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Submission date: 26-Jul-2023 01:56PM (UTC+0700)
Submission ID: 2137002151
File name: in_Bandung_City_Square_Area_based_on_Pedestrian_Perceptions.pdf (615.76K)
Word count: 3158
Character count: 16942

The Walkability Concept in Bandung City Square Area: based on Pedestrian Perceptions

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Abstract. The concept of Walkability is a pedestrian-friendly environmental condition that provides security, comfort, safety and offers visuals for pedestrians. The Bandung City Square Area has various attractions, especially historical tourism, photography, pedestrian malls, and places of worship (Great Mosque) spread across some streets: Asia-Afrika, Alun-Alun Timur, and Dalem Kaum, which leads to walking activities. However, problems such as the existence of street vendors (PKL); lack of: disabled facilities, vegetation, crossings, and supporting facilities; and also illegal parking has not fulfilled the pedestrian-friendly environmental aspects. This study aims to assess pedestrian paths condition in Bandung City Square Area using aspect of walkability based on pedestrian perception as users. The research was conducted using the Global Walkability Index and Multicriteria Satisfaction Analysis based on pedestrian perception surveys. The results show that existing condition of pedestrian path in Bandung City Square Area is Waiting to Walk which adequate for walking. However, result also showed that five parameters such as availability of crossings, security against crime, disability infrastructure, grade safety of crossing, and motorist behaviour are below average. It can also be concluded that three parameters such as crossing safety, security against crime, and disability infrastructure requires attention. This result suggest pedestrian paths improvement is needed by focusing on parameters that are below-average and requires attention. Further research is needed to find effective improvements for pedestrian paths walkability based on pedestrian perception, to ensure a pedestrian-friendly environment in Bandung City Square Area.

Keywords: global walkability index, multicriteria satisfaction analysis, pedestrian, walkability

1. Introduction

The concept of walkability can be defined as the extent to which the built environment supports and encourages walking by providing security [1], comfort and safety for pedestrians, connecting pedestrians with various destinations within reasonable time and effort, and offering visual interest in walking along pedestrian paths [2,3]. Bandung City Square (Alun-Alun Kota Bandung) is included in the primary tourist attraction in the Cultural Heritage Tourism Area which is one of Regional Tourism Strategic Area [4], which serves the western region of the city as center for economic, social and/or administrative services [5].

Alun-Alun is open space concept that can be found in Javanese city center. Alun-Alun (formerly written aloen-aloen or aloon-aloon) is a wide-open field with grass surrounded by roads and can be used for various community activities, as for Bandung City Square, previously (1967) was a government center used by people to fulfill calls or listen to announcements or see demonstrations

underwent several changes until lately become the Great Mosque of Bandung Plaza (2017) while maintaining and enhancing socializing function of the square as a public open space [6,7].

For Bandung City, Bandung City Square has strategic and important location, as one of the city icons of the city. It is also surrounded by various attractions [6] dominated by historical tourism, such as the Savoy Homan Hotel and the Grand Preanger Hotel, the Asian-Afrika Conference Museum, the Regent's House, some instagrammable selfie spots, pedestrian malls, and also the Great Mosque of Bandung. All of the attraction spread along pedestrian way around location near some street namely: Asia-Afrika, Alun-Alun Timur and Dalem Kaum, which lead to walking activities [8] in the area around Bandung City Square.

Problems in Bandung City Square Area related to pedestrian paths as infrastructure that is closely related to walking activities, such as the presence of street vendors disturbing the pedestrian way [9], a lack of disability infrastructure [6,9,10], a lack of vegetation for pedestrian shading [6,9], safe crossings and illegal parking [9] that does not meet pedestrian-friendly environmental aspects (security, comfort, and safety). Therefore, this study aims to assess pedestrian paths condition in Bandung City Square Area using the aspects of walkability concept based on the perception of pedestrians as users.

2. Methods

A preliminary study was conducted by questionnaire from March 23 to March 26, 2023 (the beginning of Ramadhan month) with 33 responses collected to strengthen selected location boundaries. The study area (Figure 1) is in the administrative areas of several districts, including Lengkong, Sumur Bandung, and Regol [5], and the road segments to be studied include Asia-Afrika, Alun-Alun Timur, and Dalem Kaum.

