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Analysis of The Effect of Side Friction on Urban Road Performance (Jl. Landorundun, Rantepao, Toraja)

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Abstract

Jalan Landorundun is one of the main roads located in the bustling economic center of Rantepao city. Along this road there are shops, restaurants and market activities. This situation illustrates that the slowdown that occurs when vehicles pass along the road is caused by high roadside obstacles and disorderly traffic behavior from vehicles crossing the research location of this final project is on Jl. Landorundun, Rantepao District, North Toraja Regency, South Sulawesi. Primary data was obtained by conducting a direct survey in the field/research location, namely, Road Geometric, traffic volume, and side frition and secondary data, namely layout and population. This study used the Indonesian Road Capacity Guidelines (PKJI) 2014 analysis method, based on the results of the survey that has been conducted, the decrease in vehicle' speed on Jl. Landorundun was caused by high side friction. The higher the side friction, the higher the degree of saturation. The higher the degree of saturation, the lower the road performance. The highest side friction occurred on Tuesday with a very high friction (ST) category of 1189.4 incidents/hour, due to market activities that occurred on that road section.

Keywords*: **Performance, side frictions, urban road***

BACKGROUND

The high purchasing power of the community has resulted in an imbalance between vehicle growth and road infrastructure growth, leading to traffic congestion. The community's need for transportation is currently also growing rapidly. One of the main roads in the growing trade center in Rantepao is Jalan Landorundun. There are shops, restaurants, and market activities along this road. This example shows the slowdown that occurs when vehicles pass through the road due to the high level of roadside obstacle activity and irregular traffic from passing vehicles. Parking areas on the side of the road slow down traffic, and this route is also used by street vendors who set up their wares on the sidewalk. Market activities, pedestrian crossings, vehicles entering and exiting the road, as well as the activity of vehicles stopping to pick up and drop off passengers, reduce traffic speed and road capacity. Therefore, on the Rantepao city road section, especially along Jalan Landorundun, it is necessary to conduct an analysis review of the influence of side obstacles on road performance. The urgency of this research is that there has been no research on the performance of roads used for market days (based on local traditions). The purpose of the research is to determine the effect of side obstacles on road performance in urban areas.

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The public's need for transportation is currently growing rapidly and the public's purchasing power is also quite high, which creates an imbalance between the growth in the number of vehicles and the growth of road infrastructure[1]. Roads are a form of land transportation infrastructure that plays a role in the movement of people and goods on land[2]. The main characteristics of the road that can affect the performance of the road section are from the traffic load on the road. If the traffic load is dense, it can cause congestion on urban roads[3]. Congestion is a major problem for traffic users that can cause accidents for road users[4]. Road side frictions can be expressed as the interaction between traffic flow and road activities related to roadside management[5]. Road side frictions have a significant impact on the level of service[6]. Even though the number of vehicles passing does not change drastically, high side frictions can make the space for vehicle movement narrower so that vehicle speed is limited to avoid the risk of unexpected accidents[7]. The presence of side frictions in the form of on-street parking causes congestion and queues, as well as reducing road capacity[8], [9]. On roads with high side frictions, vehicle speed and road service levels decreased [10]. The implementation of pedestrian fences can reduce the side frictions that occur from moderate to low with a service level of B and a free flow speed of 36.27 km/hour[11]. The higher the frequency of side friction, the higher the operational costs of the vehicle[12]. The greater the side frictions, the greater the degree of saturation[13]. Parking relocation is proven to increase road capacity, decrease the degree of saturation, and improve the level of service[14]. The effect of side frictions on road capacity is that the greater the side frictions, the lower the capacity and performance of the road section. Conversely, if the side frictions are low, the road capacity is increase[15].

METHODOLOGY

A. Research Location

The research location of this final assignment is on Jl. Landorundun, Rantepao District, North Toraja Regency, South Sulawesi.

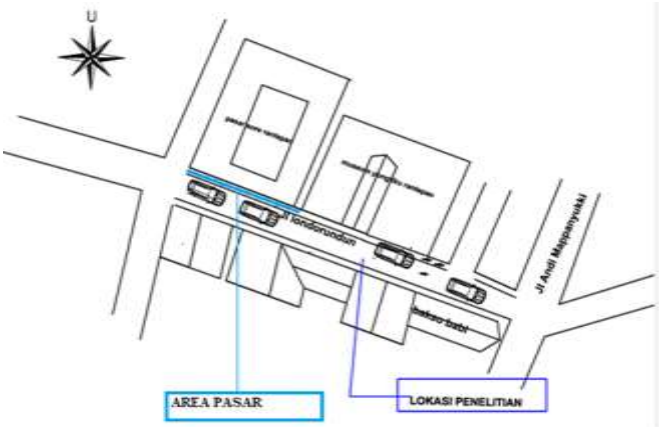

Figure 1. Research Location

B. Data Collection

1. Road Geometric Survey
   The geometric data of the road required in this study include road width, road length, lane width and road shoulder size.
2. Traffic Volume Survey
   Data collection for traffic volume was carried out for 4 (four) days during peak hours, morning from 07.00-09.00 WITA, afternoon from 12.00-14.00 WITA, evening from 16.00-18.00, with a

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p-ISSN 2775-8613

time interval of 15 minutes. This data collection was obtained by placing 4 (four) surveyors who were tasked with recording the number of vehicles at two predetermined observation posts.

