurship with the existing low-income routine and limited domestic spaces.

1. Introduction

The Covid-19 Pandemic has dramatically changed the employability and social system in countries around the world [1]. These changes force people to increase the functioning of their home to accommodate the work-from-home activity. In many countries, individual freedom is limited with regards to 'new norms' rules for curbing the Covid-19 spread [3]. The New Norm rules seem to change the public awareness on life experiences which are related to movement control order, social distancing and travelling outdoors alone. These changes have made home an important component for virtual social gatherings, working, attending virtual classes, playing sports and shopping [10].

This new norm phenomenon has been seen in people who have been laid off from work. Due to this, they started adapting home as a small-scale business platform to gain income and indirectly benefit the local community. At the same time, people should be prepared to change the function of their home as a quarantine place if one member of the household is infected. They also need to be prepared to face conflict due to stress of working at home [2]. In this regard, a house is important for people towards accommodating complex survival activities coherently during COVID-19 virus era.

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This paper will explore three types of house design for low-income groups in search for its social logic in space. The underlying meaning of social logic in space may be useful to inform spatial awareness of the whole configuration as a feature key for shaping work-from-home policy. The research will focus on how homes were designed before the covid-19 phase. This will accommodate more complex functions in the next era of endemic. The study intended to understand further meaning displayed in the layout pattern of space for low-income groups. Space syntax analysis method solves the absence of an interview session from the architect who is responsible for the house design. This analysis also revealed the perspective meaning from social logic of space. The finding found that the housing design for low-income groups are homogeneous. However, it acknowledged that experiences in housing studies may vary based on different contexts such as social logic, technology, policy, and social and demographic dynamics. People have different families and may work either full time or part-time. People live in various locations such as urban, suburban, and rural. We live in a house that witnessed how Covid-19 phenomenon had changed our way of life from normal to new norms.

2. Literature review and methodology

'Space Syntax' analysis is a popular configurational analysis that has been widely used by researchers to explore the cultural pattern of traditional and vernacular houses [13]. The configuration analysis of the space and layout plan displays its morphological values where the social logic of the household can be conveyed. The household social logic is also described in the form of housing units. The main recommendation of this method is based on social relationships and self-expressing events with regards to spatial configuration. Configuration is the relationship between two spaces by considering all the other spaces in the building. Hillier, Hanson and Graham (1987) explain:

"Therefore, spatial configuration is a more complex idea than spatial relationships, which do not just require a pair of related spaces."

In this study, several configurational analysis techniques were imported as part of research activity. The research activity aimed to investigate the meaning of social logic contained in the housing spaces of the lower income group. The main goal of this study is to extract the meaning of social logic from the house configuration that has been offered to dwellers. Site visits have been made to social housing in Bandung, Indonesia (Appendix 2), and Kuala Lumpur, Malaysia (Appendix 3) in 2019. Based on the initial view, both housing spaces have different design concepts and design goals. The Cigugur Housing Prototype in Bandung adopted the open-plan concept with shared common spaces among urban dwellers temporarily before successfully owning the house. Meanwhile, PPR Seri Semarak Housing in Kuala Lumpur adopted the concept of redesigning three-bedroom units for city dwellers to choose either to purchase or rent the residential unit. Housing design samples from Bean Hill's 1973 by the world-renowned architect Norman Foster were used as a cross-reference to describe designer's intuition.

The history of architectural spatial analysis began when Hillier and Hanson (1984) proposed a scientific research method for the purpose of understanding space and its arrangement in architecture. According to them, the layout plan has difficulty in revealing its configurational characteristics of residential units even by simply comparing it to others. The argument was based on their understanding that social structure is naturally a space. Therefore, the configuration of space has a basic form of social logic. Hillier and Hanson (1984) proposed space mapping analysis that could be generated into a Justified Permeability Graph. The value of integration of space could be numerically identified through the graph (figure 1). Hence, the characteristics of space arrangement can be objectively justified. According to Maina (2014), the calculation process must first start with the value of MD (mean depth) which is the value given by $d / k - 1$, where d is the amount of depth (d) of all space and k is the number of rooms put together in configuration form. The value of integration value (IV) space for space (1) is shown as in figure 1.

