The implementation of the Crime Prevention Through Environmental Design (CPTED) concept on Taman Setiabudi Indah 1 Estate, Medan City, Indonesia

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Abstract. Home as a place to live is the primary needs of humans as the safest place for them. The need for security is a crucial aspect for human life, and the thing that will prevent to fulfill this need is the occurrence of crimes including in residential areas. With the losses resulting from criminal acts, a defensive effort needed in housing areas by applying the concept of Crime Prevention through Environmental Design (CPTED). The study took Taman Setiabudi Indah 1 Estate. The research aims to examine the implementation of the CPTED theory in the Taman Setiabudi Indah 1 Estate and develop a security strategy based on the CPTED and its practice in a residential area. The research based on variables, namely elements of public space, footpaths, car parking, external lighting, landscaping, territoriality and maintenance, and target hardening. For this reason, descriptive research conducted with qualitative methods obtained from regional mapping techniques and interviews, also quantitative methods derived from the scoring table in each study sample. The results obtained from this study will show the CPTED implementation in the Taman Setiabudi Indah 1 Estate Medan with recommendations for the application of the concept that is suitable for urban housing.

1. Introduction
Home as a residence is one of the most prominent needs of humans, with a function as a place to return from daily activities, a place to relax with family, a place to rest, and a place to feel safe. As Abraham Maslow [1] stated, the need for security ranks second after physical needs, namely the need for food, clothing, and shelter. With this, it concluded that the need for safety is an important aspect of human life. Based on data from the Indonesian Central Bureau of Statistics (BPS), the crime rate that occurred in Indonesia in 2016 increased from the previous three years to 357,197 cases. According to 2017 Criminality Data, North Sumatra province ranks first in an area prone to crime in Indonesia, and the city of Medan is the first most unsafe city in Indonesia based on the Indonesia Research Center survey data with a security rating of only 3.2% [2]. In large cities, crime can occur in various places where humans usually carry out daily activities such as in public spaces, offices, educational institutions, highways, and in residential areas. So many criminal cases also occur in residential areas in Indonesia. With the many losses incurred, of course, a way to avoid such an event is needed to be repeated and minimize the disadvantages caused by the incident. One effort to do in preventing
criminal acts in urban housing areas is by applying the concept of Crime Prevention Through Environmental Design (CPTED) which examines aspects in preventing the occurrence of crime in the human activity environment in the design approach.

C. Ray Jeffery in 1971 first introduced the term CPTED in his book entitled, Crime Prevention through Environmental Design. Jeffery [3] argues that sociologists and criminologists overestimate the social causes of a crime without regard to the state of environmental determinants. Jeffery extends the assumption that proper design and effective use of the environment can cause a reduction in fears of crime and crime incidents and can improve the quality of life. The CPTED theory is based on the simple idea that crime is a result of opportunities generated by the physical environment. If this is one of the causes, it should regulate environmental conditions so that it can minimize the possibility of a crime. The second approach to being under CPTED is the theory of Defensible Space by an architect named Oscar Newman. In his book Defensible Space [4], Newman, like Jacobs, holds that crime is allowed to develop because housing design prevents citizens from exercising friendly control over their environment. Newman argues the management arises mainly from natural supervision, coupled with a feeling of territoriality deep within the inhabitants' souls. Newman's central concept, referred to as Defensible Space, includes four different design elements: Territorial Definition, Visibility / Surveillance, Stigmatization, and Adjacent Areas.

There are many examples of CPTED concept applications. The application of this concept is intended for designers to think about adaptation to settings in their environment. One of them is the concept of Paul Stollard, namely Crime Prevention Through Housing Design, Design Process — Site. During the design process, architects and planners must be aware of the long-term and short-term security consequences of their decisions. In the short term, they must ensure that the process of upgrading is as simple as possible. Every aspect of design must apply these principles. In the long term, they need to consider how to improve. It will involve designing to reduce the amount of care required and to make simple and inexpensive repairs and replacements. There are five concepts of environmental regulation mentioned by Stollard, which include public space, which describes the placement of public spaces in a residential area to maximize monitoring of potential crime. The second is footpaths, which explain the condition of trails and roads for vehicles as well as access control in the area and the shape of the street. Third, the aspect of car parking that explains the block distance of parking from a residential area can increase supervision by the community. The fourth is external lighting, which discusses the availability of lighting components in the zone by considering the type, intensity, and location of light. The last is landscaping elements, namely landscape elements that must also be considered the variety, distance, and height, because it can affect the optimization of supervision [5].

