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Design Management of Environmental Access Security in Priority Spatial Spaces for Green Open Space (OGS) Tropical City Surabaya - Indonesia with CPTED Approach to Reduce the Impact of Visitor Vandalism

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Abstract. This research examines environmental and social problems with a security design solution approach for green open spaces in tropical city parks related to negative visitor behavior, especially in the form of vandalism which can cause damage to facilities and vegetation in areas with dense and varied visitor activities. This research was conducted in priority spatial environments popular and paid parks in the tropical city of Surabaya, Indonesia. The classification of visitor access security detection uses the Crime Prevention through Environment Design (CPTED) vandalism management strategy theory to determine the access security model applied to spatial behavior. The results show that spatial areas with high levels of visitor density and management's low level of application of CPTED attributes have an effect on increasing the impact of visitor vandalism on park facilities.

Keywords: *Environmental Management Design, Spatial Planning, City Park, and CPTED.*

1. Introduction

Open Green Space (OGS) according to Das et al., 2022, Putra et al., 2022 in urban areas in tropical countries such as the city of Kolkata India or Surabaya Indonesia has an important role in the surrounding community [1][2]. OGS can reduce Urban Heat Island (UHI) or the effect of heat in urban areas up to 3°C. OGS also has many other benefits such as being able to provide healthy air and environment for its visitors [3], according to Besenyi et al., 2022, Handayani et al., 2018, Park et al., 2022 that OGS can also be utilized by visitors for various activities that can have a positive impact on improving physical and mental health such as: social support, energy, self-esteem, mood, and reducing depression. [4][5][6]

Kong et al., 2022, Liu et al., 2022 explained that the advantages of a large OGS area are considered a good place for various physical exercises that can help reduce the impact of various diseases, these researchers added that park quality can be measured based on 2 dimensions, first from the park design dimensions such as facility availability and environmental attributes [7][8].

Milman et al., 2020 mentioned that an attractive urban park design can increase the number of visitors to visit because it has a certain theme or character that is attractive and many attributes needed by visitors to move into it [9]. Zhou et al., 2022 further explained the importance of park managers or managerial parties to be able to maintain the safety of visitors' comfort while in the park through



attractive park design and good security [10]. design challenges in tropical parks According to Bhati & Pearce, 2017 and Mahrous et al., 2018 the managerial party needs to implement a system for the management of tropical parks, 2018) managerial parties need to implement a security design system for visitor access in a good garden spacial area to prevent bad behavior from occurring, furthermore, these researchers use security design with the CPTED - *Crime Prevention Through Environment Design* approach which consists of five main attributes namely Territoriality, Surveillance, Access control, Activity support, Image/management, and Target hardening. [11][12]

1.1 CPTED Crime Prevention Through Environment Design

According to Bhati & Pearce, 2017 CPTED is a theoretical concept of regulation and management strategies for vandalism prevention by looking at what surveillance and access features can be provided in the surrounding environmental area to protect the impact of deviant behavior of visitors on the facilities that have been provided, CPTED is suitable for open areas, tourism that has a lot of interaction between visitors and facilities. Furthermore, the regulatory/management features of CPTED can prevent the deviant behavior of actors and visitors in the City Park environment and its impact on public and social facilities. Conceptual Basis The theory of CPTED is based on crime prevention studies.

The CPTED approach is used to design the physical environment with the aim of preventing crime. This approach recognizes that environmental design can influence human behavior and can reduce the chances of crime occurring. The basic principle of CPTED is to create environments that promote safety, prevent crime, and increase a sense of security. The approach involves using physical design, spatial planning, and environmental settings to reduce the potential for crime and increase security. CPTED was originally created and formulated by criminologists to design safe and secure environments in public areas Jeffery, 1971 [13]. A more limited approach, called defensible space, was developed simultaneously by architects Newman, 1997 [14]. Both built on the earlier work of (Wood, E 1967). Its principles were widely adopted but with mixed success. The defensible space approach was later revised with additional built environment approaches supported by CPTED. Newman represents this as CPTED and credits Jeffery as the originator of the term CPTED. Newman's CPTED-enhanced defensible space approach enjoyed wider success and resulted in a re-examination of Jeffery's work. Jeffery continued to expand on the multi-disciplinary aspects of the approach, the progress of which he published, with the last one published in 1990. Jeffery's CPTED model was more comprehensive than Newman's CPTED model, which limited itself to the built environment. Subsequent CPTED models were developed based on Newman's Model.

