Integration of public open space and pedestrian pathway to the Trans Koetaradja shelter in the Masjid Raya Baiturrahman area

C Zulkarnaen¹, S Sugiarlo²*, I Caisarina³
¹Civil Engineering Postgraduate Program, Department of Civil Engineering, Universitas Syiah Kuala, Banda Aceh, Indonesia
²Department of Civil Engineering, Universitas Syiah Kuala, Banda Aceh, Indonesia
³Department of Architecture and Planning, Universitas Syiah Kuala, Banda Aceh, Indonesia

*E-mail: sugiarlo@unsyiah.ac.id

Abstract. The area of Masjid Raya Baiturrahman is an area that is integrated with public space, pedestrian pathway, and public transportation infrastructure namely Halte Trans Koetaradja. This area is always crowded because of the Masjid Raya Baiturrahman besides as a center of Islamic worship also as a center of Islamic tourism in Banda Aceh. This area is always crowded by motorists and pedestrians who visit and perform activities in the area. Because the still mix of motor vehicles and pedestrians makes the area at certain times very dense so it is not safe and comfortable for pedestrians. This research aims to identify the existing conditions of the pedestrian street in the area of Masjid Raya Baiturrahman Grand and also identify the characteristics of pedestrian movements to determine the level of service from the pedestrian path. This study was conducted using a table based on the list of Ministerial Regulation of Public Works No. 03 The Year 2014 and also the Department of Transport (DOT) to identify the existing conditions of the pedestrian path in the area of Masjid Raya, then conducted a review of the characteristics of pedestrian movements using the formula of pedestrian speed, pedestrian flow and also pedestrian density. The results of this research appointment that the pedestrian pathway in the area of Masjid Raya Baiturrahman when reviewed from the existing service level, it is still a level of service A, but if the review of existing conditions then there is an improvement to the pedestrian pathway. This is because the supporting facilities have not been compactor to the pedestrian pathway by the standard guidelines.

1. Introduction
As the center of the activity, Masjid Raya Baiturrahman (MRB) can not only stand-alone, is of course supported by the existence of the surrounding area that is connected to the pedestrian pathway and public open space around the area of the mosque. The current pedestrian path is still a sidewalk along the mosque's fence, while the public open space in the form of a park called the Aman Kuba park is connected to the public transportation infrastructure. This relates to Linkage theory which means the pseudo-line linking between the elements of one another, the nodes that are one with the other nodes, or the district with one another [1]. Meanwhile, according to Maki, the linkage is a city adhesive that brings together activities and produces the physical form of the city [2]. The pedestrian pathway in this area is used as connectivity to the means of movement or transfer of people or groups of people from the Grand Mosque to the public open space is also the Aman Kuba Park to the surrounding trade and services area.
According to Shirvani, pedestrian is part of the public space and is an important aspect of urban space, both field (square-open space) and road-corridor (street) [3]. Public open spaces as a shared space, where communities perform functional and ritualized activities in a community bond, both daily life and in periodical celebrations that have been set as open, where people do personal activities and groups [4].

But unfortunately, the current pedestrian path used as a place to sell by street vendors and also as a parking lot for motor vehicles and still can be traversed by motor vehicles. This of course inhibits the movement of pedestrians who will use the pedestrian as a transit line that descends from the Trans Koetaradja shelter and towards the stop, therefore it is required that the pedestrian path meets the standards and fulfills the movements of all regions. Also, it needs to apply the concept of walkability and Non-Motorized Transport. The walkability broadly refers to the feature variation of a community or surrounding environment that creates a quite easy place to move around without using a motor vehicle [5]. Non-Motorized Transport (NMT) is a type of transport where the model used does not depend on the engine or motor to move. It includes walking, biking, wheelchairs, and other variations of personal vehicles such as roller-skating, skateboards, and Carts [6].

A safe, comfortable, and humane pedestrian network in urban areas is an important component that must be provided to improve the effectiveness of urban mobility. The pedestrian network is a pedestrian area, either integrated or separate from the road, which is destined for the infrastructure and pedestrian facilities and connects the activities centers and/or the mode change facility [7]. According to the Government of Western Australia, pedestrians can be interpreted as walking persons or persons using the equipment running with wheels such as a person who sits in a wheelchair, a person who encourages a stroller, or runs using a skateboard [8].