Next is the CPTED theory based on the Neighborhood Watch. The CPTED theory, in principle reveals that crime is more likely to occur in areas with low levels of supervision. It is what underlies the implementation of CPTED by maximizing environmental design that is “overseeing.” This concept attempts to minimize the security role of officials formally through excessive questioning of outsiders (intimidation) and the use of gates that are too striking (unfriendly). The implementation of CPTED divided to five main components. The first is access control, which is done by limiting access to entry and exit, designing elements of an environmental street that reduces the effort of crime. The second is natural surveillance, carried out by territory arrangement that support the occurrence of natural supervision by residents. The third is territorial reinforcement, which is a territorial reinforcement by giving identity to each occupancy with material differences and a clear house numbering. The fourth is maintenance and target hardening, which is a form of safeguards such as guard posts and portals, restrictions on access to space and public facilities and environmental maintenance efforts. The last is activity support, namely the supervision carried out by the community, both natural supervision and security devices [6].

In some studies, the CPTED concept is also able to reduce the crime that occurs in residential areas. This paper attempts to examine the implementation of the CPTED theory in the Taman Setiabudi Indah 1 Estate and develop a security strategy based on the CPTED concept and its practice.
in a residential area. The results obtained from this study will show how the conditions of the CPTED implementation in the Taman Setiabudi Indah 1 Estate Medan with recommendations for the application of the CPTED concept that is suitable for urban housing.

2. Method

Physical data is obtained from observations and carried out judgments according to predetermined variables and indicators. After that, a scoring system and ranking for each sample are carried out.

![Figure 1. Study sample on Taman Setiabudi Indah 1 Estate.](image)

The analysis is carried out on physical and non-physical data obtained with quantitative and qualitative approaches. Physical data were obtained from field observation techniques by recapitulating a list of physical element checklists by taking from the CPTED concept which has been used as a research variable that shows how the implementation of the CPTED concept in Tasbih housing 1. The method has been applied to similar research by Linda Puspita Sari [7]. The following is a table of limitations on the assessment of the application of the CPTED concept to residential areas:

| No. | Variable          | Sub-Variable               | Indicator                                                                 | Value |
|-----|-------------------|----------------------------|---------------------------------------------------------------------------|-------|
| 1.  | Public Space      | Location of public space   | Close, which is one road with occupancy (direct access)                   | 3     |
|     |                   |                            | Average, public space is on a different road, but it is still a zone with occupancy | 2     |
|     |                   |                            | Far, namely public space in a different zone with occupancy               | 1     |
|     | Public space      | access                     | For only residents of the complex                                          | 2     |
|     |                   |                            | For residents of the complex and general occupants                        | 1     |
|     | Parking area      |                            | Has its parking area                                                      | 2     |
The public space parking area is in residential areas (for example in front of residential) 1

2. Footpaths
   Access control in and out of the area
   There is only one access out and into the complex area 2
   There is more than one access exit and enter the complex area 1

   The location of the main road
   Far, that is, occupancy is in a different zone with the main road complex 3
   Average, that is, residential is not far from the main road complex 2
   Near, namely residential area in the main road complex 1

   Sidewalk
   Available and functioning 3
   Available and not functioning 2
   Not available 1

   Guardhouse
   Available and functioning 3
   Available and not functioning 2
   Not available 1

   Portal
   Available and functioning 3
   Available and not functioning 2
   Not available 1

   Speed bump
   Available and functioning 3
   Available and not functioning 2
   Not available 1

3. Car Parking
   Occupants parking
   50% - 100% Residents have their garage 3
   25% - 50% 2
   0% - 25% 1

   Non-occupant visitor parking
   Available with a specific location 3
   Available without specific location (on the roadside) 2
   Not available 1

4. External Lighting
   Street lights availability
   Available and functioning 3
   Available and not functioning 2
   Not available 1

