Analysis of the needs road facilities in Jalan Soekarno Hatta Malang City

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Abstract. Pedestrians are an element of urban transportation. The Pedestrian movement includes down the road, crossing both on the road and at the intersection. The existence of adequate pedestrian facilities is needed, including crossing facilities. The number of pedestrians on the Soekarno Hatta road is very high while gap vehicles are short so that it is difficult for pedestrians to cross. The purpose of this study was to determine the need for crossing facilities on the Soekarno Hatta street in Malang. Primary data collection was carried out on March 9 -11, 2020. Analysis results obtained by the number of pedestrians is 322 people and volume traffic 4867.1 pcu/hour, PV2 = 6,3. 109 so that appropriate pedestrian facilities are pedestrian platform.

1. Introduction

Roads parts of the road, including complementary buildings and equipment intended for public traffic, which are on the ground level, above the ground level, below the ground and/or water level, and above the water level, except for rails and cable roads. A pedestrian is any person who walks in a road traffic space [1].

Pedestrians are an important form of transportation in urban areas. These pedestrians are in a weak position when mixed with vehicles, especially for pedestrians crossing the road, indirectly this activity will lead to sharp conflicts in traffic, namely the occurrence of traffic delays and even accidents. So that infrastructure for pedestrians that meets security, safety, comfort, and able to minimize delays or traffic accidents when crossing needed.

The movement of pedestrians includes walking along roads, crossing roads and intersections. Facilities for pedestrians an example important transportation infrastructure for users. The infrastructure needed to support transportation facilities for pedestrians is to build a complementary building for pedestrian comfort, smoothness, and safety.

Pedestrians is one element of road users. Most pedestrians and pedestrians are located in shopping centers, educational centers, hospitals, terminals, stations, and others. Thus, this location requires the provision of adequate, safe, and comfortable public facilities for road crossers. These facilities include zebra crossings, pelicans, control lights, and pedestrian bridges

Soekarno Hatta street, especially in front of State Polytechnic of Malang Campus, is often a crossing point for pedestrians, especially Student State Polytechnic of Malang because the majority of students live across the campus.
Figure 1. Pedestrians in front of State Polytechnic of Malang Campus.

Figure 2. The wader on Soekarno Hatta street.

The less of pedestrian facilities in the area makes it difficult for pedestrians to cross, while the heavy volume of vehicles also increases the risk of pedestrians. The purpose of this research is to determine the proper facilities for pedestrians so that they can cross comfortably and safely.

According to UU no. 22 of 2009, traffic is the movement of vehicles and people in the road traffic space [1]. Road traffic space is infrastructure designated for moving vehicles, people and/or goods in the form of roads and supporting facilities. Roads are all parts of the road, including complementary buildings and equipment intended for public traffic on the ground surface, above the surface of the ground, below the surface of the land and/or water, and above the water surface, except for rails and cable roads. A pedestrian is any person who walks in a road traffic space.

According to the Minister of Public Works Regulation No. 03 / PRT / M / 2014 A pedestrian is anyone who walks in the road traffic space. Pedestrian networks are pedestrian segments, either integrated or separate from roads, which are designated for pedestrian infrastructure and facilities as well as connecting activity centers and/or modal change facilities [2]. Pedestrian network infrastructure and facilities are the facilities provided along the pedestrian network to ensure the safety and comfort of pedestrians.

According to pedestrian facilities guidelines the completeness of pedestrian facilities includes pedestrian paths (sidewalks) and wading which consists of level waders and waders are not level [2].

2. Pedestrian crossings
There are two types of pedestrian crossings, as follows:
2.1. Level crossing
The criteria for selecting a level crossing are as follows:

- Based on the empirical formula \(PV^2\), where \(P\) is the flow of pedestrians crossing the road as long as 100 meters per hour (pedestrian/hour) and \(V\) is the hourly flow of vehicles in two directions (vehicle/hour).
- \(P\) and \(V\) are the average flows of pedestrians and vehicles during peak hours, with initial recommendations as shown in the table below:

| PV²       | P     | V       | Recommendation        |
|-----------|-------|---------|-----------------------|
| > 10²     | 50 -1100 | 300 - 500 | Zebra crossing         |
| > 2 \times 10⁸ | 50 - 1100 | 400 - 750 | Zebra cross waiting stalls |
| > 10⁸     | 50 - 1100 | > 500    | Pelican Cross         |
| > 10⁸     | > 1100   | > 300    | Pelican Cross         |
| > 2 \times 10⁸ | 50 - 1100 | > 750    | Pelican Cross waiting for stalls |
| > 2 \times 10⁸ | > 1100   | > 400    | Pelican Cross waiting for stalls |

Where:
\(P = 100\) pedestrian crossing traffic flow, expressed in people / hour
\(V = \) Two-way traffic flow per hour, expressed as vehicles/ hour

Level crossing can be applied to intersections and road sections. A level crossing can be:

2.1.1. Zebra crossing
- Installed at the foot of the intersection without or with traffic signaling devices or on roads.
- If the intersection is regulated by traffic control lights, the provision of crossing time for pedestrians becomes one unit with the crossing traffic control lights.
- If the intersection is not regulated by traffic control lights, then the motor vehicle speed limit criterion is <40 km/ hour.
- The zebra crossing refers to the Road Marking Implementation Guidelines.