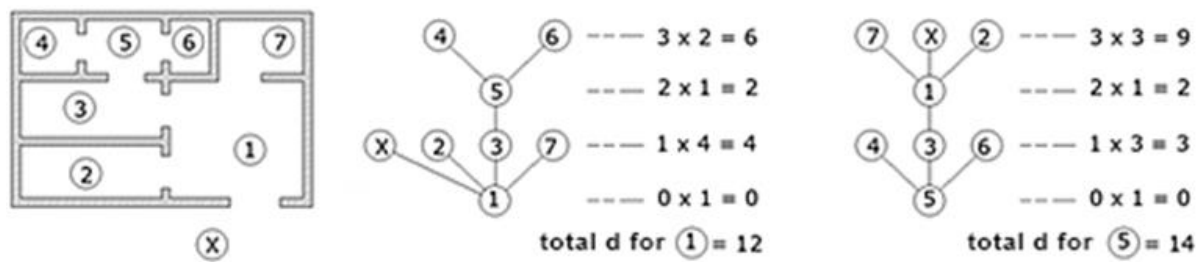


Figure 1. Examples of a layout plan (a) defined in the form of Justified Permeability Graph from ① as a carrier (b), and from ⑤ as a carrier (c).

The second step is to obtain RA (relative asymmetry) via the formula; $RA = 2 (MD - 1) / (k - 2)$ where, $d = 12$, $k = 8$, $MD = 12/8 - 1 = 1.714$., RA is the MD specified as the maximum fraction against possible depth ranges for any spaces with the same number assembled as spatial system [9]. For the space ① in figure 1b,

$$\begin{aligned} RA &= 2 (MD - 1) / (k - 2) \\ &= 2 (1.714 - 1) / (8 - 2) \\ &= 1.4285 / 6 \\ &= 0.238 \end{aligned}$$

For the third step, the value of RRA (Real Relative Asymmetry) which the value for the ratio of RA for space provided by the spatial system with the same number of spaces where $RRA = RA / D$ value for the ideal k space (Hillier & Hanson, 1984) is obtained. RRA means that the value of a space contained in a spatial system has a centrality value and is related to all spaces [12]. The value of RRA explains how highly permeable the space is. A low RRA value means higher integration, while a high RRA value means high segregation [4]. For figure 1b, the D value for 8 spaces = 0.328 (Appendix 1)

$$\begin{aligned} RRA &= 0.238 / 0.328 \\ &= 0.7259. \end{aligned}$$

The final step is to obtain the IV (Integration Value) via formula $1/RRA$. The following equation is shown:

$$\begin{aligned} IV &= 1 / 0.7259 \\ &= 1.3776. \end{aligned}$$

These are numerical figures that count for each space as a reflection of the extent to which space integrates or organises its access and movement. Furthermore, the integration has its implications towards social networks and activities inside the complex space [6][8][9][14]. It is the inverse of the RRA. The higher this value, the more integrated the space will be on the floor plan or the layout, from normal to new norms.

3. Findings

3.1 Sample 1: Cigugur social housing, Bandung, 2005

Sample 1 in figure 2 is a social housing prototype only for the people of Bandung, Indonesia. The house is designed for rental demand, while the number of occupants is limited to a couple with only a child. Therefore, the residential units share the Lobby (figure 2) with other units to cater for the need to entertain their guests. The unit layout is arranged in one-way configuration where there is no branch of linkage to the other spaces. The finding shows that the layout pattern of Sample 1 has low integration

value (IV) from the Exterior (IV=0.46) due to high segregation of space (RRA=2.16). What is interesting in this arrangement of space. It can be seen when the integration value is measured from the Living/Dining. This space becomes the centrality point in controlling social movements in configuration. Through the Justified Permeability Graph, the Living/Dining is in a strategic position to control the social movement of two types of space groups namely, Group of space 1 (Lobby, Passage 1 and Passage 2) and Group of space 2 (Bedroom 1, Kitchen, Toilet).

