Study of controlling the layout and construction on pedestrian foot-bridge based on regulation

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ABSTRACT: Pedestrian facilities in Indonesia are still very inadequate. One of the most riskiest pedestrian facilities that is underestimated is the pedestrian foot-bridge. The research objective of controlling the arrangement of the pedestrian foot-bridge construction is to control the design and location of the pedestrian foot-bridge construction, and to make the control criteria and determine the appropriate control components. This research is done with qualitative methods, namely with literature review. With this following study, the result is expected to be able to optimize the location of crossing bridges, increasing the level of security, safety, and comfort of pedestrians to cross the street.

Keywords: pedestrian foot bridge, pedestrian, regulation, control, digital

1 INTRODUCTION

Indonesian people do not have a habit of walking. In a 2017 study conducted by researchers from Stanford published in the *Nature Journal*, Indonesia was listed as the laziest country for walk in the world (Muhammad 2019). Weather factors, minimal safety, security, and comfort factors all greatly influence the people's reluctance to walk. Meanwhile, based on the number of death records in 2016, 5,005 people died due to road accidents—that's at least 14 pedestrians every day (Rahapit 2020). Generally, pedestrians are injured or die when hit by a speeding vehicle (Ihsan 2019).

Infrastructure and facilities for pedestrians in Indonesian cities are still inadequate (Wardiningsih & Hendarto 2019). One of the most underestimated pedestrian facilities is the pedestrian foot-bridge. Good pedestrian crossings must be made with regard for proper visibility and accessibility, traffic patterns, traffic stages, prohibitions to turn right, duration/time that can be used by pedestrians, and safe measures of traffic that will allow pedestrians to traverse. For more complete regulations of crossing facilities, refer to the Technical Guidelines for the Engineering of Pedestrian Facilities in the City Area SK.43/AJ 007/DRJD/97, issued by the Department of Transportation, Directorate General of Land Transportation. Some legal bases that can be referred to as the basis for controlling the construction of pedestrian crossing bridges are as follows:

- Law No. 14 of 1992 concerning Traffic and Road Transportation (UU No. 14 1992, 1992): Pedestrians are required to walk on the facilities that have been provided and road users, especially, must prioritize pedestrian safety.
- Law No. 4 of 1997 concerning Disabled Persons (UU No. 4 1997, 1997): Persons with disabilities receive facilities that support their independence to use roads and public facilities.
- Law No. 28 of 2002 concerning Buildings (UU No. 28 2002, 2002).
- Law No. 38 of 2004 concerning Roads (UU No. 38 2004, 2004).
- Law No. 26 of 2007 concerning Spatial Planning (UU No. 26 2007, 2007).

- Government Regulation No. 43 of 1993 concerning Infrastructure and Traffic (PP No. 44 1993, 1993).
- Government Regulation No. 34 of 2006 concerning roads (PP No. 34 2006, 2006).
- Minister of Public Works Regulation No. 29/PRT/M/2006 concerning Guidelines on Technical Requirements for Buildings (PERMEN PUPR 29/PRT/M/2006, 2006).
- Minister of Public Works Regulation No. 30/PRT/M/2006 concerning Technical Guidelines for Facilities and Accessibility in Buildings and Environments (PERMEN PUPR 30/PRT/M/2006, 2006).
- Minister of Public Works Regulation No. 06/PRT/M/2007 concerning General Guidelines for Building and Environmental Planning (PERMEN PUPR 06/PRT/M/2007, 2007).
- Decree of the Minister of Transportation No. KM 65 of 1993 concerning Support Facilities for Traffic and Road Transportation Activities (Mentri Perhubungan 1993).

If in an area of planning this element is ignored, then the possibility that occurs is the emergence of conflict between pedestrians with traffic flow that can cause obstacles, congestion, and endanger drivers themselves (Nawir & Rusmiyati 2019). This is a conclusion obtained from previous studies in the form of literature studies, as well as case studies that occurred in cities such as Surabaya (Jusmartinah 2011), Jakarta (Kautsar & Hamima 2013), Bandung (Koswara et al. 2014), Yogyakarta (Priastama 2015), and Tarakan (Nawir & Rusmiyati 2019). Therefore, regulating the construction of pedestrian footbridges is very important. With the following studies, it is expected to optimize the location of crossing bridges, increasing the level of safety, security, and comfort of pedestrians who will cross the road.