Piروزfar et al., 2019 states that the basic theoretical concept of CPTED is based on a series of strategic management application management attributes related to the security and comfort of open areas consisting of the main attribute structure: Territoriality, Surveillance, Access control, Activity support, Image/management, Target hardening [15]. The basis of these theoretical attributes is based on The seven principles of CPTED proposed by Cozens & Love, 2015. However, CPTED needs attention for its development, previous studies have tried to observe this CPTED theory in the entire OGS area. So the costs incurred for research are very large, very long time, and lack of focus because the OGS area as a tourist attraction can also be divided into several spatial area categories. For this reason, this research tries to observe the effect of CPTED on facilities in the spatial area environment. [16]

1.2 Facilities in the Form of Garden Environmental Design Supporting Visitor Activities

Zhai et al., 2021 explain that the design of park facilities is an environmental design consisting of various vegetation in a certain area or layout. This area can be recognized and classified based on the size of the environmental area for certain types of visitor activity movements, within the area there can be several vegetation that support each other for certain types of activities[17]. Yin et al., 2020 explain that the type of spatial environmental facilities that have a high density and diversity of visitors need more attention because they tend to cause problems for their users related to negative activities and vandalism. [18]

Zhai et al., 2023 states that visitor activity patterns in the park environment area can differ based on the variety of activities, this can be known through the density, diversity and active activity patterns

of visitors with park facilities in certain areas and times or called Moderate and Vigorous Physical Activity (MVPA) [19]. Boakye et al., 2021 and Kurka et al., 2015 added that MVPA can be grouped into several levels of physical activity from light to moderate which is called light-to-moderate-vigorous-physical activity (LMVPA) [20][21], while Huang et al., 2020 explained that the wide variety of MVPA activities in an area can be used to distinguish the characteristics of the park spatial area or called Land Use Mix (LUM) or diversity. The researcher added that high LUM areas tend to have potential problems ranging from crime to vandalism. [22]

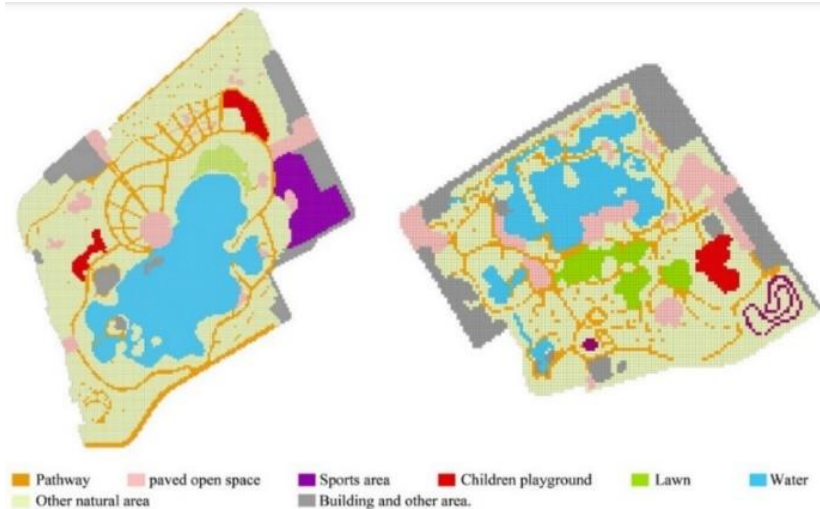


Figure 1. Example of neighborhood spatial area design division plan according to Zhai et al., 2023.

1.3 Problems

The concept of CPTED with the development of Surabaya city park environmental design is challenged, because the previous studies above were conducted outside the territory of Indonesia with different climates, behaviors, and have not been explored based on behavior carried out by visitors in the city of Surabaya.

Based on field observations, researchers found many types of vandalism committed by visitors to city parks in the form of littering, disobeying regulations, damaging environmental facilities, and vegetation to carry out activities that are not in accordance with their place in the park area. Some of this is due to the visitor safety design factor in the park's environmental facilities in facilities that is not maximized.

1.4 Limitations

This research was conducted on spatial environmental facilities prioritized by Surabaya City Park in Indonesia.

1.5 Objective

To find out the causes and types of vandalism committed by visitors to city park environmental facilities in spatial areas and design a good design to reduce the impact of vandalism.