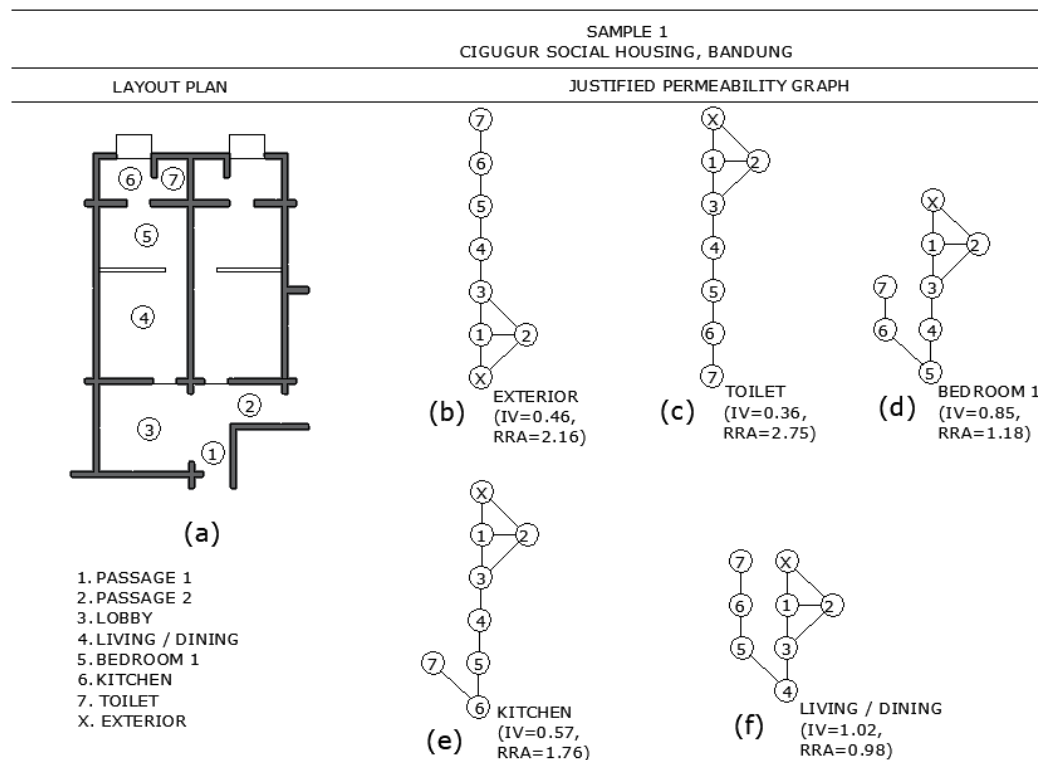


Figure 2 (a) The floor plan & Justified Permeability Graph (JPG) of the Cigugur Public Housing Prototype from space (b) exterior, (c) toilet, (d) bedroom 1, (e) kitchen, and (f) living/Dining. The number in the JPG refers to the name of the space function in the layout plan of the house.

3.2 Sample 2: PPR Seri Semarak, Kuala Lumpur, 2005

Sample 2 is one of housing estates that was completed in 2005 to replace squatter villages in Government's efforts to achieve the Zero Squatter mission in Kuala Lumpur city. The housing is designed to be purchased or rented to accommodate a household of five people in a single house unit. In accordance with the standard of residential space at the time, the house provides three bedrooms, two Toilet, a Yard, a Kitchen, and a Dining. Figure 3 shows the space arrangement of Sample 2 that focuses to develop from the exterior where space is on passage1 area with the main junction that goes to other five space branches. Group of space 1 also has a separate Passage area to go to both Toilet 1 and Toilet 2, while the second branch along with the Passage area gives dwellers the option to choose a branch to the Bedroom, Group of space 2 (Kitchen and Yard) and Group of space 3 (Living / Dining, Bedroom 2 area and Bedroom 3). Therefore, the integration value (IV) of the Exterior is at moderate level with configuration of (IV=0.92) median as a result of segregated space (RRA=1.09, the median configuration value). The interesting part of the space arrangement is that the Living / Dining is set to become the central point (RRA=0.73, the lowest configuration value) for social configuration movement to be highly permeable to all spaces. The Justified Permeability Graph shows the Living / Dining has the position to potentially create social gathering (IV=1.38, the highest configuration value) through the

informal encounter meeting resulting in Bedroom 2 and Bedroom 3 area that (segregation value of $RRA=1.45$) easily accessible from Exterior.

