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How Does the Bridge Design Affect the Behavior of Pedestrian Bridge Users?: A Case Study in Pandanaran Skybridge Corridor Semarang

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Abstract

Skybridge can be considered as a corridor space because it connects one place to another. One of which is the Pandanaran Skybridge which connects the parking building with the Pandanaran souvenir center area in the downtown of Semarang City, Indonesia. This study attempts to analyze the effect of skybridge planning on user behavior with a case study in the Pandanaran Semarang skybridge corridor. The Semarang City Government made these public facilities to cope with traffic flow and the need for parking spaces. This building is fairly new because it was completed in 2020, therefore the Pandanaran Skybridge needs to be reviewed. The study begins by studying the understanding and standards of pedestrian bridges, the factors that affect crossings, physical and non-physical views of buildings, as well as visitor perceptions of Skybridges. The architectural design approach is design recommendations based on user needs and convenience. In conclusion, there are things that need to be improved on the Pandanaran Skybridge along with design recommendations.

Keywords

Social architecture, urban architecture, skybridge, pedestrian, social behavior.

1. Introduction

Pandanaran Street is a connecting route between Simpang Lima Semarang and Tugu Muda. Traffic on this road is quite dense due to its strategic location in the city center and is an economic

area in the form of a typical souvenir center of the city of Semarang which is crowded with people. The high intensity of visitors results in the need for facilities for motorized vehicles and pedestrians. Pedestrian facilities referred to in the Technical Planning of Pedestrian Facilities, Ministry of Public Works and Public Housing (2018) are facilities on road-owned spaces provided for pedestrians, among others, can be in the form of sidewalks, road crossings on roads (bridges), on road surfaces, and on roadsides under the road (tunnel).

For the convenience of visitors, the public facility "Pandanaran Skybridge" was built. This bridge connects the parking building which also functions as a health center with the souvenir center area. The design of the bridge that is built in such a way is the main attraction for visitors. Lang (1994) states that pedestrian paths have a relationship between the purpose and origin of the movement of people, namely the relationship between the function of the pedestrian path and other functions. Various pedestrian behaviors in a public space, namely moving from one place to another, conducting social interactions, taking selfies, and so on. However, the main function in the pedestrian path is as a circulation path. This study attempts to analyze the effect of skybridge planning on user behavior with a case study in the Pandanaran Semarang skybridge corridor. Accordingly, the formulation of problem of this study are as follows:

AQ1. Does the bridge space setting meet the needs and comfort of visitors?

AQ2. How does the bridge design affect the behavior of pedestrian bridge users?

AQ3. What is the design solution to the existing problems?

2. Literature Review

According to the Ministry of Public Works and Public Housing (2018), a pedestrian pedestrian bridge is a bridge building used by pedestrians to cross from one side of the road to the other. Pedestrian bridges must be built with strong construction and easy to maintain. The types of skybridges in Ikhsan (2020), are divided into three categories. The first is regarding the ownership. The ownership of a skybridge determines functionality or usability based on who builds and manages it. While public skybridge functions as public facilities that can be accessed by anyone, managed by the government, private skybridge was managed by certain agencies and limited access based on permission from the manager.

The second is viewed from load distribution. Load distribution structure is based on field conditions and building needs. In this context, there are attached skybridge, independent and semi-independent structure skybridges. Attached skybridge is the structure attached to the building so that the load distribution is borne by the building. Independent structure skybridge refers to a stand-alone structure using supporting pillars, while semi-independent structure combined structure of attached skybridge and independent structure skybridge. The third is viewed from structure type. In this context, the skybridge can be divided into three classes, namely simple beam, suspension skybridge and skybridge truss structure. Simple beam is the simplest type of structure in the form of horizontal beams supported by trusses or columns at both ends of the skybridge. Suspension skybridge refers to a skybridge which is suspended using steel cables. The steel cables are connected to supporting pillars or buildings connected by skybridges. Meanwhile, skybridge truss structure is the type of structure that is most widely used in skybridge planning.

