Evaluation for User's Safety Through Psychological Perception and Walkable Path Physical Design

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Abstract. Safety is one of the four basic needs of pedestrians. It must be met before other pedestrian paths are met, namely: function, comfort, and aesthetics. The DKI Jakarta government has improved the quality of the walkable path infrastructure in the Thamrin Sudirman area. Which the areas are trade and service centers and primary activity centers, as well as a strategic area (Integrated Commerce Center and Upper Hamlet area are exchanges of mass public transport (TOD) (Spatial Planning for DKI Jakarta Province in 2010-2030). It is to improve pedestrian convenience and safety. This study aims to explore the safety problems of the pedestrian in the Thamrin Sudirman area. The research methodology used is qualitative by observing the perception of psychological parameters and physical design parameters for pedestrian safety. The results will show a physical parameter design: an open design and a transparent facade that gives a high perception of safety for pedestrians. Then it can be a role model for the design of other walkable paths design.

Keywords: safety, user's, psychological perception, physical design.

1. Introduction
The sustainable city development of DKI Jakarta is very dynamic and continues to be carried out. The improvement of public transportation facilities also continues to be improved, this is to provide good facilities to urban residents. Urban development is not only physically, but also improves the quality of city residents. Increasing the quality of the urban population has an impact on the habit of discipline and the quality of health. In the past five years, the DKI Jakarta government has built and improved public transportation. This development through:

1.1. Regulation:
(1) Three-in-one regulations in the Thamrin and Sudirman area in a peak hour time.
(2) Regulation of odd and even vehicle numbers arrangement at Thamrin Sudirman area.

1.2. Infrastructure Development:
(1) Developing Trans Jakarta construction on the Kota-Blok M route, the route passes the Thamrin Sudirman area
(2) Constructing the MRT line that crosses the Thamrin Sudirman center (Integrated Commerce Center and Dukuh Atas area are exchanges of mass public transport (TOD)) (Spatial Planning for DKI Jakarta Province in 2010-2030).

(3) Developing public transportation facilities: bus stops, waiting rooms, information boards, access cross-bridge facilities, shade, and shelter.

(4) Improving walkable paths quality and quantity: good design and good material.

This development aims to motivate people to walk and ride public transportation. Walkable paths in Thamrin Sudirman area, where the area is a trading area, offices and service centers, as well as a strategic activity center (Integrated Commerce Center and Dukuh Atas area are exchanges of mass public transport (TOD)) (Spatial Planning for DKI Jakarta Province in 2010-2030). Such development is carried out not only to improve the quality of the city but also to improve human quality by motivating people to walk.

A good walkable path design should consider the fulfillment of four basic conditions: safety, functionality, attractiveness (aesthetic), and comfort. [17]. The concept of walkable paths also has a major influence on pedestrian motivation, namely the creation of the physical conditions of walkable paths [12]. The main priority from the four basic needs in designing walkable paths is safety. If the need for safety is not met, then people will not care about the comfort and pleasure of walking [1]. Safety needs are very basic. In other words, a comfortable and pleasant environment cannot motivate people to walk if it is not safe. Then the safer the environment, the more people will walk [7].

The theoretical explanation shows that the fulfillment of the safety aspect is the main priority for walkable path design. Where design has a big impact to give pedestrian's perception, especially for the feeling safety perception. This study will evaluate the safety of pedestrians through the psychological perception and the walkable path physical design.

2. Literature Review

Walking is a simple activity. If you walk more, it will increase the health quality (quality of life of city residents). Walking was also a basic human activity before other modes of transportation. As well as human activities that connect one building to another. Therefore, walkable facilities must be accommodated safely and comfortably. The impact broadly improves the quality of life of urban residents, and give benefit for environmentally and economically. [2], [9], [16].

Walkable path design is part of the design of the urban design area. This can have an influence on the level of safety in the area. Safety on walkable paths includes the design of walkable paths that are built to provide safety from traffic (vehicles) and safety from criminals. [6], and also safe from wild animals. [14]. The walkable path design has important for safety conditions, with design features that can reduce the risk of pedestrians due to slippery materials, the design between pedestrians and vehicles, and the fear of Crime (crime prevention) [14]. From the walkability parameter, it shows that 3 of the 6 parameters focus on safety factors, namely: personal safety, zebra crossing, and adjacent to traffic flow. [14]. These parameters in the design application:

- Zebra crossing: type, location, condition, access, waiting time at traffic lights, and safety.
- Personal safety: conditions day and night time, comfortable social space, and lighting,
- Adjacent to traffic flow: Traffic flow along the pedestrian walkway, traffic conditions at the pedestrian crossing, traffic control by authorities [14]

Previous studies showed a correlation between safety and various types of design parameters, for example, building borders, lighting, open verandas, open façades (natural surveillance), and the use of active open spaces for public activities. This study also showed that a well-designed built area will provide a higher level of safety for pedestrians than an undesigned area [7][1]. Areas that have high outdoor activity will also increase the perception of pedestrian safety in the area [3]. Closed space spots or dark spaces in an area give the perception of being unsafe because these spots have the potential to become hiding places or places where criminals occur because they are not visible to others. [10].