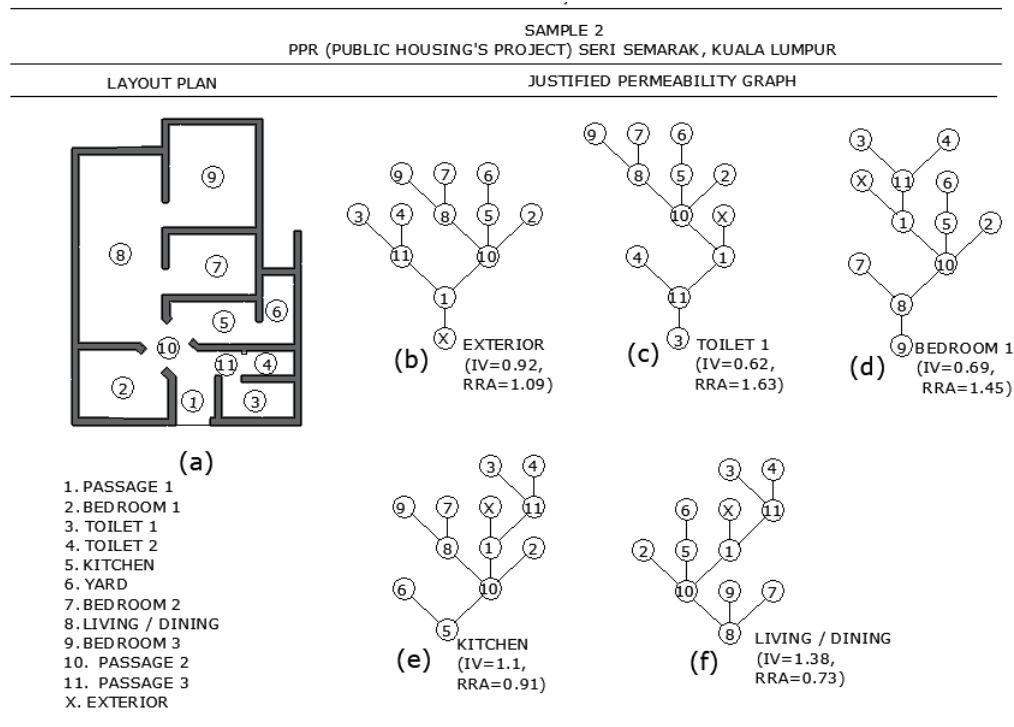


Figure 3 (a) The floor plan & Justified Permeability Graph (JPG) of the PPR Seri Semarak Housing, Kuala Lumpur from (b) the exterior, (c) toilet, (d) bedroom 1, (e) kitchen / dining, and (f) living. The number in the graph refers to the name of the function of the space in the floor plan.

3.3 Sample 3: Bean Hill Housing, England, 1973

Sample 3 is housing completed in 1973 by Architect Sir Norman Foster. This design is considered a thoughtful interpretation of modern life in architecture [11]. This housing design is an attempt to offer experiences from the occupancy and employment culture. Housing is also could be considered as an attempt to a conducive living within the industrial and commercial environments with design that reflects the economic urge. While this housing has suffered a shock in society's acceptance of minimal physical appearance (iron frames, steel walls, leaking roofs and damaged floors according to economic roads [5], but criticism of the layout of the spaces remains unspoken. Figure 4 shows layout patterns in sample 3 that evolve from the Exterior area where the Lobby area acts as the main junction to go to all segregated spaces.