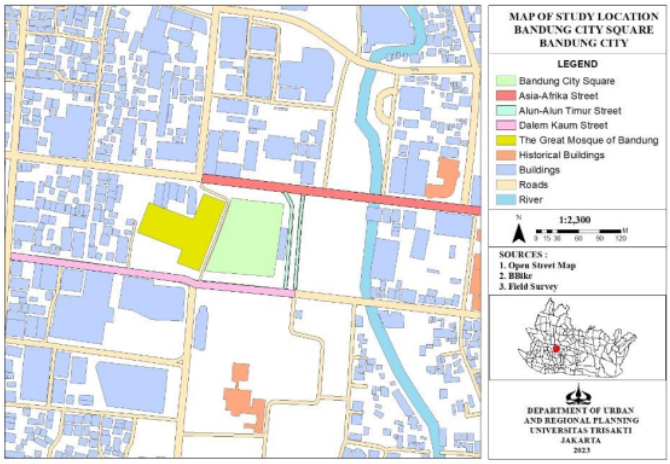

Figure 1. Study Area

Data collection and study area observation were carried out from April 6 to 10, 2023 during Ramadhan month, using questionnaires distributed directly to pedestrians as respondents. According to the Lemeshow formula [11], 100 respondents are required. Although 110 questionnaire responses were collected, 10 were invalid (missing or blank answers, ambiguous, etc.). The final data used was 100 respondents to determine pedestrian perceptions of: characteristics, walkability level based on nine parameters in the Global Walkability Index [2,11,12] and satisfaction and importance level of pedestrian pathways [13]

In this study, the following methods were used: Global Walkability Index (GWI)[2,12] to determine the level of walkability, and Multicriteria Satisfaction Analysis (MUSA)[13] in the final

form of an Action Diagram to determine the level of importance and satisfaction of pedestrian paths and parameters in the Action Opportunity (low level of interest and satisfaction). Before performing the analysis, the 1-5 rating data is converted to 0 -100 using a positive tone from the System Usability Scale (SUS) [14]. Furthermore, descriptive analysis is used to explain both GWI and MUSA analysis results as well as pedestrian characteristics data.

3. Result and Discussion

3.1. Pedestrian Characteristic

The characteristics of pedestrians in the study area (Table 1) are dominated by men aged 18-45 years, with walking being the most common activity. Starting from Bandung City Square Bus stop then pedestrian passes Asia-Afrika, Alun-Alun Timur and Dalem Kaum street, through to destination : Bandung City Square, Pedestrian Mall, and Great Mosque of Bandung. As previously stated, the most common activity is walking, which corresponds to a walking distance of more than 500 meters. This result showed that pedestrian walked more than average person (500 meters) [15] as pedestrian tend to walk around and to several destination. Since the data was collected during Ramadan, pedestrians walked the most at night (after breaking their fast) (>18.00). Pedestrian rarely visit the study area (once or twice in the last two months), and when they do, they use a private vehicle such as a motorcycle to access the area before continuing to walk around the study area. As this research was done on Ramadhan month, additional research on pedestrian characteristics in the Bandung City Area can be conducted to see if there are any differences in pedestrian characteristics.

Table 1. Pedestrian Characteristics

Characteristic	Components	Total	Percentage (%)
Age	< 18	12	12.00
	18 - 45	**79**	**79.00**
Only one answer	> 45	9	9.00
Gender	**Male**	**64**	**64.00**
Only one answer	Female	36	36.00
Activity	**Walking**	**78**	**35.45**
	Sitting	74	33.64
	Shopping	36	16.36
Pedestrians can choose multiple answers	Travelling	21	9.55
	Working	11	5.00
Starting point	**Bandung City Square Bus Stop**	**41**	**44.57**
	Bandung City Square Basement Parking Lot	26	28.26
Pedestrians can choose multiple answers	Asia-Afrika Street Parking Lot	19	20.65
	The Kings Parking Lot	6	6.52
Street passed	**Asia-Afrika Street**	**96**	**45.71**
Pedestrians can choose multiple answers	Dalem Kaum Street	65	30.95
	Alun-Alun Timur Street	49	23.33
Destination	**Bandung City Square**	**57**	**29.38**
	Pedestrian Mall	47	24.23
	The Great Mosque of Bandung	30	15.46
	Asia-Afrika Mural (Pedestrian Bridge)	21	10.82
	Asia-Afrika Monument	18	9.28
Pedestrians can choose multiple answers	Otto Iskandar Dinata Street (Shops)	11	5.67
	Asia-Afrika Museum	10	5.15
Length of walking distance	Near (<100 m)	22	22.00
	Quite Far (100-300 m)	12	12.00
	Far (300-500 m)	25	25.00
Only one answer	**Very Far (>500 m)**	**41**	**41.00**
Walking time	Morning (09.00-12.00)	17	17.00
	Afternoon (12.01-15.00)	18	18.00
	Evening (15.01-18.00)	31	31.00