In the area of Masjid Raya, the pedestrian path and the public room still has a function transition because it is still used by traders and parking of motor vehicles. This causes pedestrians to become unsafe and not inconvenient when using a pedestrian path. Also, the lack of completeness of supporting street furniture, vegetation, signage, undirected circulation, and others. This relates to the road users who will be heading for the Trans Koetaradja shelter or vice versa. Pedestrian facilities need to be well prepared following existing standards so that the environment for pedestrians surrounding the historical area (MRB) in Banda Aceh can be created and not only seen from the design aspect but also the security aspects [9].

Safety, safety and health criteria are at top priority, the criteria of attraction and comfort are at the second priority, as well as accessibility criteria and beauty are at a third priority [10]. Various land-use planning strategies and road plans to improve road safety have been created and implemented in many countries [11]. With the evaluation of the conditions of public open spaces and pedestrians in Masjid Raya Baiturrrahman, it is expected to later be a recommendation for the Government to realize a pedestrian path that is safe, comfortable, effective and pedestrian-friendly.

2. Area of study, data collection, and processing

Figure 1 and Figure 2 show the area of study in which in the area of Masjid Raya Baiturrrahman Banda Aceh. It is a pedestrian path as well as a public open space integrated with Trans Koetaradja. The pedestrian path is a major review for viewing the conditions of the pedestrianized pedestrian path as well as the characteristics of the pedestrian movements on this pedestrianized trail.

Regarding the data collection method, data retrieval to see the existing condition is by observing directly using the Checklist table to assess the current condition of the pedestrian path to see the conformity and inconsistency according to the existing guidelines. As for the data retrieval characteristics of pedestrians, movements use the stopwatch to calculate the speed of pedestrians from the west and east sides of each segment and manually calculate the number of pedestrians per segment for three days (Monday, Wednesday, Saturday) from morning to night. The number of pedestrians took every 15 minutes in the morning peak (07:00-10:00), afternoon (13:00-16:00), and evening (18:00-22:00). A sample pedestrian is a male and adult woman using a pedestrian path on every research segment.
All data of existing pedestrian and pedestrianized data are collected for processing so that later can be used in the analysis. Pedestrian data is both for pedestrian speed and the number of pedestrians is used in Ms. Excel, where it is calculated using the characteristic formula of the pedestrian movement so that the final result of the pedestrian movement characteristics will determine the level of service of this pedestrian path. As mentioned before, the analysis in this study is focused on the level of services pedestrian and improvement of existing conditions of the pedestrian path (improvement of an existing. The method used for the analysis will be described in the following section).
3. Analysis method

In this study, as mentioned above, the data analysis to get two main objectives of the (1) identification of the condition of the pedestrian path (2) Identification of the characteristics of pedestrian movements i.e. speed, pedestrian flow, and pedestrian density. The table of service identification according to the ministerial regulation of Public Works No. 3 of 2014 and also DOT (planning and designing for pedestrian guidelines) is used when observing existing conditions of the pedestrian path at the research site, as indicated by Table 1. From the results of the list can then be a recommendation for the improvement of the pedestrian path following the predefined standards. As for the number of pedestrians and pedestrians speed data is taken using the stopwatch to make the speed of pedestrians both from the west and the east side of each existing segment. The number of samples taken to see the speed of pedestrians in their segments amounted to 60 people consisting of 30 men and 30 the women. While the number of pedestrian data is calculated manually by viewing and writing the number of pedestrians for 3 days of research (Monday, Wednesday, Saturday) to see the difference in the number of pedestrians through the pedestrian path on weekdays and weekends. The number of pedestrians is subsequently processed using MS. Excel uses a characteristic formula of pedestrian movements.