3. Side Friction
   The side friction survey was carried out by filling out the side friction survey form which would be carried out by 3 (three) surveyors. The side friction studied included parked and stopped vehicles, vehicles entering and exiting road segments and pedestrians.

RESULTS AND DISCUSSION

A. Road Geometry

From the research conducted on the Jl. Landorundun section with a one-way one-lane road type, the road on both sides is used as a parking/stopping place for motorbikes, public transportation activities that pick up and drop off passengers and street vendor activities on the sidewalk. The land on the right and side of the road is designated as urban buildings and market activities with street vendors on the sidewalk and pedestrians on the shoulder of the road, therefore reducing road performance on the Jl. Landorundun section. The following is the geometric data of the Jl. Landorundun 200 meters long:

1. Road Type: 2/1 U/D
2. Road shoulder: Left = 1.7 meters, Right = 0 meters
3. Effective road shoulder: due to activities along the road shoulder, the effective road shoulder width on the left side = 0 meters
4. Road width: 6.4 meters
5. Effective road width: 6.4 meters – 1.5 meters = 4.9 meters
6. Sidewalk: Right = 2.6 meters, Left = 2.6 meters
7. Population: 21,086 thousand people

This research was conducted from Monday to Thursday

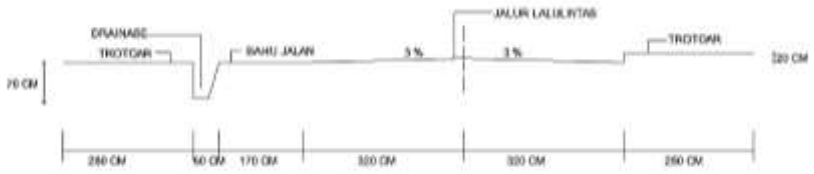

Figure 2. Cross section of Landorundun Street

B. Traffic Volume

The results of the traffic volume survey can be seen in appendix tables 1 to 4, where KR = Light Vehicles is the number of cars entering and leaving, KB = Heavy Vehicles is the number of trucks entering and leaving and SM = Motorcycles is the number of motorcycles entering and leaving. Based on the survey results, the highest traffic volume occurred on Tuesday at 07.00 – 08.00 WITA.

Here is an example of vehicle volume analysis on the Jl. Landorundun segment:

Calculation in the morning at 07.00-08.00 WITA on Tuesday.

Q_{KR} = 208 vehicles/hour

Q_{KB} = 21 vehicles/hour

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Q_{SM} = 378 vehicles/hour

The total one-way traffic flow value is less than 1050 vehicles/hour, so the appropriate heavy vehicle equivalent value is 1.3 and the appropriate motorcycle equivalent value is 0.4.

EKV_{KB} = 1.3

EKV_{SM} = 0.4

Q = KR + KB + SM

Q = 208 + 21 + 378 = 607 vehicles/hour

Qekv = KR + (EKV_{KB} x KB) + (EKV_{SM} x SM)

Qekv = 208 + (1.3 x 21) + (0.4 x 378) = 386.5 pcu/hour

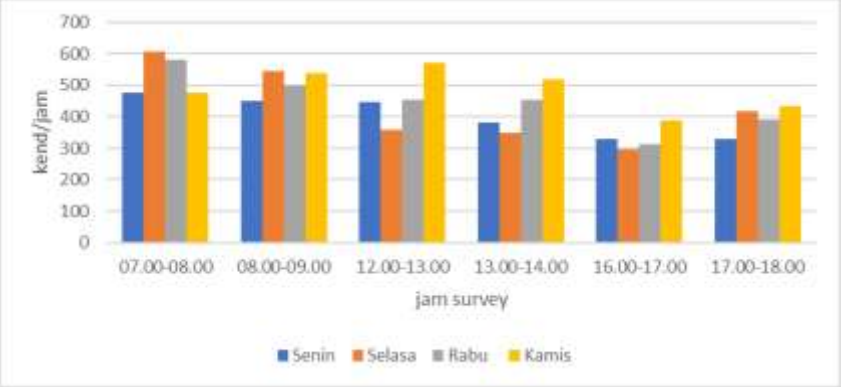

Figure 3. Traffic Volume

It can be seen in Figure 3 that the highest flow was on Tuesday at 07.00 WITA to 08.00 WITA, which was 386.5 pcu/hour or 607 vehicles/hour. The reason is that these hours are peak hours where most vehicles pass through the location because Jl. Landorundun is one of the roads commonly used by students going to school in the morning and people returning from activities at the market.