Only one answer	**Night (>18.00)**	**34**	**34.00**
Walking frequency (in the past two months) Only one answer	**Very Rarely (1-2 times)**	**63**	**63.00**
	Rarely (3-5 times)	14	14.00
	Often (6-8 times)	7	7.00
	Very Often (>8 times)	16	16.00
Type of transportation Only one answer	**Private Vehicle**	**54**	**54.00**
	Public Vehicle	40	40.00
	Walking	6	6.00
Type of vehicle	**Motorcycle**	**32**	**32.00**
	Car	22	22.00
	Bus (Damri)	17	17.00
	Online Taxi	13	13.00
Only one answer	Walking	6	6.00

3.2 Analysis of the Global Walkability Index

Table 2 displays the value from pedestrian ratings. The initial value (IV) from the 1-5 rating based on field walkability survey scoring guide [2] is then converted to a 0-100 value (CV). Based on the results of the Global Walkability Index analysis (Table 3), the walkability level of the Bandung City Square Area is Waiting to Walk, which is adequate for walking. However, there are parameters with a value (CV) below the average such as the availability of crossings, security against crime, disability infrastructure, grade safety of crossing and motorist behavior which need to be a concern for pedestrian paths.

Table 2. Walkability Score in Bandung City Square Area

P	Asia-Afrika Street			Alun-Alun Timur Street			Dalem Kaum Street		
	IV	CV	CV x PW	IV	CV	CV x PW	IV	CV	CV x PW
					Security				
1	4.32	83.00	1245.00	4.44	86.00	1290.00	4.41	85.25	1278.75
2	3.83	70.75	1768.75	3.66	66.50	1662.50	3.74	68.50	1712.50
3	3.38	59.50	595.00	3.52	63.00	630.00	3.54	63.50	635.00
4	3.89	72.25	722.50	3.88	72.00	720.00	3.62	65.50	655.00
5	3.26	56.50	282.50	3.15	53.75	268.75	3.10	52.50	262.50
					Comfort				
6	4.08	77.00	770.00	4.00	75.00	750.00	4.00	75.00	750.00
7	3.21	55.25	552.50	2.98	49.50	495.00	3.05	51.25	512.50
					Safety				
8	3.34	58.50	585.00	3.37	59.25	592.50	3.45	61.25	612.50
9	2.82	45.50	227.50	2.87	46.75	233.75	2.92	48.00	240.00
					Average Conversion Value				
		64.25			63.53			63.42	

Note : P: Parameters; IV: Initial Value; CV: Conversion Value; PW: Parameters Weight

Table 3. Bandung Square Area Walkability Score

Walkability Score		
Asia-Afrika	Alun-Alun Timur	Dalem Kaum
67.49	66.43	66.59
Waiting to Walk	Waiting to Walk	Waiting to Walk

The availability of crossings, security against crime, disability infrastructure, grade safety of crossing, and motorist behavior as concerns for the condition of pedestrian paths on Bandung City

Square Area revealed a relationship to the existing condition of pedestrian paths such as a lack of disability infrastructure [6,9,10] and safe crossings [9] which also related to the availability of crossings and motorist behavior. Security against crime is also strongly related to pedestrian characteristics such as walking at night (>18.00), which necessitates that pedestrian paths be well lit in order to prevent crime to individuals as much as possible.