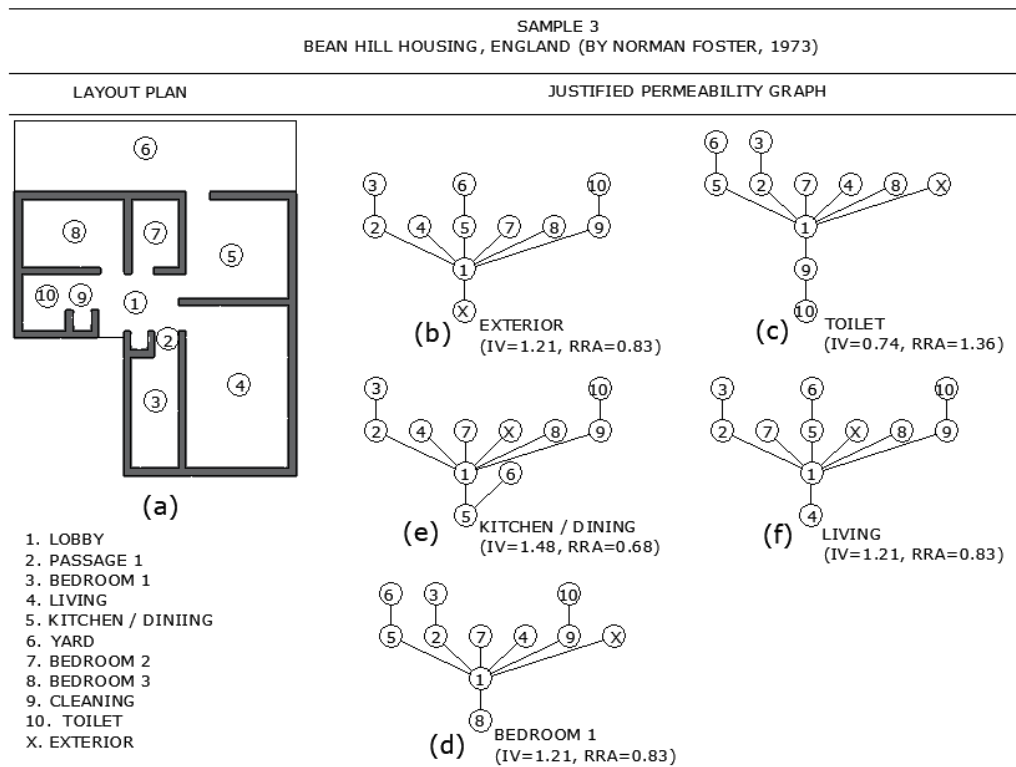


Figure 4 (a) The floor plan & Justified Permeability Graph (JPG) of the BeanHill Housing estate from (b) the exterior, (c) toilet, (d) bedroom 1, (e) kitchen / dining, and (f) living. The number in the graph refers to the name of the function of the space in the floor plan.

Living, Bedroom 2, Bedroom 3, were segregated without any shared space. Meanwhile, the Cleaning is shared with Toilet, Bedroom 1 shared with Passage 1 and Kitchen / Dining shared with Yard. Therefore, the integration value of the Exterior area is at a moderate level of configuration (IV =1.21, the median value in the configuration) as a result of the segregation of space (RRA = 0.83, the median value in the configuration). What is interesting in this layout is that when the integration value is measured from the Living, this space has a centrality point (RRA=0.83, median value in configuration) that is the same as the Exterior and Bedroom 1 subsequently with social movement. This spatial configuration has the potential to control movement to all spaces even with segregation possibilities such as a single entrance to the Living. Justified Permeability Graph shows that the Living is in a position of potential to gain more private experience as Living is not directly related to other spaces. Social gathering through formal encounters is seen as a social system in the house. It can be observed by seeing the Lobby area as a medium for movement in the entire space accessibility. The configuration also works for the dweller and visitor who visit the internal space from the Exterior (figure 4b). This configuration pattern of housing layout is based on segregation of space for creating gathering spots through formal encounters as all spaces are separately arranged from the Exterior area. The lobby area is a system that directs people to reach the intended space.

4. Discussion

Despite the varied shapes of space arrangements from these samples, this study explored the designer's nature of the space configuration that is introduced to occupants. The Cigugur prototype is a one-way way in inducing potential formal meetings where the Living /Dining area acts as a controlling centre for social movement. Meanwhile, PPR Seri Semarak has five growing branches of access to the three groups

of spaces. These branches can potentially generate informal gatherings where the Exterior has high access to the whole space. Bean Hill housing also expands from the Exterior by collecting six access branches into the Lobby area to entire spaces for generating formal meetings. This type of housing will invite dwellers into any intended space. Space arrangements (Table 1) descriptively indicate that each house has similarities and differences in organising social encounters. All samples show that the Toilet should be placed at the most segregated space. As for the easiest space to arrive from the Exterior, both Cigugur Prototype and PPR Seri Semarak agreed to position a Living / Dining for accommodating all functions compared to Bean Hill Housing which proposes a Kitchen / Dining. All three houses have different opinions for placing the space with a balanced value towards integration and segregation of space housing layouts. Basically, Cigugur prototype proposes Kitchen, PPR Seri Semarak suggests Bedroom 1 area and Bean Hill Housing proposes Bedroom 1 area and living.

