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THE PERFORMANCE OF QUEUE LENGTH OF VEHICLE ON THE ROUNDABOUT AT SELAMAT DATANG MONUMENT USING PTV VISSIM

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ABSTRACT

Traffic density or congestion in DKI Jakarta is an issue that difficult to resolved. In this study, an analysis of traffic congestion was carried out by looking at the length of the vehicle queue that occurred at the roundabout. PTV VISSIM performs simulations by entering vehicle volume data and others. The program also shows the results of projections for the next 5 years to find out the impact of traffic at the roundabout. The value of traffic growth per year is 1%. In analyzing the existing conditions using PTV VISSIM, calibration and validation are necessary. On the Jl. Thamrin N-S obtained a queue length of 461.69 m. For sections on Jl. Sudirman S-N is 482.13 m. For the queue length in the existing condition, projections are made for the next 5 years. After the projection, simulation comes with 2 alternatives, road widening and underpass. Based on the projections and alternatives made, the queue length can be obtained. Based on the analysis with these projections and alternatives, the alternative underpass for the queue length on Jl. Thamrin N-S is 0.0 m long and on Jl. Sudirman S-N is 356.20 m. On the Jl. Thamrin N-S is 407.10 m and on Jl. Sudirman S-N is 444.98 m.

Keywords: *queue length, projection, PTV VISSIM*

1. PRELIMINARY

Traffic jam is a serious problem in DKI Jakarta. It is because of the large number of private vehicles that carry out activities both for work and other activities. Density or congestion in DKI Jakarta is an issue that difficult to resolved. Traffic congestion is a condition where the traffic volume is greater than the road capacity. Traffic jams usually occur on roads that become the main access for community activities in a city. The increasing number of residents results in higher levels of activity and will directly increase movement in the area (Misdalena, 2019: 35). The density usually occurs at the roundabout at Selamat Datang monument. The congestion occurs because of critical conflicts over vehicle routes, resulting in high queues and delays. At the roundabout there was a conflict between vehicles with different interests, origins and destinations. Due to the problems, roundabout planning must be carefully planned, so not cause another problem, as queuing at traffic (Kartika, Syafaruddin, & Sumiyattinah, 2016). In this study, analysis of congestion was carried out by looking at the length of the queue that occurred at the roundabout. Queue length occurs due to the density of vehicles on the road segment. Long queues of vehicles can occur due to intersections, markets, or roundabouts. By looking at the length of the queue, it can be an indicator of congestion and make management or engineering to reduce the length of the queue on the road. To find out the queue length and the actual roundabout capacity, the VISSIM PTV program was used. PTV VISSIM performs a simulation by entering vehicle volume data and others to see results of delays and queue lengths. The program also shows the results of projections for the next 5 years to find out the impact of traffic at the roundabout.

2. THEORETICAL BASIS

Traffic Flow

According to MKJI, traffic flow is the number of traffic elements passing through an undisturbed point in the upstream, approaches per unit time (for example: vehicle traffic/hour; PCU/hour). The calculation can be done per hour for one or more periods. For example, based on traffic flow conditions (Q) for each movement, such as turning left, turning right and going straight, the conversion is carried out from vehicles per hour to passenger car units (PCU) per hour using the equivalent of passenger vehicles (EMP) for each shielded and countered approach. In this study, a review was carried out on delays and queue lengths. Delay is the waiting time for vehicles caused by traffic interactions which can be in the form of crossings, intersections or contradicting. The length of the queue is the length of the congestion due to the high volume of vehicles so that the speed is reduced or until it stops on the road segment.

Roundabout

Roundabout is a traffic rule in Indonesia with the condition of giving way to the left first. The roundabout is an alternative for traffic engineering or creating a monument in the area. The large intersections between roads, the closure of the area is thick and the safety of the roundabout decreases (Sumina, 2015: 3). The designed roundabout can be simulated according to the characteristics and the volume of vehicles that will cross the roundabout. This is to predict future conditions related to queue lengths and delays along the road. The definition of each roundabout used in MKJI is shown in the following table.