Previous research also identified security against crime, disability infrastructure, grade safety of crossings, and motorist behavior as below-average parameters [11,12]. However, this study found that amenities in the Bandung City Square Area are already above average, indicating that the area provides adequate amenities for pedestrians. However, contrary to previous findings, the availability of crossings in the Bandung City Area is below average, despite the fact that crossings are available and can provide an option for pedestrians to cross in term of its quantity. The quality of the crossing is not in good condition, so pedestrians face hardship if they want to cross; the same finding regarding availability of crossing is not met in terms of quality can be found in previous research as well. Since there is a difference in result of this finding, this study suggests that more walkability assessments be performed to see if there is a difference in the results, particularly in the availability of crossing parameters in the Bandung City Square Area.

3.3 Multicriteria Satisfaction Analysis

According to the analysis results (Table 4), walking path modal conflict have the highest level of satisfaction and interest on all streets. The least satisfied parameter on the Asia-Afrika Street is motorist behavior (53.75%), followed by disability infrastructure on Alun-Alun Timur (49%), and Dalem Kaum (47%). Meanwhile, the parameters of all street obstacles have the lowest level of importance.

Table 4. Level of Satisfaction and Interest of Pedestrian Pathways

No	Parameters	Level of Satisfaction (%)			Level of Importance (%)		
		Asia-Afrika	Alun-Alun Timur	Dalem Kaum	Asia-Afrika	Alun-Alun Timur	Dalem Kaum
1	Walking Path Modal Conflict	86.00	85.75	85.25	92.50	91.25	90.50
2	Availability of Walking Paths	79.50	77.00	75.25	84.75	86.25	83.50
3	Availability Of Crossings	70.25	66.75	67.00	85.50	85.00	83.00
4	Obstructions	75.50	71.00	70.75	81.50	80.25	82.25
5	Security from Crime	61.50	56.75	57.75	85.25	84.25	86.50
6	Amenities	75.25	70.25	69.00	90.25	87.25	87.25
7	Disability Infrastructure	57.50	49.00	47.00	87.75	88.00	89.00
8	Grade Crossing Safety	64.50	60.25	60.50	85.25	84.75	86.75
9	Motorist Behaviour	53.75	52.50	52.75	83.50	85.00	83.25
	Average (Quadrant Limit)	69.31	65.47	65.03	86.25	85.78	85.78

In the upper-left quadrant (Figure 2), pedestrian expectations are met but it is not the main priority, at the lower-left quadrant it has not met pedestrian expectations but is not the main priority for pedestrian pathway improvement. In the upper-right quadrant, indicates that the parameter has met pedestrian expectations and can become an area of strength. Meanwhile, the lower-right quadrant indicates parameters that need attention [13].