Table 1 Basic syntactic data in three housing samples

House	k	MD	RRA		
			Min	Median	Max
Cigugur	7	2.8	0.98 (Living / Dining)	1.76 (Kitchen)	2.75 (Toilet)
PPR Seri Semarak	10	2.9	0.73 (Living / Dining)	1.45 (Bedroom 1)	1.63 (Toilet 1)
Bean Hill	11	2.3	0.68 (Kitchen / Dining)	0.83 (Bedroom1, Living)	1.36 (Toilet / Cleaning)

Based on the understanding of all permeability levels, two new questions have arisen in relation to the control of outbreaks spread. The considerations of domestic spaces control which based on the new normal practice for work-from-home consideration are:

1. *Is the existing housing layout design able to accommodate small business activities and at the same time avoid the spread of virus in the domestic space?*
2. *How to educate the public to think and cultivate entrepreneurship that starts from small business in limited space with existing daily home routines?*

Bean Hill housing can generate formal encounters for households to reach the intended space. However, the design will also face the urgency of outbreak in the Lobby. The lobby of Bean Hill design is the most humane and accessible space ever. Similarly, Cigugur housing has differences in encounters for creating social gathering as all spaces are segregated from the exterior. The urgency of the spread of the outbreak remains only to one-way movement over time and it is difficult to control. Meanwhile, Living/Dining spaces in PPR Housing Seri Semarak are vulnerable to the outbreak because it was the central point for accessibility. Social movement in central configuration is highly permeable to all spaces. Therefore, these three housing samples showed a vulnerability of covid-19 spread and faced the complication from work-from-home practice. This situation might have a socio-spatial impact on households in managing built form activities.

5. Conclusion

Each house shows its arrangement of a social space between men and women, young and old, hosts and guests in its building. Designers should think about the implication of these dimensions towards its space configuration. In addition, designers should not design merely with only self-intuition or visual evaluation. Architecture can enrich human experiences in various social aspects. This can be achieved by placing the architect in the experience of the dweller through space and form configuration during design practice. The nature of this research assessment concluded that the Cigugur prototype has exhibited the uniqueness of composition in providing an adequate space with clear occupancy level. Meanwhile at PPR Seri Semarak, the space composition is distorted with uncontrolled social movement

configuration. Bean Hill Housing also shows the lobby as a transition space and acts as a space management system for a specific visitation purpose.

Throughout this study, it is understood that the design of these houses has size limitation and high space integration value except for the house design produced by Architect Norman Foster. Preparing the endemic phase of Covid-19 requires undefined home spaces to rest after all day's work. However, a house is a microhabitat and all exterior social spaces need to be integrated with its domestic space. Therefore, home functions need to be flexible in accommodating new routines. A new perspective on the relationship between architecture and livability can be realised through design determination that encourages social logic thinking in mathematics and as well as design intuition in art. The research provides architectural possibilities for realising a suitable condition with regards to the endemic phase of Covid-19. It is suggested that mathematical evaluation should be combined with an intuitive compositional thinking in art to obtain truly an innovative architectural housing design. Therefore, it can accommodate complex and various social activities that could result from the pandemic.

6. Appendices

Appendix 1. Table of D values. Source: Hillier & Hanson (1984), p. 112

k	D value	k	D value	k	D value	k	D value
1		8	0.328	15	0.259	22	0.214
2		9	0.317	16	0.251	23	0.209
3		10	0.306	17	0.244	24	0.205
4		11	0.295	18	0.237	25	0.2
5	0.352	12	0.285	19	0.231	26	0.196
6	0.349	13	0.276	20	0.225	27	0.192
7	0.34	14	0.267	21	0.22	28	0.188
						29	0.184
						30	0.181
						31	0.178
						32	0.174
						33	0.171
						34	0.168
						35	0.166

Appendix 2. Fieldwork, Cigugur Housing, Bandung Indonesia



Appendix 3. Fieldwork, Projek Perumahan Rakyat (PPR) Seri Semarak, Kuala Lumpur, Malaysia



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