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Analysing implications of visibility for crime occurrence in low income vertical rental-housing complex

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Abstract

This study analyses the correlation between visibility level and crime occurrence inside a particular vertical rental-housing complex. The basic concept of living free from crime as explained by Newman in Defensible Space (1973) is explored with the main emphasis on residents gaining control over their living environment. This concept has been developed into a strategy called 'crime prevention through environmental design' (CPTED), which also considers the importance of not only physical design but also social development within the building. Visibility has become a central focus of living free from crime as it enables people to gain control over their environment. A case study of visibility levels was conducted in Jatinegara Barat Vertical Rental-Housing Complex, Indonesia. Residents in this housing complex are low-income people. They have adapted over time as the current housing type (vertical) differs from their previous housing type (horizontal). An analysis of visibility using a VGA with DepthmapX was conducted to provide specific data regarding visibility levels inside the building. The visibility graph identified a place that was vulnerable to crime occurrence inside the building because of its low visibility caused by its spatial configuration. In addition, some areas' visibility levels were defined not only by their physical properties but also by their residents' living habits. Further studies are required to analyse social background features when interpreting similar spaces because of their effect on visibility level in various ways.

Keywords
Visibility, Defensible space, Crime occurrence, Low income people, Vertical housing.

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1. Introduction

Visibility is a factor in many design concepts related to the discussion of crime prevention. In particular, it is crucial in order to increase the natural surveillance of an area. One of the concepts that highlight the importance of natural surveillance is 'defensible space' by Oscar Newman (1973). This theory was well-known during the urban renewal era when there was a movement to relocate communities from areas considered to be slums to other locations as part of the slum clearance policy (Michalos, 2014). His study, for example, found that Pruitt-Igoe has been categorised as an unsafe area (Newman, 1996). Newman warned that failure could result from housing design that neglected its socio-cultural context. The development of crime prevention design concepts is now termed 'crime prevented through environmental design' (CPTED). This concept has developed over time and consists of several key components that relate to the physical appearance of an area as well as the role of the community.

This study relates a specific, ongoing analysis in a low-income vertical rental-housing complex located in Jakarta, Indonesia. Indonesia's Central Bureau of Statistics (2018) reports that Jakarta in 2017 has the highest population density of any province in Indonesia; it reached 15.624 person/m2. This high population density requires Jakarta's government to strategise on how to fulfil housing needs. In order to improve land use efficiency, residential needs are met through vertical housing. Vertical housing is classified as a housing type according to article 1 paragraph 1 of Law number 20, 2011, of the Republic of Indonesia. These vertical housing complexes consist of several types: vertical-public housing, vertical-specific housing, vertical-state housing and vertical-commercial housing. The building we analyse in this study can be categorised as vertical-public housing type.

One of the vertical housing projects in Jakarta is the Jatinegara Barat Vertical Rental-Housing Complex. This complex, occupied since 2015, serves as a relocation area for residents of Kampung Pulo. Kampung Pulo was a densely populated residential area located on the banks of the Ciliwung River that frequently suffered from flooding. The building's design was chosen during a design competition held by the government. As the building developed over time, residents seemed to adapt their previous habits and group activities to the current building's form. This adaptation led to unique living habits that impacted territoriality and visibility levels. Therefore, this study aims to analyse the correlation between visibility levels and crime occurrence inside a low-income vertical rental-housing complex by considering not only its physical appearance but also its social activities.

2. Methods

The site observed in this study was Jatinegara Barat Vertical Rental-Housing Complex, which is located in Jatinegara Barat street, Jatinegara, Kampung Melayu, East Jakarta as shown