   Street light intensity
   50% - 100% of residents exposed to light 3
   25% - 50% 2
   0% - 25% 1

5. Landscaping
   Vegetation layout
   Available and does not disturb the view to the residential area 2
   Available and disturb views to residential areas 1

   Vegetation type
   Branchless trees with a height of less than or equal to 1.5 m 3
   Branchless trees with a height of more than 1.5 m or branched trees with a height of less than 1.5 m 2
   The branch trees with a height of more than 1.5 m 1

6. Territorial Reinforcement
   Material and residential style similarity
   0% - 25% occupancy has identical material and residential style 3
   25% - 50% 2
   50% - 100% 1
Residential with its fence
50% - 100% occupancy equipped with its fence
25% - 50%
0% - 25%

Residential with clear numbering
50% - 100% occupancy has clear numbering
25% - 50%
0% - 25%

Then according to the indicators that have been determined on each variable, a scoring and ranking system will be carried out for each study sample. After that, do quantitative analysis based on the scoring results to conclude.

**Table 2. Conversion rating.**

| Score | Explanation         |
|-------|---------------------|
| 1     | Not good            |
| 2     | Good enough         |
| 3     | Very good           |

Then after determining the conversion rating with the existing score, the highest and lowest values are decided for each variable. For example, the aspect of public space has three (3) research indicators, so if the value is good and given a score of three (3), the highest value for the public space variable is 3 x 3 points = 9 points, likewise with other variables.

**Table 3. Final scoring scale.**

| CPTED concept                  | Value | (3)Good | (2)Average | (1)Less |
|--------------------------------|-------|---------|------------|---------|
| Public space                   |       | 9       | 6          | 3       |
| Footpaths                      | 18    | 12      | 6          |
| Car parking                    | 6     | 4       | 2          |
| External lighting              | 6     | 4       | 2          |
| Landscaping                    | 6     | 4       | 2          |
| Territorial reinforcement      | 9     | 6       | 3          |
|                                | **54**| **36**  | **18**     |

The CPTED system is inseparable from the presence of residents. Therefore, it is necessary to assess the physical elements from the viewpoint of the block occupants to take into consideration at the end of the study. This data obtained from a questionnaire distributed to residents of each study sample. Questionnaire results were used as a reference for assessing occupants’ sense of security. The Likert scale value used in this study is 1 (not good), 2 (good enough), and 3 (very good).

**Table 4. Questionnaire assessment.**

| Variable                      | Indicator                                | Required data                                         | Method  |
|-------------------------------|------------------------------------------|-------------------------------------------------------|---------|
| Maintenance and Target Hardening | Security conditions with/without portals | Security quality for each sample with or without a portal | Questionnaire |
|                               | Security system (siskamling)             | The quality and how the security system (siskamling) applied to each sample | Questionnaire |
|                               | Garbage disposal system                   | The quality and how the waste disposal system applied to each | Questionnaire |
Interaction between residents

The quality of interactions between residents that occur in each sample

Each indicator then looks for an average to simplify the results of the questionnaire recapitulation distributed. Compilation of each value obtained by each indicator will then be averaged. After obtaining the average value, then an analysis of the relationship between the implementation of the CPTED concept has been carried out with the perception of the security of residents living in Taman Setiabudi Indah 1 Estate.

**Table 5.** Final questionnaire assessment.

| Score | Explanation    |
|-------|---------------|
| 3     | Very safe     |
| 2 - 2.99 | Safe enough |
| 1 - 1.99 | Not safe     |

The results of the analysis carried out aim to answer the problem formulated, namely, the implementation of the concept of Crime Prevention Through Environmental Design (CPTED) in urban housing areas.

### 3. Results and Discussions

#### 3.1. CPTED Concept Implementation Assessment

After doing the observation process and making a recapitulation of the results of the field survey, the scoring for each element of the CPTED concept made so that the accumulation of scores in each sample location.