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Babb & C. Curtis, 2013, explained that active transportation for children is walking and cycling. Monitoring pedestrian safety with photo collages shows that pedestrian lane design with clear signs, traffic signs, and active interaction [19]. A pedestrian path in an area that is well maintained will provide security for pedestrians. So the design and materials designed the route area between schools in such a way as to be easy to maintain [20]. Pedestrian behavior on pedestrian paths relates to the design of pedestrian paths. Understanding their behavior will provide an understanding of design improvements to achieve comfort and safety. Walkable paths with signs, clear traffic signs, and adequate lighting will provide pedestrian safety [21]. Safety is an important factor in well-designed pedestrian facilities. This can significantly contribute to a better perception of the psychological safety of pedestrians in the environment [22]. Pedestrian path designs, especially sidewalk designs, will provide a sense of security. The sidewalk design should provide a separation between the sidewalk and the vehicle road. This provides security from vehicles, as well as criminals [23]

Key parameters for achieving safety for pedestrians: natural surveillance, territoriality, access control, and activity [24]. Parameter of natural surveillance: regarding the perception of safety because the balcony design and open façade will increase the passive surveillance of any open area. So that pedestrians who pass through the area feel safe and can minimize the chance of Crime. The shape of the building provides a sense of safety for pedestrians [15]. The next parameter is territoriality: related to the perception of a sense of belonging to residents of an area, the more they feel they have and know the area, the higher the sense of safety [8]. The next parameter is access control, it is easy to access for pedestrians into the building, physically accessible, and has a visual view [18]. The last parameter is the activity in an area. This is an important factor in creating a safe place. Diverse and dynamic activities make the area have a safe perception by pedestrians. So in urban planning, public activities can have an important effect on regional safety [11]. These four parameters are complemented by personal perceptions to feel the ambiance of the level of safety in an area, including personal safety during the day and night, comfortable social space, a sense of safety from criminals, motorized vehicles, and wild animals. These factors design related to public facilities, lighting, and outdoor design [14].

3. Method

This research methodology uses qualitative and quantitative approaches. by comparing people's perceptions of each parameter that affects safety (Figure 1)

Research stages divided:
- The first, observing and identifying safety parameters of Thamrin and Sudirman areas.
- The second, assessing pedestrian's psychological perception toward walkable physical design.
- The third: Evaluating the relationship between pedestrian's psychological perception and walkable physical design.

The first stage is observation and identification of the physical safety condition in the Thamrin Sudirman area. Details of the observed parameters can be seen in the table. 1

![Image of Methodology of the safety assessment process](image-url)
Table 1: Safety assessment Parameter and measures

| No | Parameter               | Physical Design                                                                 | People’s perception - Psychological perception |
|----|-------------------------|---------------------------------------------------------------------------------|-----------------------------------------------|
| 1  | Personal Safety         | day and night time, Public facilities, lighting (open walkable path design), lighting | Ambiance, activity, lighting                  |
| 2  | Mechanical/Formal surveillance | Lighting; CCTV; safety patrol                                                    | Lighting; safety patrol                        |
| 3  | Passive surveillance    | Active frontages; façade solid-void ratio;                                     | Surveillance from adjacent buildings           |
| 4  | Territoriality          | Maintenance; Occupancy                                                           | Abandoned buildings; inappropriate uses; run-down areas |
| 5  | Activity                | Mixed uses facility                                                             | People Activity                                |

Source : [14][24]

For the second, this study uses a questionnaire approach to collect its primary data. A total of 42 respondents, age 18-23 years old. They walked in each area and then gave safety ratings. The evaluation was based on a 1-10 Likert rating scale, with 1 very poor and 10 being very good. The results of this assessment will show the trend and consistency of the scale of the ten points Saaty [17]. The scale is used to determine the value of pedestrian safe with the parameters condition: personal pedestrian, mechanical/formal, surveillance, passive surveillance, territoriality, and activity. Evaluation of the assessment of psychological perception of pedestrian’s safety scale will be combined with physical parameter design, which then to compare and give recommendations for safe pedestrian facilities. Table 3 shows the details of the user’s safety value.