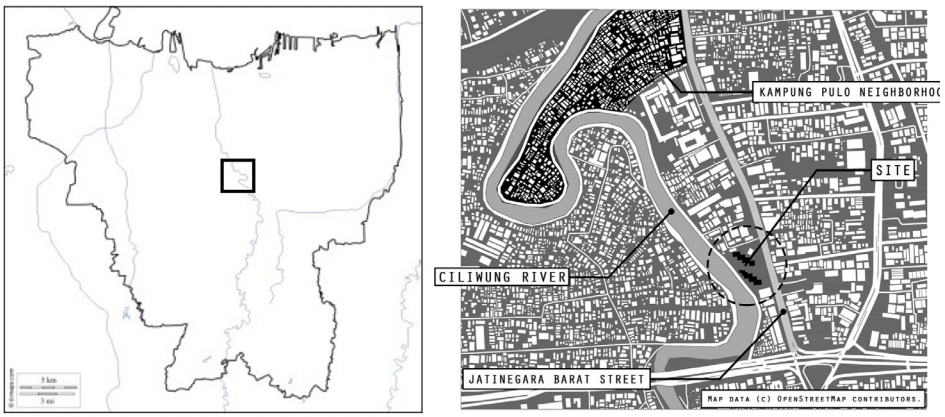

Figure 1. *Location map of Jatinegara Barat Vertical Rental Housing Complex. The map data has been modified from the original source openstreetmap.org.*

in figure 1. This building comprises two towers, namely, Tower A and Tower B. The building is located adjacent to several areas, such as a residential area, shopping centres and also within easy reach of public transportation facilities. Generally, the first floor and the second floor have been established as semi-outdoor areas that contain an office, a commercial area and public space. Meanwhile, the third floor through to the sixteenth floor contains residential units that can be accessed through elevators and emergency stairs. Our examination focused on the residential unit floors that have identical plans for each floor.

The residents of the Jatinegara Barat Vertical Rental-Housing Complex are mostly former residents of Kampung Pulo and surrounding areas who were relocated in 2015. The buildings in that area typically had one to three floors and were usually inhabited by more than one head of household. According to recapitulation data obtained from the local residents, there are now 2,203 people who occupy the Jatinegara Barat Vertical Rental-Housing Complex. They work in various professions (trade, services, or formal sector). The monthly income of most residents in the neighbourhood is around $73.2–$219.5 per month, which can be categorised as below Jakarta's minimum wage ($288.5 per month in 2019).

First, to gain an understanding of the site, a study was conducted by using field observations and interviews. Generally, the observations focused on how residents lived their daily life and how the built environment worked both spatially and visually. Observations were conducted on weekdays and weekends to understand differences in residents' activities, visitors and crowds. The interviews were conducted qualitatively in the form of deep conversations with the head of the neighbourhood association and several residents. An interview with the head of the neighbourhood association was conducted to gain information regarding residents' general statistics and crime occurrence. Meanwhile, the interviews with residents were conducted to gain information regarding their daily lives, how they used to live before they moved into their current housing and crime occurrence. Following this process, we made a map of crime occurrence that was based on the information that we gathered at the site.

An analysis of visibility was conducted by Visibility Graph Analysis (VGA) using DepthmapX software (Turner, et al. 2001). VGA generates a graph of mutual visibility between sets of isovists (Turner, et al. 2001). We created the VGA by using computational software, DepthmapX, which operates in a 2-D area of spatial configuration. The visibility relationships generated by the setup grid included all the spaces that could be analysed from every other point (Lee and Ha, 2015). VGA can be used to assess architectural projects or can be directly applied to the design process (Arnold, 2011).

We developed a layout to make a graph comprising several conditions based on an issue that we found in the building. First, overall views of isovists inside the building were generated from the closed geometry of the identical plan of the building while eliminating the door. This served two purposes: one where we ignored window function and another where we used window function. We set up grids in a dimension of 0.04. The VGA used greyscale, which indicated that the darker the colour the fewer the number of corresponding points in the areas and therefore the lower the visibility. On the other hand, the brighter the colour the more corresponding points in the area and the greater the visibility.

Following the visual graph analysis, the results were analysed using the concept of defensible space and CPTED, focusing on the relationship between visibility features and crime occurrence inside the building.