**Table 6.** Score accumulation of each sample.

| No. | Sample | Research aspects | Total score |
|-----|--------|-----------------|-------------|
|     |        | Public space Foot paths | Car parking | External lighting | Landscaping | Territorial Reinforcement |             |
| 1.  | Sample 1 (VV, TT, SS, UU) | 6 | 11 | 5 | 5 | 5 | 9 | **41 (B)** |
| 2.  | Sample 2 (RR) | 3 | 12 | 5 | 5 | 4 | 9 | **38 (B)** |
| 3.  | Sample 3 (D, E) | 7 | 6 | 5 | 6 | 2 | 9 | **35 (C)** |

The location of public space in a residential area is calculated well if space is in an area close to residents' occupancy. Natural monitoring by residents will be better if the location of public space is still in a place that can be reached by residents. In sample 1, the open spaces at the site were several parks located between residents' dwellings. Its location, which makes it easy for residents to monitor activities that occur in public spaces, is one of the CPTED concepts well implemented in this sample area. Then coupled with the portal making this park can only be used for residents. The aspect that is not well implemented in this area is the unavailability of individual parking locations for users of this public space. Although park users are residents of the complex itself, there are still vehicles parked on the side of the park and the part of the road near the park. It is certainly not good because it can hinder the occupants' natural supervision, especially for children playing around the vehicle. Then in this area, there is a road corridor where there are several buses that are parked irregularly that can result in the formation of hidden spaces that can be used by criminals to commit crimes. In sample 2, there is
no public space in this area. There is only open space in the form of empty land that is not functioning. It is contrary to the CPTED concept, which encourages public spaces to be close to residential areas to create interaction between citizens and facilitate citizens to supervise the possibility of criminal acts.

In sample 3, the location of public space is the same as sample 1, which is between residents' occupancy. Open spaces in the form of badminton courts in block D only used by residents. No parking area reserved for users of this public space, but with users who are only residents and in the regions that are easily accessible on foot. The disadvantage in this sample area is that many commercial is close to the residential. Commercial in the form of supermarkets and eating places that public can access and require a considerable parking area. Some shops have their parking area, but some use the front area of the residents' house as a parking lot. With the number of vehicles parked in residential areas, it can be difficult for residents to supervise, especially for children who can hide behind the car parked.

In the aspect of footpaths, there are several elements need to consider, namely the number of entry and exit access, the location of the main road and the sidewalk, until the availability of guard posts and portals. Access control can be done by limiting the number of entrances and exits to the residential environment, a maximum of two accesses to enter and exit. At sample location 1, there are two accesses to enter and exit, that is from block XX and block of law. There are several possible accesses to this location, three accesses from the VV block, and three other accesses from the SS block. But these accesses cannot be skipped because they blocked by a barrier portal. The location of sample 1 located close to the main road, but it does not allow the user to take a shortcut by passing through this location, because the form of the way is quite complicated and blocked by the portal. This is a proper application of the CPTED concept because the high proportion of vandalism due to people taking shortcuts between circulation pathways.

The unavailability of pedestrian roads at this location will make it difficult for natural supervision by residents and motorists passing on the street. The guard post is only available at one point, namely access to the Act block. The road is also not equipped with sleep police who can control the speed of motorists passing around the location. In sample 2, access to entry and exit is only at one point. It is a good application of the CPTED concept because, with only one entrance and exit access, it makes it easier for both security officers and citizens to monitor who enters their environment. The location of sample 2 located close to the main road and the door to access to housing, but this area does not allow for a shortcut to the main road because the location and shape of the street in this area is complex and also blocked by the portal. Pedestrian lanes are also not provided in this area. Portal placement is in the front area directly adjacent to the main road. The guard post is in access, and there are several speed bumps, but the conditions are not too helpful to reduce the speed of motorists passing by. In sample 3, there is a lot of access to and out of this area because every road is not restricted to any barrier. The sample location is also located close to the main residential road. With the absence of a barrier portal, the street within this area is possible to use as a shortcut by vehicle users. Coupled with its location adjacent to many commercial areas, it can allow people outside the complex to pass through the road within the zone. With the freedom of people passing by in this area can increase the probability of criminal action because it makes it difficult for residents to supervise anyone who enters their environment. The unavailability of pedestrian-specific roads at this location will also make it difficult for natural supervision carried out by residents of the house and motorists who cross the streets. Then there are no guard posts and sleeping police in this area.