Figure 2: Map of the selected walkable path on Thamrin-Sudirman Area  
Source: (Google, edited by the author, 2020)
The study took location on Thamrin Sudirman Area. The area is a trade and regional center area, as well as a primary activity center, and is a provincial strategic area (Integrated Commerce Center and Dukuh Atas area is an exchange of mass public transport (TOD)) [6]. The walkable path that were evaluated are the Thamrin Sudirman corridor, which covers 8 areas: Sarinah area, Bunderan Hotel Indonesia area, Dukuh Atas area, Setiabudi-Chase Plaza area, Bendungan Hilir - Universitas Atmajaya area, Gelora Bung Karno (GBK) area, Sudirman MRT Senayan- Ratu Plaza area, dan MRT ASEAN area. (Figure 2).

| Code | Location | People's perception - Psychological perception |
|------|----------|-----------------------------------------------|
| A    | Sarinah Area | 1-10                                          |
| B    | Bunderan Hotel Indonesia Area | 1-10                                        |
| C    | Dukuh Atas Area | 1-10                                        |
| D    | Setiabudi-Chase Plaza Area | 1-10                                        |
| E    | Bendungan Hilir - Universitas Atmajaya Area | 1-10                                        |
| F    | Gelora Bung Karno (GBK) Area | 1-10                                        |
| G    | Sudirman MRT Senayan- Ratu Plaza Area | 1-10                                        |
| H    | MRT ASEAN Area | 1-10                                        |

4. Findings And Discussion

Overall, the physical design conditions of pedestrian paths in the Thamrin Sudirman area have good design quality. The average road width is 4-10 meters, with walkable paths on two sides of the road. The material selection for walkable paths is quite good: natural stone, paving, and concrete. The material is designed for pedestrian safety with safe materials that are not slippery and can be traversed by all, including the disabled, the elderly, and children. Another physical design element for the safety of the pedestrian lane is the clear separation between the pedestrian lane and the vehicle road. The whole separation is in the form of a garden (bush and small tree), 0.5-1 meter wide as a barrier from the vehicle. In certain locations, for example, in the MRT ASEAN area, which has a pedestrian lane width of 1.8-2.5 separation with a fence.
Table 3: Safety rating of streets based on people's Psychological perceptions

| No | Criteria                  | Variables/ (Code)                                                                 | Location |
|----|---------------------------|----------------------------------------------------------------------------------|----------|
|    |                           |                                                                                  | A  | B  | C  | D  | E  | F  | G  | H  |
| 1  | Personal Safety           | Personal safety (day and night time), comfortable Social space, fear of Crime, fear of motorized vehicles, fear of stray animals. | 6.64 | 7.45 | 7.52 | 7.24 | 7.24 | 7.90 | 7.86 | 5.69 |
| 2  | Mechanical/ Formal surveillance | Lighting                                                                         | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 6.00 |
|    |                           | Safety patrol                                                                     | 7.50 | 7.50 | 7.50 | 7.50 | 7.70 | 7.90 | 7.75 | 5.80 |
| 3  | Passive surveillance      | Building frontage                                                                 | 7.25 | 7.25 | 7.30 | 7.10 | 7.20 | 7.90 | 7.80 | 5.50 |
|    |                           | Façade design                                                                     | 7.25 | 7.80 | 7.30 | 7.50 | 7.30 | 7.85 | 7.80 | 5.60 |
| 4  | Territoriality            | Maintenance & Abandoned buildings/vacant/isolated places/inappropriate activity areas | 7.70 | 7.80 | 7.80 | 7.80 | 8.00 | 8.00 | 8.00 | 7.70 |
| 5  | Activity Overall safe street rating | Activity/people on street                                                          | 6.65 | 7.25 | 7.30 | 7.01 | 7.20 | 7.90 | 7.85 | 5.50 |

Table 2 shows the psychological results of the respondents' perceptions of the eight locations in Thamrin Sudirman. The results of the psychological safety perceptions of the pedestrian path design showed that the overall highest value is in the F. Gelora Bung Karno area (GBK). Location details see in figure 3.

![Figure 3: Gelora Bung Karno Area](image-url)
The explanation of the observations is as follows:

**Personal Safety**, from the observation results, shows that personal safety has the highest value in the Gelora Bung Karno area (GBK) and has the highest value of high psychological safety perception. Pedestrians feel safe walking both during the day and at night. Pedestrians feel safe walking with various activity purposes, walking at high speed for walking to work, or pedestrians at low speed for walking leisurely for leisure. Enough lighting at night with sufficient distance between one lighting and another (below 10 meters).

The walkable path design is a walkable open space design. So that it can be seen by many people. The design and material of the walkable path are easy to clean and have a width: 6-8 m. There is also a pedestrian bridge, it has good design and lighting. There is a separation between the road and a walkable path in the form of a park. As well as for intersection road, provide a small column as a safety barrier. The overall perception is safe from traffic and from criminals.