3. Literature study

3.1. Vertical housing for low income residents and crime safety

Vertical housing, especially high-rise housing, is useful for its ability to occupy a smaller footprint in comparison with low-rise and mid-rise housing (Gifford, 2007). This leaves more open space for greenery and parks in a city (Broyer, 2002, stated in Gifford, 2007). Yet it also has some adverse impacts

on its residents. Residents of high-rise buildings tend to have higher rates of stress, schizophrenia and phobias relative to their broader community (Husaini, Moore & Castor; Husaini, Castor, Whitten-Stovall, Moore et al., 1990, quoted in Gifford, 2007). The design of vertical housing is considered to cause low coherence and low control in the residents (Mazerolle and Terill, 1997, quoted in Rephann, 2009).

James Lynch, as quoted in Maxfield (1987), has suggested that people who are involved in different levels of social activity experience different levels of crime risk. For example, in a residential domain, single parents who are the only adults in their households are usually unemployed and often victims of crime (Maxfield, 1987). This often make low-income housing bears a stigma of criminality in society (von Hoffman, 1996, quoted in Tillyer and Walter, 2019).

Yet a study by (Tillyer and Walter, 2019) has shown that this stigma is not entirely true, because not all low-income housing is crime-ridden. The potential and actual rates of crime in a housing complex are influenced by the building's security and design development as well as by the character of the people who occupy the area (Tillyer and Walter, 2019). Different building designs can bring out different strengths and weaknesses in people (Sinnett, Sachson & Eddy, 1972, quoted in Gifford, 2007). Furthermore, low-income housing is not an isolated and stand-alone system; rather, it is a part of the larger community in which low-income residents live, and this larger community affects the vulnerability of their living environment (Tillyer and Walter, 2018).

In Indonesia, the definition of Vertical Housing is specified in Law No. 20 of 2011. The types of vertical housing consist of vertical-public housing, vertical-specific housing, vertical-state housing and vertical-commercial housing. On the basis of the Regulation of Minister of Public Works and Housing No. 01 of 2018, vertical-public housing is intended for low-income residents, most of whom receive subsidies from the government. Vertical rental-housing is one means by which the Indonesian government can fulfil its people's need for housing, which has significantly increased, especially in urban areas. Most vertical rental complexes built by the government can be categorised as high-rise buildings. The majority of residents of these buildings were relocated from areas that are now considered slums or from riverbank areas.

3.2. Visibility role in defensible space and CPTED concept

Visibility in designing with crime is about crime being at the back of one's mind as one essential subject. The earlier works referred low visibility or surveillance as a parameter related to criminal behaviour (Lee and Ha, 2015). The concept of defensible space, which is directly related to the environmental context of design, is considered to be more applicable than sociological theory in addressing the problem of crime (Reynald and Elffers, 2009). The defensible space concept comprises four key concepts, namely, territory, natural surveillance, image and milieu and safe area. Natural surveillance is the residents' ability to naturally control and observe their neighbourhood (Newman, 1973). The quality of natural surveillance in the building is thus affected by both physical and socio-cultural elements of the building. Newman (1973) describes the need for design after considering the visibility of physical elements such as the visibility of vertical and horizontal access, the visibility of the building by pedestrians and the visibility of public areas.

The concept of design to prevent crime gradually developed into CPTED, which is more advanced. It evolved over years of discussions and is now in its third generation (Mihinjac and Saville, 2019). Newman's defensible space was one of the foundations of CPTED. The first generation of CPTED comprised seven dimensions, including territoriality, surveillance, access control, target hardening, legitimate activity support, image management and geographical juxtaposition (Cozens and Love, 2015). However, it attracted criticism because it ignored social factors and was overly focused