In the Car Parking aspect, the three samples have similarities to the CPTED concept that applied to their respective locations. All houses in sample locations 1, 2, and 3 have their garage for parking their vehicles. Parking requirements for residents must be placed as close as possible to the owner of the residence, to ensure quality supervision of parked transports. If possible, car parking should be located in individual garages in residential cages, with approaches and entrances seen by occupants with car garage positions that should not obscure the general view. The garage location listed on each residence is on the front page. It is a good application because robbery cases often occur in homes with parking spaces for vehicles that are behind the occupancy. The three samples also showed the same results on
non-occupant parking variables. All three samples do not have a specific location for parking for non-residents. Vehicles parked on the side of the road that is directly adjacent to the occupancy. Placement of parking on the part of the road like this can be done as long as it does not interfere with the needs of residents.

On the External Lighting aspect, all sample locations have the same results on aspects of the availability of regional lighting. The locations of samples 1, 2, and 3 each have functioning street lighting and spread throughout almost all areas of the area. It is prominent to consider the type, intensity, and location of the light. Lighting uniformity is important, and care must be taken to ensure that the lamp fittings are set to obtain an even distribution over an area. For the aspect of lighting intensity, in sample 1, it produced a fairly dark environment with only 31% of occupants exposed to street lights. Hidden areas (where busses are exposed) also get the minimal light intensity and can result in criminal offenders being easy to commit crimes. At sample location 2, as well as location 1, street lights have not provided enough light intensity to lighten a residential area with only 47% of residential zones exposed to light exposure. Although almost all street lights are available and functioning, the intensity of the light produced still lacks to lighten the road and the environment. One lamppost is only enough to illuminate two to three houses. At sample location 3, street lights are sufficient to produce a sufficiently bright neighbourhood, with 61% of occupancy exposed to light. But often the ray is blocked by trees that are high in this area.

Landscape plays a crucial role in creating a friendly environment. However, planted areas are often not properly maintained or damaged. The landscape should not reduce pedestrian visibility, nor does it have to create a remote area for intruders to lurk. Landscape settings in sample locations 1 and two have applied the CPTED concept, and some have not. Some trees on the roadside block the exposure of light from street lights. However, for landscape management, the residents' occupations have been implemented quite well and do not obstruct the view from home to the outside. At sample location 3, the landscape settings applied were not following the CPTED concept criteria. There are still many branching trees found in front of the residents' houses that are more than 1.5 m high and obstruct the natural control of the residents of the surrounding environment. The existence of these trees also prevents exposure to street lights to the streets and residents' occupancy.

Territorial identity can distinguish private areas and public spaces to prevent violations by criminal offenders. This aspect has been applied well to all sample locations. Almost all houses in each sample 1, 2, and 3 have different residential styles and diverse materials. Each residence also has fencing and house numbering. This territorial strengthening indicates that residents care about their areas, namely in distinguishing private and public areas

3.2. Questionnaire Assessment
After the previous five aspects were assessed based on direct observation by the researcher, then the maintenance and target hardening aspects were recorded using a questionnaire. With the data obtained to determine the perception of security by residents.

| Location | Maintenance and target hardening | Total score |
|----------|---------------------------------|-------------|
|          | Guardhouse/portal | Security system (Siskamling) | Garbage disposal system | Interaction between residents |  |
| Sample 1 | 2.21 | 2.11 | 2.11 | 2.00 | 2.11 |
| Sample 2 | 2.00 | 2.17 | 2.08 | 2.58 | 2.21 |
| Sample 3 | 1.79 | 2.00 | 2 | 1.86 | 1.91 |
Forms of safeguards such as guard posts and portals, restrictions on public space and facilities, the presence of security personnel, parking arrangements that require the placement of vehicles within the home area are one way to improve security conditions in an environment.

From figure 2 above, it concluded that areas with limited access to barrier portals (samples 1 and 2) make residents feel safe enough to live in the area. Then with an area that is not restricted by barrier portals, people feel insecure living in the area with an average rating of 1.78.

Furthermore, another way to improve regional security is through a particular security guard system such as siskamling system. Such a system will help if the natural supervision of residents is considered to be lacking.