**Table 1. Existing pedestrian conditions**

| Conformity               | Description                        |
|--------------------------|------------------------------------|
| Track width              | At least 1.5 meters                |
| Surface Line             | Stable, strong, and flat           |
| Floor Textures           | Smooth and not slippery            |
| Degree of tilt (ramp)    | 1:12 (8%)                          |
| Lighting                 | Space required 60-75cm             |
| Signs and markings       | Space required 60-75 cm            |
| Trash Can                | Space required 90cm per 20m        |
| Shade Plants             | Planted greenery on furniture lines 1, 5m |
| Bench/Seat               | Requires Room 1, 5m                |

*Source: The Decree No.3 2014 [12] and DOT [8]*

**Table 2. Pedestrian Level of Service.**

| Service level | Space (m²/pedestrian) | Speed (m/min) | Current and expected speed (m/min) | Volume/Cap |
|---------------|-----------------------|---------------|-----------------------------------|------------|
| A             | ≥ 12                  | ≥ 79          | ≤ 6,5                             | ≤ 0,08     |
| B             | ≥ 4                   | ≥ 76          | ≤ 23                              | ≤ 0,28     |
| C             | ≥ 2                   | ≥ 73          | ≤ 33                              | ≤ 0,40     |
| D             | ≥ 1,5                 | ≥ 69          | ≤ 46                              | ≤ 0,60     |
| E             | ≥ 0,5                 | ≥ 46          | ≤ 82                              | ≤ 1        |
| F             | ≥ 0,5                 | ≥ 46          | Vary                              | Vary       |

*Source: Transportation Research Board [14]*

To analyse the characteristics of pedestrians on the pedestrian path of the Masjid Raya Baiturrahman Use the appropriate method of formula as a parameter in analysing. To calculate the flow of pedestrians, pedestrian speed, pedestrian density using the characteristic formula of pedestrian movements [13]. To determine the level of service of the pedestrian path in the mosque of Masjid Raya Baiturrahman using Level of Service (LOS) analysis. Service level is the classification of traffic flow quality at the maximum range of capacity fraction [14] (Transportation Research Board, 2000). The concept of service level relates to the comfort factor. Like the ability to choose a walking speed, precede the slower pedestrians avoiding conflicts with other pedestrians. The level of service can be classified in service level A to F service level,
all of which reflect the conditions on the specific needs or currents of service. The details of these service levels can be seen in Table 2.

4. Analysis of results and discussion

After the field observation to see the existing condition of the pedestrian path in the area of Masjid Raya Baiturrahman obtained analysis made in the form of a table containing the suitability of the guidelines adapted to existing conditions in the research location that has been determined in determining analysis with the description of the mark (√) has a meaning fulfilled, while the sign (x) is still not being fulfilled, then the following analysis results in each segment has been determined on the pedestrian route in the area of Masjid Raya Baiturrahman. The result is presented in Table 3.

| Table 3. Existing condition Analysis Pedestrian pathway. |
|----------------------------------------------------------|
| Conformity | Description | Segment 1 | Segment 2 | Segment 3 |
| Track width | At least 1.5 meters | √ | √ | √ |
| Surface Line | Stable, strong, and flat | √ | √ | √ |
| Floor Textures | Smooth and not slippery | | x | √ |
| Degree of tilt (ramp) | 1:12 (8%) | √ | x | x |
| Lighting | Space required 60-75cm | | √ | x |
| Signs and markings | Space required 60-75 cm | | x | √ |
| Trash Can | Space required 90cm per 20m | √ | x | x |
| Shade Plants | Planted greenery on furniture lines 1, 5m | | x | x |
| Bench/Seat | Requires Room 1, 5m | | x | x |

Based on the existing condition analysis of the pedestrian path in segment 1, the results of the suitability have been much fulfilled (√) only 2 parts that are not met (x). As for segment 2 and Segment, 3 are more incompatibilities (x). Hence it can be concluded that the pedestrian path in this area still needs improvement according to the existing guidelines so that it has a comfortable and safe pedestrian path for pedestrians. The calculation of the pedestrian data in the current can be after obtaining the number of pedestrians passing through the location of the research in the survey for 3 days in each segment of segment 1 to segment 3 in the Masjid Raya Baiturrahman. Calculations in the can of the number of pedestrians and divided by the effective width of the pedestrian path.

| Table 4. Pedestrian characteristics. |
|--------------------------------------|
| Segment | Flow Pedestrian/min/m | Speed m/min | Density Pedestrian/m² | Space m²/pedestrian |
|---------|-----------------------|-------------|----------------------|---------------------|
| 1 West  | 0,312                 | 416,76      | 0,343                | 3291,24             |
| 1 East  | 0,358                 | 361,01      | 0,000                | 3416,18             |
| 2 West  | 0,218                 | 633,35      | 0,000                | 3830,96             |
| 2 East  | 0,240                 | 1345,80     | 0,000                | 6484,92             |
| 3 West  | 0,706                 | 1051,71     | 0,001                | 1800,30             |
| 3 East  | 0,755                 | 796,28      | 0,001                | 1332,20             |