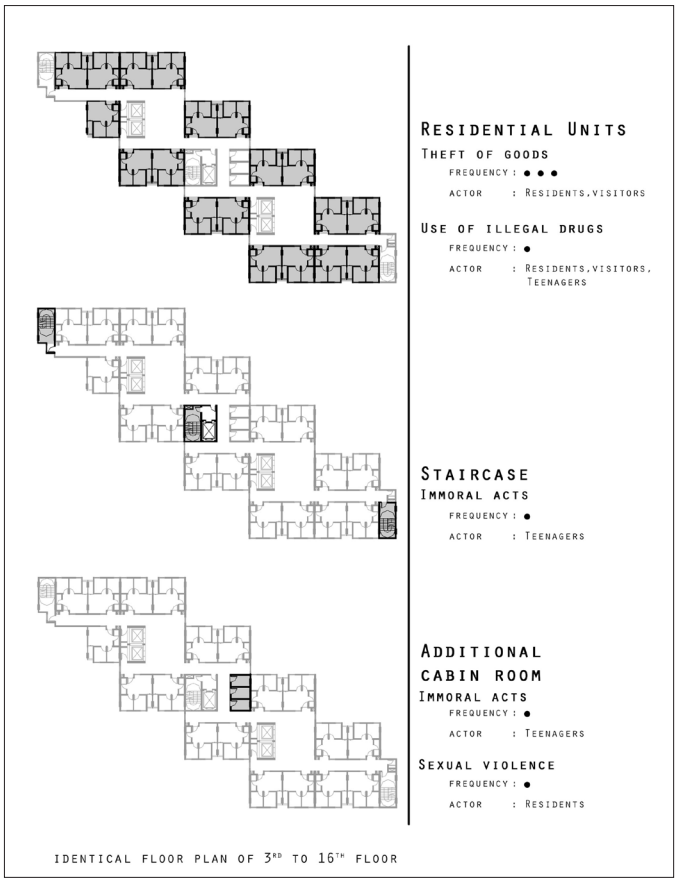

Figure 2. *Crime location inside building.*

on physical factors (Cozens and Love, 2015). CPTED then developed into its second generation, which extended its conceptual reach to focus on community participation to improve social control (Saville and Cleveland, 1997, quoted in Cozens and Love, 2015). These key concepts included social cohesion, community connectivity, community culture and neighbourhood capacity. A study by Kim et al. (2019), discussed the different effects of first-generation CPTED and second-generation CPTED. Second-generation CPTED emphasises the characteristics of the community and had a more significant impact on crime reduction (Kim, et al. 2019).

4. Findings

4.1. Crime occurrence in low income vertical rental-housing complex

On the basis of interviews with residents and the Community Association's annual report in 2018, we collected data regarding crime occurrence inside the building. Subsequently, we made a map of the locations and crimes throughout 2015–2018. Figure 2 below contains general locations of crime occurrence inside the building, because of the specific location, such as residential unit number and/ or floor where the crime occurred, remaining unknown.

The study found that crime inside the building occurred most frequently on the staircases, in housing units and in additional cabin rooms. Staircases and additional cabin rooms have relatively low visibility. The building layout played a role for this visibility level to come into being. The residential units were the scenes of several crimes, such as theft of goods and use of illegal drugs. We found out that theft was the most frequent crime in the area, while the others occurred much less often. Theft occurred in several different conditions.

First, it occurred when a housing unit was left empty by the owner. Second, it happened when the door was left open and the owner fell asleep. This condition indicated that many residents like to open their doors. This was a habit from their old way of living. Residents said that opening the door improved air circulation and also enabled them to observe other resident activities outside their units. Finally, theft also occurred when residents placed goods around the doorstep. The people who committed this crime were known to be a mix of insiders and outsiders. The other crime that occurred most frequently in residential units was illegal drug use. This crime was mostly committed by insiders and could also be considered to be juvenile delinquency.

The other locations prone to crime were the staircase area and additional cabin rooms. Staircase areas were the locations of immoral acts by teenagers because of the low visibility from the outside area. The area relies on artificial lighting because there are no windows available. Meanwhile, additional cabin rooms were a location of immoral acts, and sexual violence also has a similar physical association with the staircase area. We cannot directly see what goes on inside cabin rooms because there is only a single door to each room, which does not support visibility into the room. This room was used as a prayer

room for residents' guests and/or as a janitor's closet.

4.2. Visibility level inside building

In this section, we discuss visibility levels inside buildings on the basis of direct observation and VGA. The focus of the analysis centres on the residential floors, which consist of the 3rd floor until the 16th floor and which are represented by a single building plan, as the floors have an identical plan. The building's spatial configuration forms a zigzag circulation. The main circulation inside the building is a double-loaded corridor that is directly connected to residential units on its both sides. The corridor walls are windowless and offer no view outside the building, nor are the corridors visible from outside the building. There is one opening in the form of a louvre window at the end of each corridor, which allows sunlight to enter the building's interior and improves the air circulation.