From figure 3 above, it concluded that the siskamling system that runs in each sample gets a pretty good average value. For sample 3, in the absence of a portal, a quality siskamling system can increase the security of residents of the complex. The difference between these three samples lies in the siskamling system. For sample 1, siskamling officers are residents outside the complex provided by housing developers. While for samples 2 and 3, siskamling officers are residents outside the complex financed by residents' dues themselves.

Locations that show that there are efforts to preserve the environment, such as the absence of scattered rubbish, lack of vandalism levels, and environmental care efforts from the community will provide an image that the neighbourhood still has a level of public awareness of the environment.
In all samples of the garbage disposal system, it works quite well with the presence of private garbage officers who are outside residents who are financed by a fixed fee from residents of the complex. The cleanliness of each resident is indeed well maintained, but for environmental hygiene, it can be said that it is not too swampy properly. It is because there is no cooperation or action to clean the environment from residents around the complex.

Furthermore, the most crucial aspect is the interaction between block residents because to realize fine natural supervision, between residents, must have an awareness of their environment.

Interaction between residents that occurred in the locations of samples 1 and 2 had gone quite well. Then in sample 3, the interaction that took place between complex residents did not go well (with a score of 1.86). But it is known that there are no special activities such as cooperation that is held to allow inter-residents to interact.

3.3. Correlations analysis

It is necessary to draw conclusions based on the results of the research that has been done to find out how the application of the CPTED concept can influence the perceptions of occupants' sense of security at this sample location. If each gets the same value and is not contradictory, then there is a positive relationship, vice versa.

| No. | Location | Sense of security | CPTED implementation | Relation |
|-----|----------|-------------------|----------------------|----------|
| 1.  | Sample 1 | Safe enough (2.11) | Good (41)            | Positive |
| 2.  | Sample 2 | Safe enough (2.21) | Good (38)            | Positive |
| 3.  | Sample 3 | Not safe (1.91)   | Average (35)         | Negative |

The table above shows that samples 1 and 2 produce a positive relationship, that is, there is a relationship between perceptions of occupants' sense of security and the application of the CPTED
concept to residential areas. The value of CPTED implementation in sample 1 is good (with a score of 41) directly proportional to the perception of security created by residents. The value of CPTED implementation in sample 2 is good (with a score of 38), which is directly proportional to the perception of occupants' security. Then for sample 3 it produces a negative relationship with the opposite value. Likewise, the value of the application of CPTED in sample 3 is sufficient (with a score of 35) which shows that with the application of the CPTED concept that applied, it still cannot meet the security needs of residents.

4. Conclusions
Based on the results of the analysis above, the authors conclude that from the three sample locations taken from Taman Setiabudi Indah 1 Estate, the sample location 1 is the sample location that has applied the CTPED concept well and is also proven by the perception of security of residents who are also good. The location of sample 1 is also a restricted location with many portals at each access to entry and exit. For sample 2 locations, the CPTED concept has also been implemented well and has the highest average score in the perception of occupants' security. Furthermore, for sample location 3, some CPTED concepts have been applied but still cannot produce a good sense of security for residents in this location.

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References
[1] Maslow, Abraham H., 1970, Motivation and Personality Second Edition, New York: Harper & Row.
[2] Sagita Purnomo, 2016, Medan Peringkat Satu Kota Tidak Aman [article], reported from http://harian.analisadaily.com/opini/news/medan-peringkat-satu-kota-tidak-aman/261246/2016/09/06
[3] Jeffery, C. R., 1971, Crime Prevention through Environmental Design, Beverly Hills, CA: Sage Publications.
[4] Newman, O., 1972, Defensible Space: Crime Prevention through Urban Design, Macmillan, New York.
[5] Stollard, Paul., 1990, Crime Prevention Through Housing Design, Chapman & Hall.
[6] Fennelly, Lawrence., & Crowe, Timothy., 2013, Crime Prevention Through Environmental Design 3rd Edition, Butterworth-Heinemann.
[7] Sari, Linda Puspita. Hubungan antara Pola Penataan Lingkungan Perumahan Terhadap Terciptanya Persepsi Keamanan bagi Penghuni Perumahan. (Tesis Magister Fakultas Teknik Departemen Arsitektur Universitas Sumatera Utara, Medan, 2012)