In bridge construction requirements, provisions on pedestrian facilities refer to the Guidelines for Building Construction Materials and Civil Engineering regarding the technical planning of pedestrian facilities in 2018 which have general principles and technical principles. The general principles of pedestrian facility planning at least meet the rules such as (a) system integration, from environmental structuring, transportation systems, and inter-regional accessibility; (b) continuity, namely connecting between the place of origin to the destination; (c) safety, security, and comfort; and, (d) accessibility as the facility must be accessible to all users, including people with disabilities, for example adding a ramp or using an elevator.

Furthermore, the technical principles in pedestrian facility planning include the requirements to meet the criteria for meeting capacity demand. It is also obliged to meet the continuity requirements and meet the technical requirements of accessibility for all users including pedestrians with special needs. The construction or materials used needs to meet safety requirements and are relatively easy to maintain as maintenance guidelines are set out in other guidelines.

As humans tend to choose the shorter route to cross, to increase the use of crossing facilities, it is necessary to apply a guardrail at the edge of the road and or in the middle of the road so as to make the crossing route longer or not passable at all (O'Flaherty, 1997; Hartanto, 1986; Bruce, 1965; TRRL, 1991). Setiawan (2006) divides the factors that influence the use of road crossings, including safety, comfort, convenience, security, design, and obstacles.

3. Methods

The type of research used is quantitative research. Punch (1998) stated that quantitative research is empirical research, where the data in the research can be measured. Quantitative research pays attention to the collection and analysis of data in numerical form. The research locus is the Pandanaran Skybridge located on Pandanaran Street, Semarang City, Central Java. The research was conducted on September 28-29, 2021. The focus of this research discusses the Pandanaran Skybridge as a corridor connecting parking spaces and the gift center area related to user attributes, including personal space, privacy, density, crowding, visibility, accessibility, and others. The collection and recording of primary data are conducted by using survey techniques of observation, photography, and measurements on built physical objects, as well as data collection through questionnaires distributed online. Secondary data is utilized by exploring official documentation techniques which is theoretically done by using library research, literature studies, and government regulations or policies. The study contains the physical data of the building.

4. Results

4.1 Building Physical Data

Pandanaran Skybridge is a pedestrian bridge located on Pandanaran Street, Semarang City, Central Java. Construction of the crossing facility and parking building will be completed in early 2020. The parking building consists of 11 floors, and shares space with the Health Center and the Semarang City Health Office. Access the elevator on the ground floor through a small hallway past the main door of the public health center (*puskesmas*) and several shops. Skybridge has four accesses to go up, namely two lifts and two spiral staircases. The first spiral staircase is located

near the roadside parking lot, the other spiral staircase is across the street from the souvenir center area.

Source: Author's Documentation (2020)

Figure 1. Skybridge Pandanaran with rotary stairs and elevator

Beside it there is an elevator, the location of the elevator in the parking building is quite hidden, and you have to go through the hallway next to the Public health center which is the shop access. There are two parking spaces that can be used by visitors to the Pandanaran Skybridge, namely parking in front of Bank BRI and parking inside the building. The facilities in the area under the bridge include three benches overlooking the pond, road and leaf tunnel. The body of the bridge has an attractive design that attracts people to visit.

Source: Author's Documentation (2020)

Figure 2. On street parking, bench and pool under the bridge, and pedestrian of souvenirs

4.2 Non-Physical Building

The data from Google about the visit of the Pandanaran Skybridge shows the high intensity of visitors on weekends, especially at night around 18.00-19.00 WIB. Weekends are a favorite day to visit so there is a significant difference with weekdays.

Source: google.com, 2021

Figure 3. Pandanaran Skybridge visit graph

Direct observations were carried out from August 30 to September 5, 2021. On Monday there were five visitors, on Tuesday there were four visitors, Wednesday there were six visitors, Thursday there were 5 visitors, Friday there were seven visitors, on Saturday there were six visitors and Sunday there are ten visitors.