**Mechanical / Formal surveillance**, observation for mechanical design (CCTV and lighting), and guarding by officers (police, security staff). According to respondents’ perceptions, lighting conditions are good, lighting works well at night in seven locations, and lighting conditions are the worst at the ASEAN MRT; respondents gave the worst scores. For safety patrols, in this condition, the respondent feels safety perception psychologically, not because of guarding the officers, but because of the placement of CCTV. Providing CCTV in every private office Areas that have CCTV that look like a pedestrian bridge in the Gelora Bung Karno area and Sudirman MRT Senayan-Ratu Plaza Area.

**Passive surveillance** is an observation of passive control between building users and pedestrians, namely access building frontage and façade design. The building frontage is the pedestrian entrance to the buildings along the pedestrian path. The distance between the entrance to one another is 10-15...
meters. The best access to the entrance is at the location of Gelora Bung Karno and Sudirman MRT Senayan-Ratu Plaza area. Not only the distance between the entrances but also the design of the entrance that is open, making the psychological safety perception of pedestrians feel safe. Another element is the façade design (solid-void ratio); in this case, the percentage of material is observed, transparent and openings (glass and windows). The design condition of the building façade along the pedestrian path of the Thamrin Sudirman area shows that the highest value of psychological safety perception is in the Gelora Bung Karno and Sudirman MRT Senayan-Ratu Plaza areas. In this area the percentage of the Gelora Bung Karno building façade area ratio is 1st floor: 50% - 80%, 2nd floor: 70% - 85%, 3rd floor: 70% - 85%, and Sudirman MRT Senayan-Ratu Plaza area 1st floor ratio: 40% - 60%, 2nd floor: 70% - 85%, 3rd floor: 70% - 85%. Perceptions of psychological safety are high because pedestrians and building users can visually see each other, and the perception of mutually guarding interactions is created. So that pedestrians feel safe.

Figure 6: Ratio solid, void, and entrance access.

Territoriality, on elements regarding maintenance and occupancy in this area. The condition of the area and buildings that are maintained and used or inhabited will give a psychological perception of security. The highest psychological security perception value was in the Gelora Bung Karno area and the Sudirman MRT Senayan-Ratu Plaza area. Conditions in this area, because the area and buildings are well maintained and are inhabited by more than 80%.

Activity overall safe street rating, various activities in an area with high frequency will influence the psychological perception of pedestrian safety. The highest value of psychological security perceptions on this element is in Gelora Bung Karno and Sudirman MRT Senayan-Ratu Plaza area. There are mixed activities in this area: (1) Commercial activity (FX Plaza), (2) Formal activity (Government office: Ministry of Education & culture building and Private office building), (3) Informal activity (outdoor activity), (4)Service activity, and (5) Community activity (Gelora Bung Karno).

Activities like cycling and dynamic start from 06.00 AM until 12.00 PM. (see figure 12). For formal activity in the morning until the afternoon. Then at night are non-formal leisure activities. Meanwhile, there are mixed activities in the Gelora Bung Karno area and the Sudirman MRT Senayan-Ratu Plaza area. Moreover, in the ASEAN MRT area, in this area, there is only one activity, namely offices. However, do not be too dense because the dense activity will give feel fear and insecurity for the pedestrian.
The results show that a good walkable path design can give influences the good perception of psychological safety. The passive design provides a better perception of pedestrian psychological safety than mechanical and formal safety. The design of the open pedestrian path and open façade is psychologically pedestrians feel each other monitored and guarded because conditions are monitored. And increase the perception of the sense of safety of pedestrians.

5. Conclusion
This study aims to explore the psychological perceptions of pedestrian safety on the Sudirman Thamrin pedestrian path. This research also wants to show a strong relationship between the psychological perceptions of pedestrian safety and the physical design of the built environment, especially the walkable path design. Active controls such as CCTV also have an influence, but not as big as other elements. The most powerful element is the passive surveillance of the interaction of building occupants with pedestrians. Reference from the five elements of physical design to the psychological perception of pedestrians in order to achieve a sense of security from pedestrians, it is necessary to create a safe environment for day and night. Things that need to be considered in designing an area are:

- Providing a visual connection between buildings inside and outside
- Increasing passive surveillance with open entrance design with distance < 15 m every entrance, and solid-void façade ratio > 30% (1st floor) and > 60 % (up 2nd floor).
- An increasing sense of knowing the area with a better-preserved area.
- Provide good lighting to prioritize pedestrians.
- Providing an area design with a mixed-used activity

The above walkable physical design recommendations are expected to increase people's motivation to walk. This can also be used as input for the official government policy for urban design areas to support safe walkable paths in Jakarta.

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