2.1.2. Pelican crossings
- Installed on the road, at least 300 meters from the intersection, or
- On roads with the average operating speed of vehicle traffic> 40 km / hour.

2.1.3. Pedestrian platform. The pedestrian platform is a pedestrian path in the form of level crossing facilities whose surface is higher than the road surface.

2.2. Non level crossing
Non-level crossing is used when:
- The level crossing facility has disrupted the existing traffic flow.
- The frequency of accidents involving pedestrians is quite high.
- On roads with a design speed of 70 km / hour.
- In a strategic area, but does not allow road crossers to cross the road other than at non-level crossings.

Some of the provisions that must be considered in planning the plot of the crossing facilities:
- non-level crossings should be easily accessible to the disabled, for example by adding RAM or an elevator.
- The crossing facilities must be equipped with good lighting which can increase safety for pedestrians.
The location and building must pay attention to the aesthetic value and the needs of pedestrians. The selection criteria for an off-level crossing are shown in the table below.

**Table 2.** Criteria for determination of non-level crossing facilities [2].

| P (people/hour) | V (Vehicle/hour) | PV² | Recommendation       |
|-----------------|------------------|-----|----------------------|
| > 1100          | > 750            | > 2 \times 10^8 | The crossing is not level |

3. **Headway**

According to the Highway Capacity Manual the headway is the time between (in seconds) between two consecutive vehicles as they pass through a point in the road section measured by the common features of both vehicles (for example front axle or front bumper) [4]. According to Tentero Rianti, critical Gap and Gap are Important factors to consider pedestrians who will cross the road are the availability of gaps/gaps or time/distance between vehicles on the main traffic flow which is sufficient to join and cross and cross into the traffic flow [5,6].

![Figure 3. Headway and gap.](image)

4. **Methodology**

The research location is located on Soekarno Hatta street, Malang City.

![Figure 4. Research location (www.google map.com).](image)

The data required includes:

4.1. **Primary data**

- Geometric path data
- Speed data
- Pedestrian data
- Wader data
• Vehicle gap data

4.2. Secondary data
The secondary data required are:
• Location map
• Total population of Malang city

Data collection is carried out on working days from 06.00-17.00 WIB

5. Discussion
Geometric road:

Figure 5. Placement of surveyors.

Figure 6. Geometric road Jalan Soekarno Hatta.

Geometric data is obtained from a direct survey of geometric road conditions. The geometric data for Jalan Soekarno Hatta Malang are as follows:

5.1. Geometric conditions and road facilities
• Type of road: 4/2 D
• Width per lane: 3.5 m
• Sidewalk width: 2.00 m
• Median: 4.5m

5.2. Traffic
The composition of traffic passing through Soekarno Hatta road is as follows:
• Motorcycles (MC), i.e. two or three-wheel vehicles.
• Light vehicles (LV), which are four-wheeled motorized vehicles with two-axle distances of 2.0 - 3.0 m (including passenger vehicles, pick-ups and small trucks).
• Heavy vehicles (HV), namely motorized vehicles with two axles distances of more than 3.50 m. Usually more than four wheels including buses, 2 axles, and 3 axles trucks).

### Table 3. Traffic volume.

| Time Period     | MC | LV  | HV  | MC | LV  | HV  | Total pcu/hour |
|-----------------|----|-----|-----|----|-----|-----|----------------|
| 06.00-07.00     | 1278,25 | 1090 | 6   | 1042,25 | 847 | 10,8 | 4274,3 |
| 06.15-07.15     | 1467,25 | 1062 | 2,4 | 1268,25 | 919 | 13,2 | 4732,1 |
| 06.30-07.30     | 1523,5 | 974 | 2,4 | 1395,25 | 936 | 18  | 4849,15 |
| 06.45-07.45     | 1583 | 936 | 2,4 | 1446,5 | 874 | 25,2 | 4867,1 |
| 07.00-08.00     | 1577 | 889 | 0   | 1366,25 | 916 | 26,4 | 4774,65 |
| 07.15-08.15     | 1574,5 | 926 | 3,6 | 1236,25 | 950 | 33,6 | 4723,95 |
| 07.30-08.30     | 1514,5 | 962 | 7,2 | 1180 | 993 | 40,8 | 4697,5 |
| 07.45-08.45     | 1443 | 994 | 8,4 | 1083 | 1012 | 40,8 | 4581,2 |
| 08.00-09.00     | 1395,25 | 1027 | 9,6 | 1025,5 | 995 | 45,6 | 4497,95 |

The peak hour traffic volume occurred at 06.45-07.45 with the number of vehicles 4867.1 pcu / hour.