4.3 Pedestrian Behavior Activities

The results showed that regarding pedestrian behavior towards bridge access, there are two swivel stairs that can be used for access to the body of the bridge, namely the stairs in the middle area and the stairs across the road. The middle staircase is not used by visitors because the construction material for the median road blocks access to the central staircase making it difficult to pass.

Regarding pedestrian behavior towards the body of the bridge, the Pandanaran Skybridge design is not made straight but there are twists and turns and there is a game of roof shapes. The middle area of the bridge that is close to the balcony tends to be crowded with visitors, in contrast to the area close to the parking building.

Lastly, regarding pedestrian behavior towards the souvenir center, the access down which is connected to the Pandanaran pedestrian street is enough to attract visitors to look around the souvenir center area. Visitors walk through the pedestrian street, there is a density phenomenon in the busy street vendor's area. In addition, at some points, pedestrians cannot use the overcrowded pedestrians, so they need to take to the streets.

The author collects data on visitor perceptions of Skybridge by distributing questionnaires. As of October 1, 2021, there were 10 respondents who were willing to collect visit data. Visitors to the Pandanaran Skybridge are not only residents of Semarang, but the surrounding areas such as Grobogan, Purwodadi and Wonosobo also visit the Pandanaran Skybridge. The results showed that the respondents' last visit was quite varied, sorted from the longest in July 2020 and the latest in September 2021. Meanwhile, the intensity of each person's visit had been to the Pandanaran Skybridge 1-2 times.

The vehicles used by visitors are motorbikes, cars, and public transportation. Different types of vehicles affect the choice of parking space, namely car users parking inside the building,

motorbike users parking on the side of the road in front of the BRI bank or parking in nearby places such as Indomaret and McDonalds.

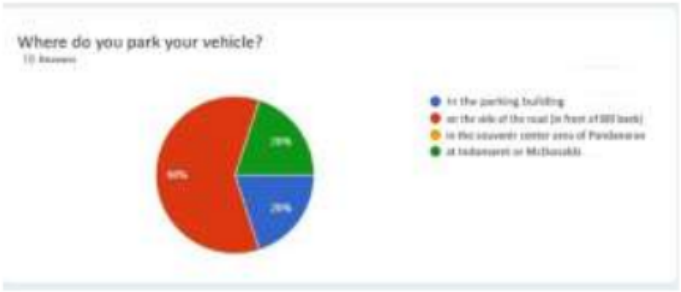


Figure 4. Parking lot usage chart

Visitors' comments on the parking building are presented in the diagram below. The parking building is considered safer by 2 people, 1-person easy access to JPO, 3 people unclear entry marker, 2 people easy parking elsewhere, 1 person unsafe and uncomfortable and 1 person far away. The score given when on average is 6.2 points.