Vertical access inside the building consists of stairs and elevators. Stairs inside residential floor consist of three sets of emergency stairs in each tower. These stairs have closed walls, and thus, they cannot be observed from the outside. The staircase area's lighting depends on artificial lights. The doors to these access stairs are always left open as the stairs are often used by the residents.

The other vertical access route is the elevators. Each tower has three elevator units, two of which are intended for residents' use, while the third is for cargo, which is located in the centre of the tower. The elevators for residents' use are located in a corridor with a wide front, which is also often used by residents for many activities. The presence of people using this space and the presence of people waiting for the elevator can be seen from the nearby corridor and from several residential units that face directly into the elevator area. Meanwhile, the elevator area in the residential floor cannot be seen from outside the building or from other floors.

The zoning changes of the public and private spaces in the interior of the building were found to have a role in changing visibility levels inside buildings. This is beyond its spatial configuration; besides, it is described in terms of the activities and behaviour in the corridor and residential units. Residential units are generally defined as private areas. However, in this building, these private areas can change their zoning to become semiprivate or semipublic. There is one window in each housing unit that offers a view of the corridor. However, these windows rarely function as intended. Rather, these windows are usually intentionally blocked with curtains and/or permanent covers such as gift wrapping as shown in figure 3. On the other hand, residents also have a habit of leaving their unit doors open. Based on our interviews, this habit came with many residents from their previous neighbourhood. According to residents, leaving the unit door open reduces stuffiness in the room, facilitates air circulation and makes it easier to see activities and/or people in the corridor. This situation introduced zoning into the residential units, which then became semiprivate. It was not only the residents who benefited from seeing the corridor but also outsiders, who could also see into the residential unit.

In other cases, some residents had

Figure 3. *Types of window covering.*

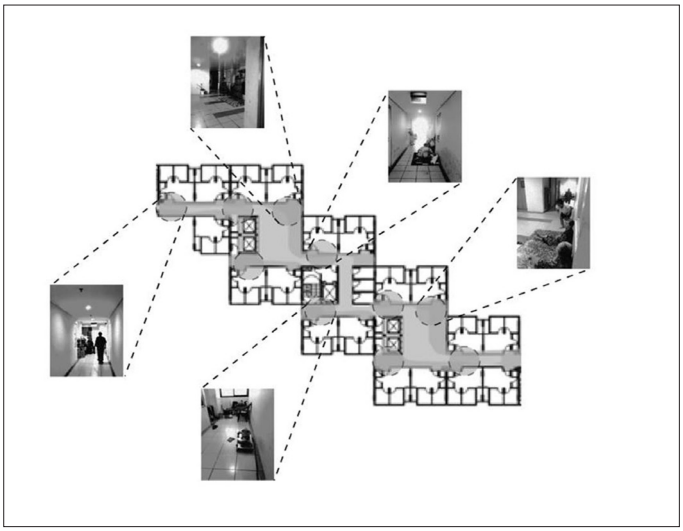

Figure 4. *Crowd location inside the building.*

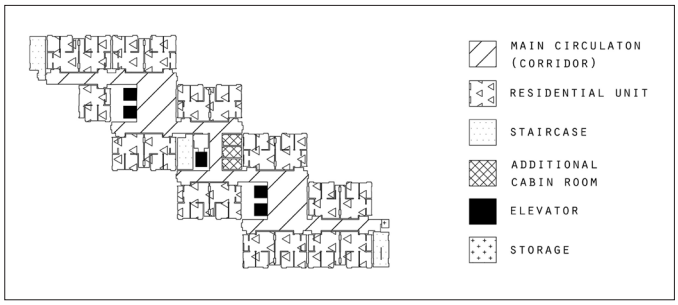

Figure 5. *Building layout.*

opened small shops to sell food inside their residential unit so that buyers could easily access (at least) their living room. This phenomenon changed residential unit territory to semipublic. Outsiders could easily see the interior from the corridor or even have access to their living room.