2 Theoretical Foundation

Basic theory of park vandalism associated with public facilities according to James, 1946, Bhati & Pearce, 2017, Mahrous et al., 2018, He and Li 2017, Chuang et al., 2022, Bhuiyan et al., 2021, Shackleton & Njwaxu, 2021, Wu et al., 2020 mention is a form of activity or visitor activity that can be considered "disturbing, making noise, harassing, damaging or deteriorating" the quality of facilities in public areas, (Douglas et al., 2018) further states that vandalism behavior can take the form of individual and social vandalism[23][24][24][25][26][27]. Toet & van Schaik, 2012 explain social vandalism is that a form of vandalism committed by a group of individuals that can harm other people and available facilities such as can be: theft, robbery, destruction, harassment, defacing facilities, loitering, public drunkenness, littering, vandalism, robbery, criminality, and others. [28]

3. Method

This research uses the development of a park environmental facility security design using the environmental access security theory approach based on CPTED from Bhati & Pearce, 2017. The

method of data collection and the mechanism used to interpret the data is to use the method of in-depth observation of subjects and visitor behavior or called focused ethnography of park facilities based on Dimitrovski et al., 2023 state that this type of method, researchers can limit the focus of observation on certain aspects or phenomena in a particular subject or environment. For example, researchers can focus on social interaction patterns in the site area, changes in the research subject's system, or the influence of security attributes on visitor behavior. The main goal is to gain a deeper understanding of the phenomenon. [29]

3.1 Research Data Source

The main data source in this research uses observation data through the collection of photos of spatial area objects that have been categorized with real-time cameras. This technology can be used to detect and distinguish the presence of human objects from their environment in an up-to-date manner. (Khan et al., 2022 [30] explained the real-time camera system to be able to see the conditions that occurred more recently. with real-time cameras more practical and quickly used to evaluate the number and activity in spatial areas compared to other technologies such as Zhai et al., 2023 which uses Actigraph technology, which uses Actigraph wGT3X-BT accelerometer technology (Actigraph, Pensacola, FL, USA), where this technology must be attached to each respondent to determine the effectiveness of activity in the spatial area is also better than Global Positioning System (GPS) cameras because the data shown is not real-time Cai et al., 2023 [31][32].

In relation to the research location, researchers used a multifunctional or comprehensive type of urban park in Surabaya City. Comprehensive parks according to Kong et al 2022, Zhang and Zhou, 2018, and Mahmoudi, et al 2022 explain this type of park have complete facilities and a larger area, as well as a variety of uses than other parks. For this reason, researchers used the most complete park in Surabaya City, Surabaya Zoo – Kebun Binatang Surabaya (KBS), which is the most complete park that is most widely known by the public.[33][34][35]