2 METHODS

This research is done with qualitative methods (Creswell & Poth 2018), namely literature review (Snyder 2019). The data obtained are taken from journals, articles, and regulations. At the data analysis stage, using a prescriptive qualitative analysis method. The scope of this study contains the layout, control criteria, components of pedestrian foot-bridge in urban environments that cross over highways, and or railroads, which include upper buildings, basements, connecting stairs, and the surrounding environment.

3 RESULTS AND DISCUSSION

By looking at the problems, and the impact caused if the arrangement is not regulated, it is necessary to have a control measure on the construction of pedestrian foot bridges. This is related to the increasingly dense traffic flow and the many problems in it, especially in big cities. It also relates to service to the community by improving the quality of infrastructure and facilities of a city. The issues considered in controlling the pedestrian footbridge construction are accessibility, safety, security, convenience, and aesthetic.

3.1 *Accessible*

Accessibility is concerned with the ease at which pedestrians move through pedestrian so that circulation is smooth and does not complicate the users. The target is the location of the pedestrian footbridge that is easily reached. The indicator is that the location of the pedestrian footbridge must be easily accessible and easily visible, and must be accessible to all groups, including the disabled. The following are the control components of the accessibility control criteria

Location: Elevated/bridges are provided at different locations This type of crossing cannot use zebra cross; pelican crossings have disrupted the vehicle traffic; roads with high-frequency pedestrian accidents; and are easily visible and accessible (Departemen Pekerjaan Umum 1995a). The

maximum distance from the activity centers, the crowd, and bus stops is 50 m; the minimum distance from the intersection is 50m (UU No. 4 1997, 1997).

Dimensions of Space: Availability of stairs and ramp. The width of the footbridge, stairs, and ramp is at least 2 m so that the disabled can use it (UU No. 28 2002, 2002).

3.2 *Safety*

Safety refers to the safety within the pedestrian crossing bridge for the people using it. The goal is to provide safety guarantees for pedestrian footbridge users. The indicator is the bridge structure must be able to support the load inside the bridge, and users on the footbridge must be visible from the outside. The following are the control components of the safety control criteria

1. Stairs: There are no holes that can endanger the stairs; must be equipped with a handrail.
2. Structures: Structural planning must be carried out on a combination of fixed and uniform loads; Active soil pressure must be calculated based on standard pressure theory.
3. Visibility: There is nothing blocking the view from the outside towards the pedestrian foot bridge; There is good lighting during the day and at night.
4. Backrest of the footbridge. The minimum height of the backrest is 1.35 m from the surface of the floor to the top edge of the backrest (Departemen Pekerjaan Umum 1995b); each rod must be taken into account and be able to bear the vertical and horizontal forces that work simultaneously at 0.75 kN/m. For the pedestrian crossing over the road with high-speed traffic, the back structure must act as a safety wall covered with 12×12 mm wire and a minimum height of 3 m.

3.3 *Security*

Security refers to the sense of security against various disturbances that result from inside a pedestrian footbridge. The goal is to provide security guarantees for pedestrian footbridge users. The indicator is the user inside the footbridge must be visible from the outside. Visibility refers to the fact that there is nothing blocking the view from the outside toward the pedestrian footbridge. There is also good lighting during the day and at night.