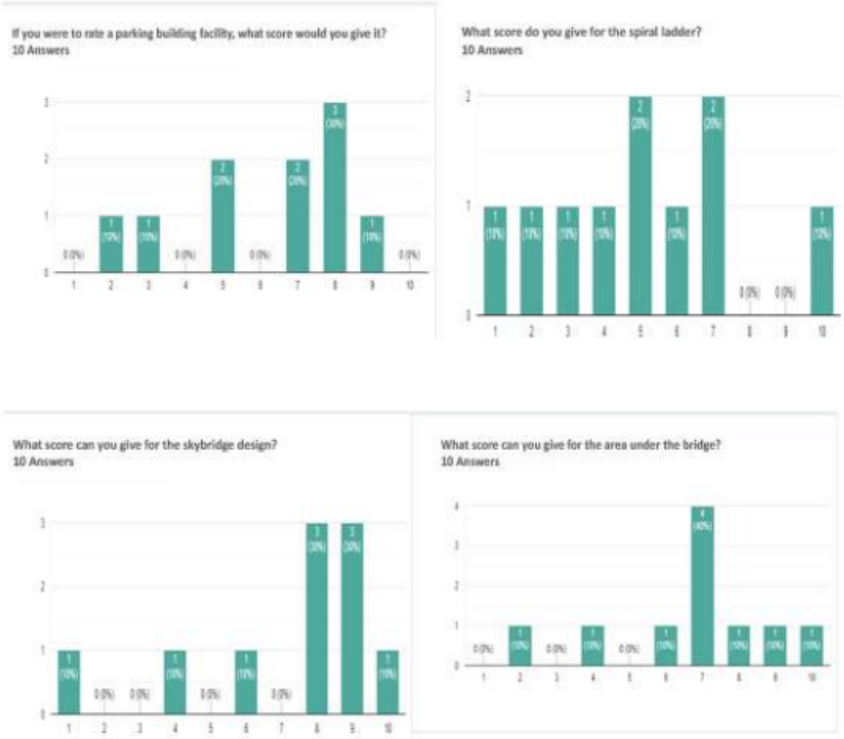


Figure 5. Respondent's response to parking building, ladder, design and area under the bridge

Some suggestions from visitors for the parking building are that the parking zoning of the building is moved to the public health center floor, the parking lot is further expanded, placed in an area close to the JPO but still friendly to the existing traffic flow. Between motorbikes and

cars are made separately. Signs are made to make it visible from a distance the location of the intended parking building. In the parking building, it would be better if CCTV was installed, made more organized, the access was made easier and adjusted to the needs, the road is too narrow to turn so it needs to be repaired.

The use of rotary stairs is the main access because the elevator is not operating. 7 out of 10 visitors use the stairs access in the middle because it is considered close to the parking lot, while the other 3 use the rotary stairs on the opposite side because the lift is dead or coming from the souvenir center area.

The opinion of visitors about access to the rotary staircase 3 of them felt there were no obstacles, 2 rated it too high, 6 rated it too steep to pass and 5 people felt tired because there were no landings to stop for a moment. The average score of visitor ratings is 5 out of 10.

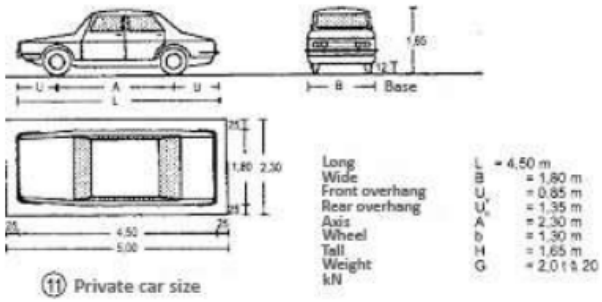
Some of the visitors' suggestions about the spiral staircase include that the spiral staircase is replaced with a U-style ladder, so that emergency maneuvers remain safe. If made indoor will be more comfortable. If you have to go outside, please make it gradual, wider, and have safety (handrail for stairs, protective roof for stairs, and emergency button). Paying attention to the needs of people with walking aids is even better. Don't be too steep, cleanliness is not maintained, it's too complicated, the lift is enabled, and the stairs are made sturdy, not just iron.

The location of the lift in the parking building is quite hidden so that 3 out of 10 do not find the lift access point. The use of the lift is not yet effectively working, but there are 2 people who have tried the lift which is operating. The purpose of visitors to the Pandanaran Skybridge is 4 people as a place of recreation, 4 people taking photos as hobbies or work, and 5 people crossing to the souvenir center area. The average score for the Sky Bridge design is 7.2 for cleanliness 6.8 and for safety 7.1.