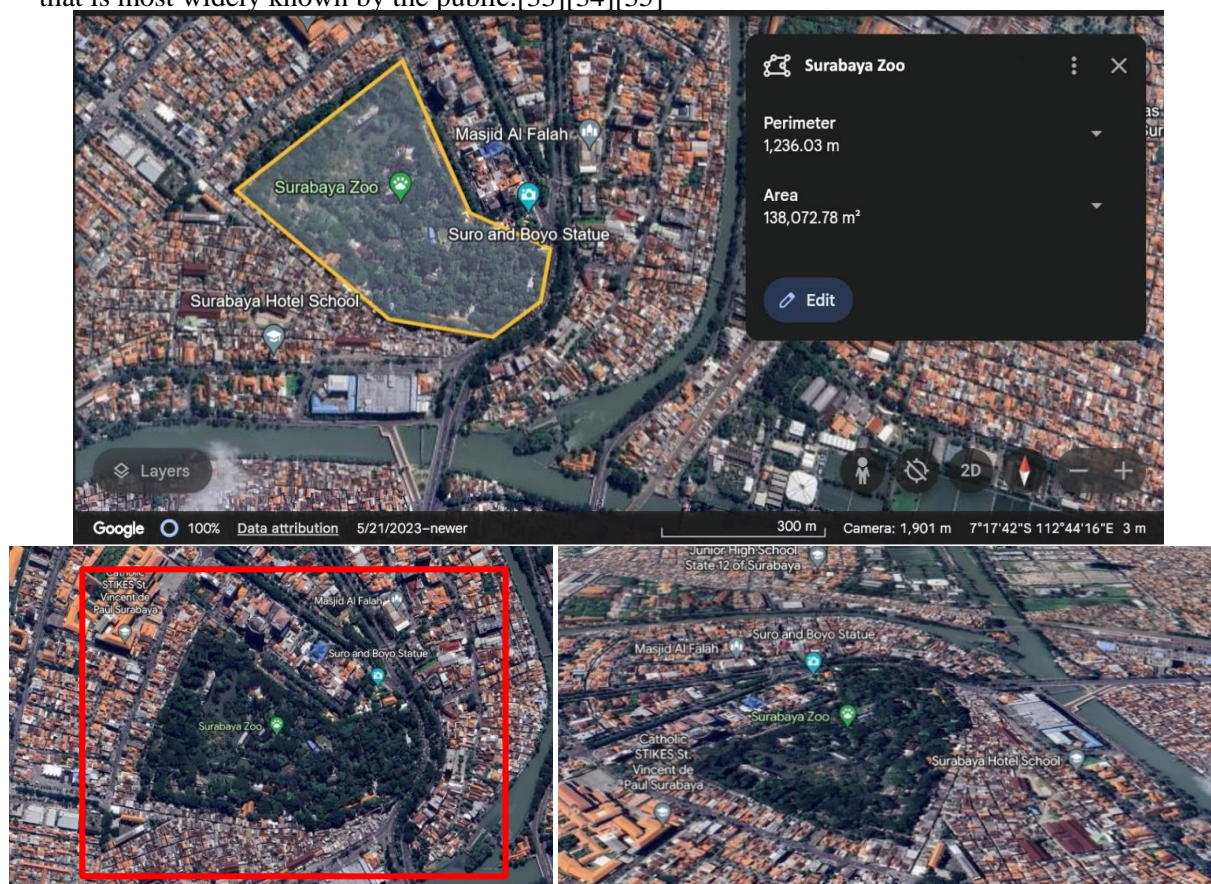


Figure 2. Map of Surabaya Zoo/ Kebun Binatang Surabaya (KBS)

3.2 Results and Discussion

Researchers conducted in-depth observations or focused ethnography of the KBS area on two weekend weeks and holidays, namely on September 2 and 9, 2023, and September 17, 2023, which were carried out from 09.00 - 15.00 WIB according to KBS opening times in the spatial area of the most crowded environment according to Z. Sadeghi & Haghighat Bin, 2023.

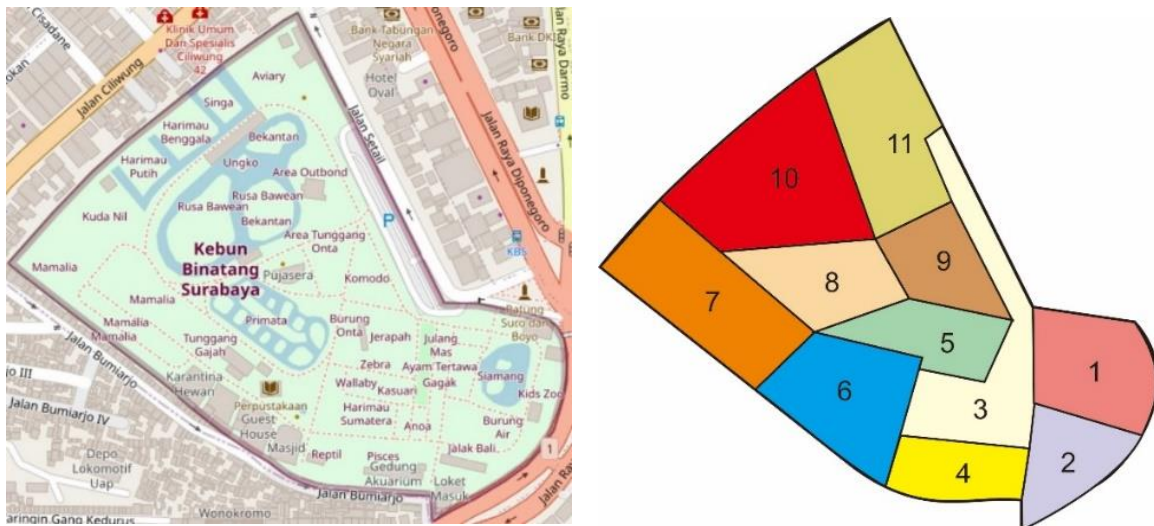


Figure 3. KBS Spatial Area Division.

In the KBS floor plan map above, the researcher divides it into 11 spatial areas based on the point of activity and the visual distance of the visitor's eye view and the environmental design function area based on Z. Sadeghi & Haghighat Bin, 2023. Then from this, researchers conducted a classification of in-depth observations based on the level of density or crowd of visitors and the presence of forms of vandalism in the area.