3.4 *Convenience*

Convenience concerns the state of the pedestrian footbridge that provides a sense of comfort. The goal is to provide a guarantee of comfort for pedestrian footbridge users. The indicator is the location of the pedestrian footbridge should be easily accessible and visible, must be accessible to everyone, including the difable, and the bridge should be able to see clearly in the bridge. The following are the control components of the comfort control criteria

1. Location: Visible and easily accessible; The maximum distance from the activity centers and the crowd and bus stops is 50 m. The minimum distance from a crossroads is 50 m.
2. Dimensions: Availability of stairs and ramp; The crossing bridge width is at least 2 m (UU No. 38 2004, 2004).
3. Visibility: There is good lighting during the day and at night.
4. Ramp: The ramp slope in the building must not exceed 7° (the angle between the slope of the ramp and the horizontal plane). The slope calculation does not include the start or suffix (curb ramps landing). The prefix and suffix of the ramp is even more gentle. While the slope of a ramp outside the building is a maximum of 6° , the horizontal length of one ramp (with a slope of 7°) must not exceed 900 cm. The length of the ramp with lower slope can be longer. If the length of the ramp exceeds the provisions, then every 9 m there is a borders as a temporary resting place; borders at the beginning or end of a ramp must be free and flat so that it is possible to rotate a wheelchair with a minimum size of 160 cm. The ramp's minimum width is 95 cm without a railing and 136 cm with a railing. The flat surface prefix or suffix of a ramp must have a texture so it is not slippery either when it rains. The width of the ramp edge is 10 cm designed to prevent the wheelchair's wheel from falling in or out of the ramp. The ramp should be equipped with a

handrail which is guaranteed to be of sufficient strength as the handle when the difable is not with the driver.

5. Stairs: Must have an oprade and antrade dimension of uniform size. Must have a slope of the stairs less than 60°. There are no holes that can endanger the stairs users. Must be equipped with a handrail minimum on one side of the stairs. The length of the handrail must be increased by the edges (the top and bottom of the stairs) with a length of 30 cm. The handrail should be easy grip hold with a height of 65–80 cm from the floor, free from intrusive construction elements and the edges should be rounded or deflected either toward the floor, wall, or pillar.
6. Railing: The minimum height of the railing is 1.35 m from the surface of the floor to the top edge of the railing (Departemen Pekerjaan Umum 1995b). If the length of the bridge is more than 40 m, protection must be installed against the sun and rain (Departemen Pekerjaan Umum 1995b).

3.5 *Aesthetic*

Aesthetic is concerned with the state of the pedestrian crossing bridge that provides visual enjoyment. The goal is to guarantee the beauty of the city. The indicator is the location of the pedestrian footbridge placement must also pay attention to the composition of the city facade, and the shape of the bridge must adjust to the characteristics of the surrounding environment. The following are the control components of the comfort control criteria

1. Location: Placement should not be blocking the view towards the landscape or landmarks.
2. The Bridge's Shape: Keep attention to the design of pedestrian foot-bridges to keep them in harmony with the atmosphere and characteristics of the surrounding environment. At the bottom of the outside side of the railing can be installed elements that function to plant ornamental plants whose shape and dimensions must be in accordance with applicable regulations (UU No. 38 2004, 2004).

Planning the pedestrian bridge should be done not only by the government but should also involve the community. The government can use the correspondence method to get a point of view from the general public as well as from experts. JMP and SPSS are the most commonly used software to analyze data text. To analyze the performance of this pedestrian bridge, simulation methods can be used. Commonly used software are VISSWAL and SIMWALK. This software is able to predict the movement of pedestrians by taking into account the points of destination and the interactions between pedestrians.

4 CONCLUSION

The ineffective function of the pedestrian footbridge can be due to several aspects, namely, accessibility, safety, security, convenience, and aesthetic. The purpose of managing the construction of the pedestrian footbridge is to control the location and design of the pedestrian footbridge construction, and to establish control criteria and determine the appropriate control components. The expected target of managing construction of the pedestrian crossing bridge is as a guideline for the local government in determining the laying and type of pedestrian crossing bridge that considers the accessibility, safety, security, convenience, and aesthetic factors.

The continuation of the decision-making process from the pedestrian bridge design stage, in determining the location and design of the bridge, would be better if it involved the community and experts. To find out the performance of a pedestrian bridge that accommodates human movement, simulation is needed. This is influenced by human behavior that tends to be random and also because of the interaction between humans in the movement area.

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