In addition to the assessment of visitors in the form of scores, there are several additional facilities that are expected to be available at Skybridge, including seats, roofs, drink machines, trash cans, vegetation and CCTV. The area under the Skybridge is a place that has been designed in such a way as to become a park that attracts visitor activities. However, 3 out of 10 immediately climbed onto the bridge, 4 took walks, and 5 people sat by the pool. Some visitors' opinions about the area under the bridge include good design, cool, dirty pool, slippery small bridge, seating disturbed by passers-by, and lighting. The average score given by visitors for the area under the bridge is 7.3. The suggestions from visitors include paying more attention to the layout under the bridge, maintaining cleanliness, especially the pool, repairs to make it comfortable for children, the elderly, and people with disabilities.

4.4 Redesign Recommendations

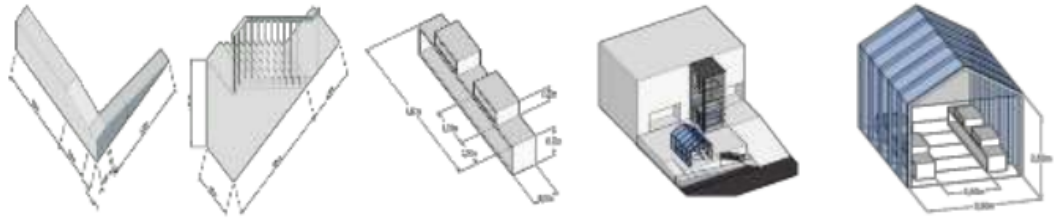
The redesign of the Pandanaran skybridge is as about parking building, vertical access, skybridge body and the area under the skybridge. The first is regarding parking building. There is an accessibility problem because the driveway is narrow and difficult for vehicles to pass, so widening is needed. The ideal car access is 3 meters for one-way lanes. In the case of this parking building, it should be converted into a two-way lane with a width of 5 meters. As recommendations, it is recommended that sign in should be clarified, set the flow of vehicles in and out, add CCTV for security, separate of motorcycle and car areas and rearrange parking outside the building to facilitate the flow of vehicles.



Source: Neufert (2000)

Figure 6. Standard car size and the access to parking building

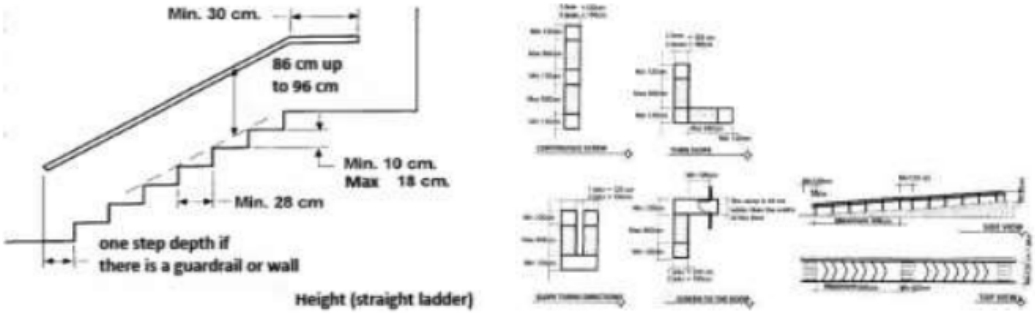
Now, access to the parking building is quite narrow for four-wheeled vehicles. The widening of the entrance access is needed to make it easier for visitors to maneuver and add a path for pedestrians to access the lift which is located in the parking building.



(a) (b) (c) (d) (e)

Figure 7. (a) ram size, (b) stair size, (c) details of sitting group, (d) sitting group, (e) parking building

The second is vertical access (stairs and elevator), it needs changing the model and material of the stairs with a sturdier construction. Because the body of the bridge is quite high, it is necessary to design a ladder that pays attention to safety, namely with handrails on both sides of the stairs, step nosing, and landing.



(a) (b)

Source: SNI 03-1746-2000

Figure 8. (a) stair standard size, and (b) alternative forms of ramp

Moreover, it is necessary to add a canopy and the design to increase the friction of the steps so that they are not slippery when it rains, clearer markings are needed for lift access in the parking building. The lift area is connected to the gift center needs to be clarified, taking into account visual and accessibility aspects. For lift access, there is a ramp but it is not up to standard, a ramp with a slope angle of 7 degrees is needed so that it can be easily accessed independently.