Table 1. Various Conditions of Vandalism in the KBS Spatial Environment Area.

Environmental Category KBS Spatial Area	Visitor Density Level			There are forms of vandalism on vegetation			There are forms of vandalism on facility products		
	Low (1-10 Person Total per minute)	Medium (>10-20 Persons Total per minute)	High (>20-50 Persons Total per minute)	Low (1-3)	Medium (>3-5)	High (>5)	Low (1-3)	Medium (>3-5)	High (>5)
Area 1			v	v			v		
Area 2		v		v			v		
Area 3			v			v		v	
Area 4	v				v			v	
Area 5		v				v		v	
Area 6			v			v			v
Area 7		v			v			v	
Area 8			v			v			v
Area 9		v			v			v	
Area 10		v			v			v	
Area 11	v			v			v		

In the table above, it can be seen that the areas that get the most damage due to vandalism and the level of visitor density are areas 6 and 8, but researchers chose one of the priority areas, namely area 9 because of its more diverse facilities and functions. Area 8 is a meeting point for various activities because in that area there are food courts, souvenirs, animal cages, road intersections, elephant riding areas, and water boat tourism areas, making this area a point of various activities and a meeting point for visitors from various directions. Facilities in this area are also more diverse.



Figure 4. The atmosphere of density in spatial area 8 of KBS.



Figure 5. Forms of visitor vandalism in the environment of KBS spatial area 8.

Table 2. Types of Visitor Vandalism in each priority area of the KBS environment.

No	Forms of Vandalism	Damage to vegetation	Causes of Vandalism based on CPTED
1	Vegetation damage.	a. Damaged leaves and fruits. b. Broken plants. c. Plants are stepped on. d. There is garbage around the plants. e. Visitors violate the rules / climb the fence and remove leaves.	a. No hardening of the area near the plants (<i>Target hardening</i>). b. There is no guardrail in the plant area (<i>Surveillance</i>). c. There are no information regulations or the design of the information board is not clear and the impression of a dirty area (<i>Image Management</i>). d. There is no territorial plant leaves that are prone to breaking (territoriality) e. There is no security post and CCTV (<i>Access Control</i>). f. The main access road is narrow so that there is a mass accumulation in the crowd center area (<i>Activity support</i>).
2	Vandalism on facility products.	a. Statue accessories damaged. b. Guardrails.	a. There is no hardening of the fence material (<i>Target Hardening</i>). b. No information regulations or unclear

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- | | |
|----------------------------------|--|
| c. Garbage around the product. | information board design and dirty area impression (image management). |
| d. Many violations of the rules. | c. There is no protected product territory (Territoriality).
d. There is no security post and CCTV (<i>Access Control</i>). |
-

3.3 Design Recommendations

After getting the cause of the form of vandalism. Furthermore, researchers provide design recommendations based on CPTED attributes for priority environmental areas in KBS city parks and researchers provide a Likert priority scale of 1-5 ranging from low to high for each design recommendation.

Table 3. Priority Spatial Area Design Recommendations Based on CPTED.

No	Design Recommendations based on CPTED Attributes	Priority Scale
1	Target hardening: provide strong and hard material to the barrier for areas where vandalism is common.	4
2	Surveillance: provide clear boundary areas or fences in areas of vegetation that are easily broken.	5
3	Image management: provide information and warning boards that are clear and easily visible at the location of the area.	4
4	Territoriality: placing vegetation that is easily broken in a safer place from the center of the crowd and visitor activities.	3
5	Access Control: provide CCTV at crowded centers and security guard posts.	3
6	Activity support: provide wider and wider access roads at the center of the crowd.	4

4. Conclusion

Based on the paper review above, it shows that CPTED can also be used to develop vandalism security strategies in priority spatial environment space areas. Deep observation can also be used to find quick design solutions based on a managerial point of view, this can be a consideration for managers on the importance of using CPTED strategies in priority areas that are crowded and dense with visitors to reduce the impact of vandalism. It can also be used for park designers to design safer improvements to priority spatial areas.

This research has weaknesses, namely the lack of review from the visitor's point of view and the limited location area. Future research recommendations are how this CPTED can be further developed in spatial areas more comprehensively from various points of view so that the accuracy of the data needed for vandalism prevention design strategies is better. In addition, it is possible that CPTED can also be developed with a combination of other security strategies because there are various influences of vandalism that are different for demographics or social in park visitors in other areas.

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