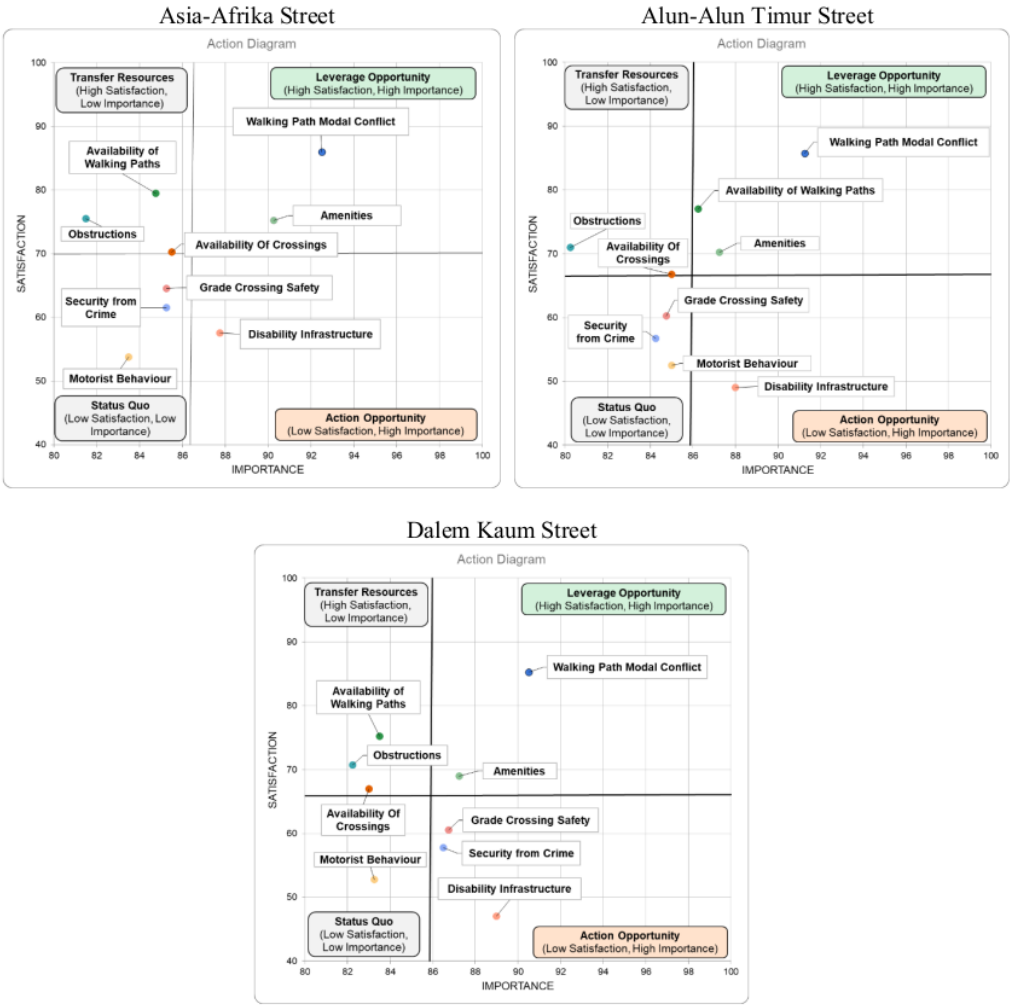

Figure 2. Bandung Square Area Action Diagram

Figure 2 shows that disability infrastructure falls into action opportunity (lower-right), indicating that this parameter requires attention, particularly in the development of pedestrian paths on both Asia-Afrika and Alun-Alun Timur streets. Three parameters fall into action opportunity (lower-right) on Dalem Kaum street: grade crossing safety, crime security, and disability infrastructure. This result for pedestrian satisfaction demonstrated that, while motorist behavior was the least satisfied parameter, particularly on Asia-Africa streets, disability infrastructure is the parameter that requires the most attention based on current conditions. However, there is a similarity in that the least satisfied parameter in Alun-Alun Timur and Dalem Kaum streets is disability infrastructure, which aligned with the parameter that requires the most attention; however, Dalem Kaum street demonstrated that the existing condition requires further attention in other two parameters such as security against crime and grade crossing safety, making this street the most attention to be improved to be pedestrian-friendly.

Previous research using Multicriteria Satisfaction Analysis [11] on different streets revealed that parameters that requires attention are comfort related to amenities and safety related to motorist behavior as well as inadequate crossing. This made a difference because the amenities in the Bandung City Square Area are adequate, but the disability infrastructure is not. However, there is a similar result regarding crossing that is inadequate, particularly in terms of providing pedestrian-safe crossing related to quality of crossing that is insufficient leading to pedestrians facing hardship if they want to cross. More research is needed on the parameters that requires attention in the Bandung City Square Area to see if there is a difference and find effective improvements on pedestrian condition based on certain Global Walkability Index parameters.

4. Conclusion

Result showed that Bandung City Square Area is Waiting to Walk, which is adequate for walking. However, parameters such as availability of crossings especially on Asia-Afrika and Alun-Alun Timur Streets, security against crime, disability infrastructure, grade safety of crossing, and motorist behavior are below average based on Global Walkability Index. Three parameters such as: crossing safety (Dalem Kaum street), security against crime (Dalem Kaum Street), and disability infrastructure that needs attention according to Multicriteria Satisfaction Analysis based on existing condition. Based on the result of this study, pedestrian paths improvements are needed. This improvement should be based on parameters that are below average and requires attention in order to achieve a pedestrian-friendly environment, particularly on Dalem Kaum street. Further research is needed regarding the effective improvements on pedestrian paths based on walkability aspects and pedestrian perception as users, so that walkability in Bandung City Square Area can be highly walkable and giving pedestrian a good environment to be walked on.

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