The Data used in the pedestrian speed calculation is the travel time of the pedestrians passing through the observation. The implementation of the travel time survey is conducted in each segment, namely segments 1 to segment 3 on the west and east side. In this study, long-term observation is 10 meters. The travel time is counted in seconds. The speed unit used is a meter per minute. Since within 1 minute there are 60 seconds, the T should be divided by 60. Density is derived from the advanced calculations sought in
pedestrian flow calculation and the average speed calculation of the pedestrian space. Density is calculated from the results for both variables. The result of the density calculation will be used in fulfilling one sub variable in determining the service level. The pedestrian space Data is a division of 1 divided by the density of each segment. Pedestrian characteristics include pedestrian flows, pedestrian speed, pedestrian density, and pedestrian space. Table 4 is the result obtained from each of the characteristics in segments 1 to 3 segments on the west and east.

Service level analysis is an advanced analysis of the first goal. The analysis is divided into 2 (two), namely the analysis of the service level based on the average value is 1 (one) day. And the level of service based on the highest score in 15 minutes, namely looking at the characteristics of pedestrian movements (current, speed, and space). Table 5 is the result of Level of Service (LOS) that is obtained in each segment of the pedestrian path in the area Of Masjid Raya Baiturrahman.

| Segment   | Space m²/pedestrian | Speed m/min | Flow pedestrian/min/m | Ratio (Vol/cap) | Level of Service |
|-----------|---------------------|-------------|-----------------------|-----------------|-----------------|
| Segment 1 West | 1542.81            | 416.76      | 0.160                 | 0.0004          | A               |
| Segment 1 East  | 1514.97            | 361.01      | 0.158                 | 0.0004          | A               |
| Segment 2 West  | 3830.96            | 633.35      | 0.218                 | 0.0003          | A               |
| Segment 2 East  | 6484.92            | 1345.80     | 0.240                 | 0.0002          | A               |
| Segment 3 West  | 1800.30            | 1051.71     | 0.706                 | 0.0007          | A               |
| Segment 3 East  | 1332.20            | 796.28      | 0.755                 | 0.0009          | A               |

To determine the level of service based on the characteristics of movement on the pedestrian path in the area of Masjid Raya Baiturrahman by looking at the highest value of an analysis that has been done before in the calculation of current, speed, and space, as follows:

- Based on the largest 15-minute pedestrian flow interval, where the maximum number of pedestrians occurred in segment 1 at 15.15-15.30 WIB, which is 40 pedestrians, and the width of the pedestrian line 2.2 meters. So the current magnitude as follows:

\[ Q_{15} = \frac{N}{15 \times \text{WE}} = \frac{40}{15 \times 2.2} = 1,212 \text{ pedestrian/min/m} \]

- Based on speed, the length of the observation is 10 meters. The travel time is counted in seconds. The speed unit used is a meter per minute. Since within 1 minute there are 60 seconds, the T should be divided by 60. For more details is stated in the formula:

\[ V = \frac{L}{T/60} = \frac{600}{1.20} = 500 \text{ meter/minute} \]

- Based on the largest pedestrian 15-minute interval space, where the value of density occurs in segment 1 at 09.15-09.30 WIB on the west side of 1.503 pedestrian/m² as follows:

\[ S = \frac{1}{D} = \frac{1}{1.503} = 0.665 \text{ M²/pedestrian} \]

From the above calculation, based on pedestrian flow, the level of service is A, based on the speed of service level is A, based on space, the service level is E.

5. Conclusion

Based on the analysis of service levels on the pedestrian route reviewed from the pedestrian flow, speed, and density in one day for each segment it meets the A service level A. Whereas if the review of the highest value in 15 minutes is known that based on the pedestrian flow, the level of service is A, based on the speed of service level is A, based on the density of service level is E. This journal is expected to be input for
government and related for pedestrian pathways such as shade plants, trash cans, lighting lamps, seating, directions, and other supporting facilities are well organized according to existing standards. Also, it is expected that the government can apply the concept of walkability and Non-motorized transport so that pedestrians can realize the importance of the pedestrian path and can use this pedestrian path with a sense of safety and comfort.

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