In the corridor area, there are also interesting activities that change the zoning of this semipublic area. Our observations and interviews show that the residents' activities often extend into corridor areas. Some residents seem to make the corridor as a reception room as shown by the presence of carpets and/or chairs and tables placed in front of some residential units as we see in figure 4. In addition, the corridor also functions as a space to store large items such as children's toys and work-related items. Corridors can also function as children's playrooms. Sometimes the corridor area is even used as an extension of the kitchen and a venue for shared activities. The existence of activities related to a household changed the area into a semiprivate space. In terms of visibility, this change in zoning gave the residents a sense of belonging to the corridor. The more they occupied the area the more they gained control over the area.

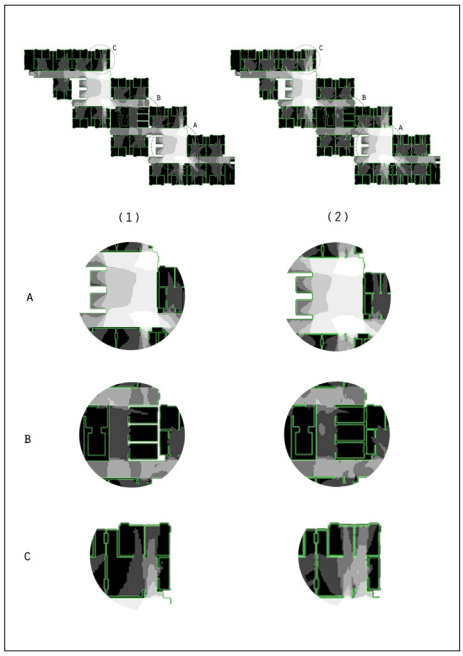

Figure 6. *Visibility Graph Analysis. (1) Set up layout without housing unit's corridor window function. (2) Set up of layout with housing unit's corridor window function.*

We turned a setup into a VGA in accordance with the observations above. The rooms named in the VGA layout are as shown in figure 5. Meanwhile, figure 6 shows a visibility graph of a residential floor of Jatinegara Barat Vertical Rental-Housing Complex. We developed the layout by ignoring the existence of a door to have the maximum visibility when the residential unit as a private area turned semiprivate/semipublic. Then, we created two-conditions; where the window of a residential unit that faced the corridor did not function at all (1) and one where it was functioning well (2).

This visibility graph was mapped using greyscale colour as its parameter, with the darker the colour the lower the area's visibility. According to the conditions in (1) and (2), several differences are important to be noticed. The zoom out graphs A(1) and A(2) consider a corridor with the widest area. Both areas have a brighter colour and so can be described as high-visibility areas. If the window functioned well in A(2), a wider area of bright colour was visible in the map of the corridor area.

Another circulation area shows differences in B(1) and B(2); this is the area in front of an additional cabin room. The dark grey of the corridor area indicates that the area has medium–low visibility. Meanwhile, the additional cabin room has an almost

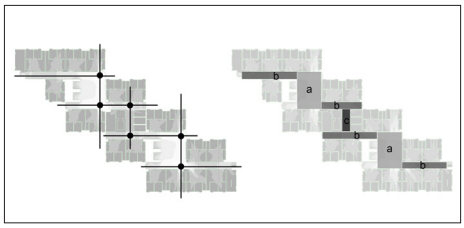

Figure 7. *(left) Intersection of corridor axis, (right) rhythmical visibility level in corridor.*

black colour indicating that this area has low visibility because it can only be seen from several points. This black colour in a public or semipublic zone was not only found in additional cabin rooms but also in almost all the staircase areas. A well-functioning window also made some difference to the graph; however, it mostly appeared to have a specific colour change in front of a residential unit.

Next, we noticed specific visibility changes inside each residential unit as drawn in C(1) and C(2). The well-functioning window, in this case, a barely transparent window, provided higher visibility not only in the corridor area but also in the residential unit itself. It provided visibility from the corridor into the housing unit.

From the visibility graph, the corridor as the main circulation area had the highest visibility level. However, the VGA mapping shows differences in visibility according to the rhythm b-a-b-c-b-a-b as shown in figure 7.