Regarding vertical access, the rotary ladder has 36 steps with a distance of 17 cm between the stairs, and the distance of the top rung is 15 cm. There are no facilities that guide road users to the souvenir center area.

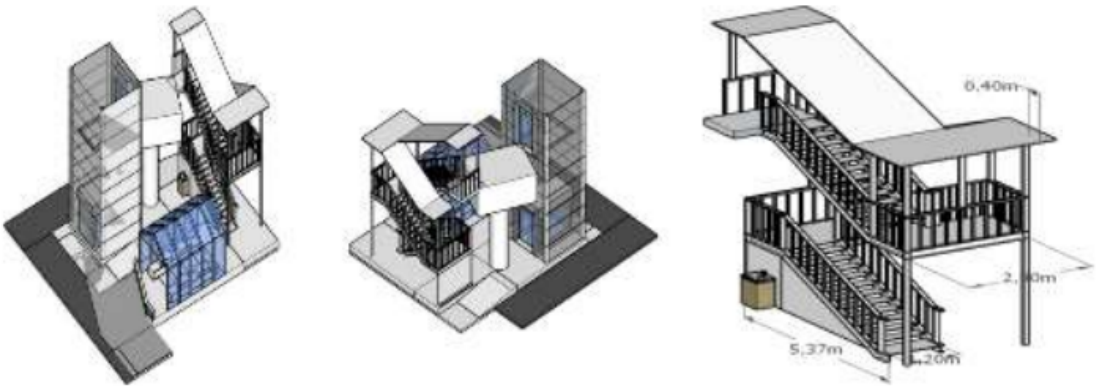


Figure 9. Skybridge Access

The third is regarding skybridge body, it is necessary to add bench facilities, vending machines, trash cans and CCTV. Meanwhile, the last regarding the area under the bridge, its design needs to pay attention to seating and distance from the pool.

5. Conclusion

The pedestrian bridge is one of the public facilities needed by road users. The high number of motorized vehicles makes it difficult for pedestrians to cross. The existence of a pedestrian bridge is useful for the safety and comfort of road users, both motorized vehicle users and pedestrians. The results about the effect of skybridge planning on user behavior with a case study in the Pandanaran Semarang skybridge corridor revealed that the parking building has not been fully utilized by visitors. Pandanaran Skybridge is a place that attracts visitors, but there are things that need to be improved so that the facilities become better. The area under the bridge has been designed quite well, it needs to add some considerations to make it more beautiful and comfortable. The Pandanaran Skybridge facility has not taken into account the various needs of users according to age, namely children, adults, elderly and disabled groups. Vertical access in the form of a swivel ladder does not meet the aspects of comfort, safety, and convenience according to visitors and up to now, the use of elevators has not been operating effectively. There is no clear marker for the vertical access of stairs and lifts with pedestrian paths in the souvenir center area, so it has the impression of not being connected.

Based on the existing case study, the transition room or corridor system can be applied to apartment buildings by taking into account the accessibility, anthropometry and density.

Accessibility is an attribute that is closely related in a connecting room or corridor. In the case study of the Pandanaran Skybridge, there are problems with access to the parking building which is too narrow and vertical access that makes it difficult for bridge users, especially the elderly and disabled. This is a serious problem because it can cause the corridor space to not function properly. Regarding anthropometry which refers to the dimensions of the minimum space elements are in accordance with building standards that have been set by the government so that the transition space can function properly, the swivel staircase design is considered too tiring and unsafe by visitors to the Pandanaran skybridge. If it is applied to an apartment, it will certainly be very ineffective due to the large number of floors. Lastly, the density of people in the corridor space needs to be anticipated by having a waiting room as a transitional space between one room and another. One of the places that allows congestion in the apartment is around the elevator lobby, and rinse room for swimming pool.

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