5.3. Number of pedestrians

Based on the survey results, it was found that the number of pedestrians during peak hours was 322 people.

### Table 4. Number of pedestrians.

| Time     | Pedestrian | Side Friction | Total |
|----------|------------|---------------|-------|
|          | Stop/Parking | In/Out | UM |       |
| 06.00-07.00     | 233 | 79 | 2732 | 49 | 3093 |
| 06.15-07.15     | 291 | 77 | 3850 | 59 | 4277 |
| 06.30-07.30     | 322 | 83 | 4384 | 66 | 4855 |
| 06.45-07.45     | 280 | 93 | 4476 | 87 | 4936 |
| 07.00-08.00     | 249 | 105 | 3849 | 93 | 4296 |
| 07.15-08.15     | 197 | 103 | 3303 | 77 | 3680 |
| 07.30-08.30     | 178 | 114 | 3090 | 66 | 3448 |
| 07.45-08.45     | 201 | 130 | 3088 | 49 | 3468 |
| 08.00-09.00     | 241 | 134 | 2995 | 32 | 3402 |

Take advantage of the time between vehicles. If the time between vehicles is long, the pedestrian can cross the road but if the time between vehicles is small, the pedestrian cannot cross the road.

Based on the results of the analysis, it is obtained that the average gap on the Soekarno Hatta road can be seen in Table 5.

### Table 5. Gap average on Soekarno Hatta street.

| No | Transp. Type | Direction of Movement | Gap Aver. (sec) |
|----|--------------|-----------------------|-----------------|
| 1  | LV           | N-S                   | 3,35            |
|    |              | S-N                   | 2,71            |
| 2  | MC           | N-S                   | 0,52            |
|    |              | S-N                   | 0,39            |

Gap average on Jalan Soekarno Hatta was very short. That is 0.39 seconds. Based on table 3 it is included in the high density category so that the wading will be difficult to cross.
### Table 6. Flow determination criteria.

| No. | Category       | Time Headway  |
|-----|----------------|---------------|
| 1.  | High Density   | < 2.5 second  |
| 2.  | Density        | 2.5 - 9 second|
| 3.  | Low Density    | > 9 second    |

5.4. Vehicle speed

The speed of the vehicle in question is the instantaneous velocity of vehicles that will interact with pedestrians. When there are road crossers, it is hoped that the vehicle will provide space for the pedestrian to cross the road by reducing its speed. The vehicles being measured are also differentiated for each type of vehicle into groups of light vehicles, heavy vehicles, and motorbikes. Based on the analysis results obtained the average speed

![Average speed](image1)

5.5. Selection of crossing facilities

From the side obstacle survey data, the data on the number of pedestrian crossings at peak hours is 322 people/hour (P). And the traffic volume from two directions is 4867.1 pcu/hour (V).

Information:
- p: Number of Pedestrians (person/hour)
- v: Amount of Two-Way Traffic (vehicle/hour)

So that $322/4867.1 = 6.3 \times 10^9$ and $PV > 2 \times 10^8$ then the appropriate pedestrian facilities are the Pedestrian Platform. The surface is made in contrast so that is clearly visible to the driver and is equipped with markings near the ramps so that the driver can see the upper edge of the pedestrian platform, a zigzag mark / line of white paint that can sparkle/reflect light and must be mounted across the full width of the approaching ramp.

![Pedestrian platform on Jalan Soekarno Hatta](image2)

6. Conclusion

- Total peak hour traffic volume is 4867.1 pcu/hour
- The number of pedestrians during peak hours 322 people
- The right crossing facility for Soekarno Hatta Street is the Pedestrian Platform

References
[1] UU No 22 of 2009 concerning Road Traffic and Transportation (Jakarta)
[2] Minister of Public Works Regulation 2014 Guidelines, Provision, and Utilization of Pedestrian Network Infrastructure and Facilities in Urban Areas No.03 / PRT.M / 2014
[3] Ministry of Public Works and Public Housing 2018 Pedestrian Facility Technical Planning No 02/SE/M/2108
[4] Transportation Research Board 2000 Highway Capacity Manual
[5] Tentero R 2015 The Requirement of Road Crossing Facilities Based on Critical Gap at The Wolter Mongisidi Road Freshmart Bahu Mall Manado Jurnal Sipil 3 8
[6] Ikbal M and Mashuri M 2011 Study of Pedestrian Characteristics and Selection of Types of Pedestrian Crossing Facilities in the City of Palu (Case Study: Jl. Emmi Saelan Front Taruta Mall, Palu City) Unpublished Journal. Palu: Civil Engineering Department of Tadulako University