The 'a' area had the highest visibility level and also the widest corridor area connected to the elevator and several residential units. This area had become an extension of housing space and hosted several resident activities. Meanwhile, the 'b' area had medium visibility and was a small hallway that connected to several residential units. The 'b' areas could be observed from the 'a' areas, as in figure 4, which points out the crowd located around the intersection axis. The lowest corridor visibility levels were in the 'c' area hallways in front of additional cabin rooms. This 'c' corridor area only belonged to one additional cabin room that was not a resident extension space. This condition would change when there were activities around the intersection with the 'b' area. The visibility level during this rhythm changed every direction in axis circulation.

5. Discussion

On the basis of the VGA, the corridor had the highest average visibility inside the building. However, the visibility in the corridor area also differed, depending on its spatial configuration. Several areas prone to crime, such as the staircase and additional cabin room, had low visibility levels. The interior area of the staircase and additional cabin room could hardly be seen from outside the area (such as from the corridor or a residential unit). Meanwhile, the residential unit was one location that was prone to crime when the door was well-closed because it became a private area and could not be seen from the corridor.

Yet, spatial configuration is not the only thing that can influence the visibility level inside a building, because residents' activities also play a role in creating visibility levels. When there is a habitual preference, such as 'opening a door', visibility becomes a paradox. It provides surveillance of the corridor and improves safety. The VGA shows that opening the door increased visibility in almost every room inside the housing unit, particularly the living room.

Meanwhile, other habitual preferences, such as covering windows, also affect visibility. The lack of use of a window (such as using curtains) that directly faced the corridor decreased the visibility of the area. While the use of curtains can be considered to be a good thing because a resident can then control when they want it opened or closed; a fully open window without any covering increases outsiders' view of the residential unit. If these corridor windows were left uncovered, the view of the corridor in front of the cabin rooms from inside each unit would be well monitored. The use of windows has an impact not only on the corridor but also on several areas attached to it, such as additional cabin room areas or staircases.

Moreover, the location of the crowd around the corridor can be a potential subject to increase the natural surveillance. The extension of residents' living space to the corridor results in a higher sense of belonging to the corridor or in residents even spending their time in corridor. The presence of residents functions indirectly as an environmental control. When they used to gather around the corridor, they can barely see who passed the corridor. The presence of residents reduces the opportunities for potential criminals and engenders the fear of being caught, as people are

observing the area. The number of natural surveillance areas is higher when residents gather around an intersection axis because intersection areas provide wider visibility. This explanation indicates that the visibility level inside the building depends not only on its spatial configuration and physical appearance but also on how the residents interpret space and building elements in unique ways. Incidents are more likely to occur in low-visibility areas, when the area is not connected to resident activity and/or when the view is blocked due to the physical elements of the building such that the residents as natural surveillance agents cannot perform well.

6. Conclusion

Crime occurrence inside the Jatinegara Barat Vertical Rental-Housing Complex includes immoral acts, sexual violence, use of illegal drugs and theft of goods. The rates of these crimes are mainly influenced by variations in natural surveillance and territoriality at specific locations in the building due to their visibility. The physical characteristics of buildings influence the visibility of certain areas, such as staircases and additional cabin rooms, can be defined as low-visibility areas. Buildings' spatial configurations also determine whether visibility is good or poor. Certain socio-cultural characteristics of the residents, such as the habit of leaving doors open and/or blocking windows, as well as patterns of daily activities such as gathering in the corridor and lobby as opposed to remaining in the residential units can influence a building's security conditions as well. This means that the visibility configuration inside a building is not only formed by its physical appearance (whether it has openings, a door, or a wall), but the role of these elements can be affected by residents' behaviour.

The results of this study cannot be generalised. In particular, this study focused on a particular resident group living with their unique living habits inside housing for low-income people. However, this study may prove to be beneficial when considering the design or development of other low-income housing, particularly vertical constructions. The general design of such a building should consider not only physical elements but also the social aspects of spatial organisation. For more advanced and comprehensive results, further research is required that compares different kind of residents (social background) within similar building forms to investigate whether the results differ. Researchers could also consider broader environmental elements because in this study we only focused on the building's interior configuration.

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