Traffic volume also has a high value on Thursday at 12.00 – 13.00 with a value of 380.8 pcu/hour, continuing at 13.00 – 14.00 WITA with a value of 356.2 pcu/hour. While the lowest traffic volume occurs on Tuesday at 16.00 – 17.00 WITA with a value of 189 pcu/hour.

Figure 4. Fluctuation of Traffic Volume (pcu/hour)

C. Side Friction

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PED (Pedestrian) is the number of pedestrians on Jl. Landorundun, PSV (Parking and Slow of Vehicles) is the number of vehicles that stop/park on Jl. Landorundun, EEV (Exit and Entry of Vehicles) is the number of all vehicles passing on Jl. Landorundun, and SMV (Slow Moving of Vehicles) is the number of 3-wheeled vehicles passing on Jl. Landorundun. The maximum total side frictions occurred on Tuesday with a total of 1189.4 events/hour, Tuesday was included in the very high friction (ST) class because the total events reached >900 events/hour.

Example of side obstacle event calculation

Total frequency = (PED x F. Weight) + (PSV x F. Weight) + (EEV x F. Weight) + (SMV x F. Weight)

= (358) + (214) + (547.4) + (70)

= 1189.4 events.

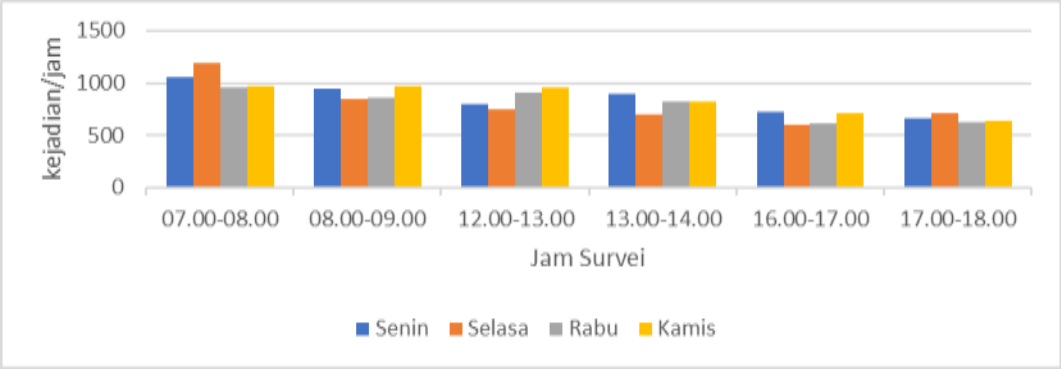

Figure 5. Side Friction Frequency

The highest side friction value was on Tuesday at 07.00 – 08.00 WITA with a value of 1189.4 events/hour. The high frequency of side friction also occurred on Thursday at 12.00 – 13.00 WITA with a value of 961.1 events/hour. The lowest frequency of side friction occurred on Tuesday at 16.00 – 17.00 WITA with a total of 596.2 events/hour.

D. Road Capacity

For one-way roads, the capacity (C0) on Jl. Landorundun is 1650 skr/hour. Based on the survey results, the lane width on Jl. Landorundun is 6.4 meters. However, due to activities around the shoulder of the road, it reduces the effectiveness of the road lane performance. The left shoulder of the road = 1.7 meters is used as a parking lot, so it is considered that there is no shoulder because of the activities around the shoulder of the road, as well as the right side of the road is used as a parking lot of 1.5 meters. Thus from the survey results obtained: The effective lane width is 6.4 m - 1.5 m = 4.9 m so that the adjustment factor due to the width of the lane is interpolated to 1.23. Because the size of the shoulder on the road is ≤ 0.5 m, the value for the adjustment factor due to side friction (FC_{HS}) is 0.73 for the Very High side friction e class (ST) and 0.82 for the High side friction class (T). City size <0.1 million population then the capacity adjustment factor related to city size (FC_{UK}) is 0.86.

The road segment capacity is calculated as follows

C = Co x FC_{LJ} x FC_{PA} x FC_{HS} x FC_{UK}

Co = 1650 pcu/hour

FC_{LJ} = 1.23

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FC_{PA} = 1

FC_{HS} = 0.73

FC_{UK} = 0786

C = 1650 x 1.23 x 1 x 0.73 x 0.86 = 1274.12 pcu/hour

E. Degree of Saturation

The degree of saturation according to PKJI 2014 is the result of dividing the traffic volume by the road capacity. The calculation of the degree of saturation is carried out on the day with the highest degree of saturation. On Tuesday, at 07.00 - 08.00 WITA, which is the busiest day and hour on the road with a saturation degree of 0.303 so that the performance service level is at point B. The highest degree of saturation on Jl. Landorundun ranged from 0303 on Tuesday at 07.00 – 08.00 WITA, while the lowest degree of saturation occurred on the same day at 16.00 - 17.00 WITA with a degree of saturation value of around 0.148. It can also be seen that the degree of saturation increased on Thursday at 12.00 – 13.00 WITA with a value of around 0.298, continuing on the same day at 13.00 – 14.00 WITA with a value of 0.279.

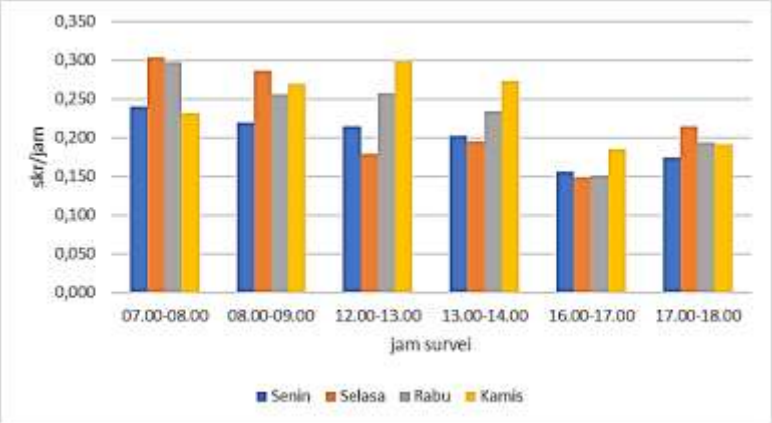

Figure 6. Degree of Saturation

The higher the value of side friction, the higher the degree of saturation. The higher the degree of saturation, the lower the road performance.

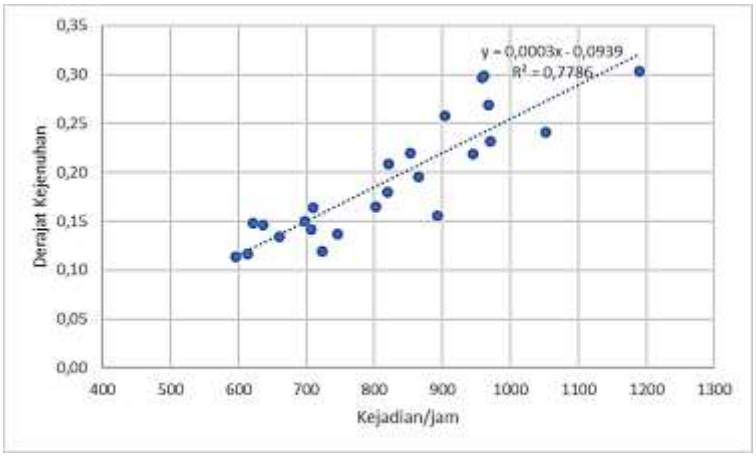

Figure 7. Relationship Between Side Friction and Degree of Saturation

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Some problems found at the research location are: the dominant type of side obstacles are PED (Pedestrian) or pedestrians and EEV (Exit and Entry of Vehicles) or vehicles entering and exiting Jl. Landorundun, resulting in decreased road performance. Vehicles were found going against the flow because there were no traffic signs. Sidewalks used by street vendors to sell. Therefore, the alternative solutions that can be proposed are: there should be no street vendor activity on the sidewalk or shoulder of the road that can reduce road capacity, and provide strict sanctions for violators of traffic signs, especially for road users who go against the flow because on Jl. Lamdorundun a one-way system has been implemented.

CONCLUSION

The decrease of vehicle speed on Jl. Landorundun is caused by high side friction. The higher the side friction, the higher the degree of saturation value. The higher the degree of saturation value, the lower the road performance. The highest side friction occurred on Tuesday with the Very High (ST) friction category, which was 1189.4 incidents/hour, due to market activities that occurred on the road section. The type of side friction that had the highest occurrence were pedestrians and vehicles entering and leaving Jl. Landorundun, therefore it is necessary to regulate street vendors who use the sidewalk as a place to sell and impose sanctions on road users who violate. It is hoped that in further research, a comparison can be made on the effect of side friction on non-market day conditions.

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