Table 1. Type of roundabout

Type	Radius (m)	Number of entry lanes	Widht of entry lanes W_1 (m)	Lenght of Road L_w (m)	Widht of Road W_w (m)
R10 – 11	10	1	3,5	23	7
R10 – 22	10	2	7,0	27	9

Type	Radius (m)	Number of entry lanes	Width of entry lanes W_1 (m)	Length of Road L_w (m)	Width of Road W_w (m)
R14 – 22	14	2	7,0	31	9
R20 – 22	20	2	7,0	43	9

Source: MKJI, 1997: 4-14

Strategy and Traffic Management

According to (Susilo, 2015), traffic management is described as the process of applying road system techniques to meet certain goals by improving, regulating or changing the use of existing road systems for some or all road users, without having to rely on new road construction. In the strategy and management scenarios are made to take advantage of existing conditions so that in the analysis one must look at the road network or other conditions such as ways to reduce the volume of vehicles by using local policies or increasing public transportation.

Growth Factor

In the Decree of the Director General (KEPDIRJEN) of Bina Marga in 2012 it is explained that the traffic growth factor is based on historical growth data or correlation formulas with other valid growth factors, if not available then the traffic growth factor estimate can be used as follows:

1. Arterial and urban roads with 5% growth for 2011-2020 and 4% for 2021-2030;
2. Rural Roads with growth of 3.5% for the years 2011-2020 and 2.5% for the years 2021-2030.

Based on the KEPDIRJEN above, the calculated average vehicle volume will be projected for the next 5 years with a traffic growth of 5%.

PTV VISSIM

According to (Aryandi & Munawar, 2014) in the proceedings entitled Use of Vissim Software for Signalized Intersection Analysis (Case Study: Mirota Interchange, Terban Campus Yogyakarta) Vissim is a software that can perform simulations for microscopic multi-modal traffic, public and pedestrian transportation, developed by PTV Planung Transport Verkehr AG in Karlsruhe, Germany. PTV is software that is used in the field of transportation to simulate traffic flow conditions and also alternative traffic which can be seen in 2D and 3D.

3. RESEARCH METHODOLOGY

In this study, various literatures were collected in accordance with the research conducted. This study also examines the performance of the roundabout at the Selamat Datang monument which at peak hours always experiences traffic jams. The purpose of this study is to see the length of the queue from the HI Roundabout and with forward projections to find out the performance of the roundabout at the Selamat Datang monument.

The surveys conducted geometric survey at roundabouts, a vehicle volume survey and a queue length survey. The secondary data used is a satellite map from Google Earth and the required supporting data. In collecting the primary data, the geometry of the roundabout is taken. For the volume of traffic, the calculation of the vehicles entering and leaving the roundabout at the welcome monument. The following are the research locations and survey points for vehicle volume collection.

Figure 1. Research Site map

In the picture above is the location of the team that count the volume of vehicles. Technical data collection is every 15 minutes by calculating the type of vehicle that passes. The vehicles reviewed are light vehicles, heavy vehicles and motorcycles.

The traffic volume survey that has been carried out, then the next stage is entered into the PTV VISSIM program for analysis on its existing condition. Data analysis was conducted to compare the existing condition with the projected condition for the next 5 years. With the projection for the next 5 years, the existing condition can be described in the traffic simulation at the roundabout. The projected existing condition requires an alternative to reduce traffic at the welcome monument roundabout.

4. RESULT AND DISCUSSION

The data that used in the VISSIM modeling is primary data. The survey was conducted to obtain primary data. The primary data is to count the number of vehicles entering and leaving the HI roundabout. The geometry of the HI roundabout is in the form of a measure of the width of the road at the roundabout including the roads entering the roundabout and exiting the roundabout. For geometrics obtained from direct observations in the field. The geometry in the HI roundabout is required for analysis using VISSIM. Here are geometric drawings to be included in the VISSIM PTV.

Figure 2. Geometry of the road at the HI Roundabout

Source: Modeling VISSIM, 2021

Analysis on Existing condition

Existing conditions that are carried out are to know the behavior and outputs of the VISSIM program so that they can be compared with alternatives. Existing conditions are displayed in the form of volume, speed, delay and queue length. In the VISSIM, existing conditions are required for calibration and validation. On the process of calibration and validation, change the driving behavior of the VISSIM program are necessary. The changes are shown in the following table.

Table 5. Calibration values used in VISSIM

No.	*Type of Driving Behavior*	Parameter of *Driving Behaviour*	Score	
			Default VISSIM	Calibration
1	*Car Following*	*Average standsill distance*	2 m	0.45 m
2		*Additive part of safety distance*	2 m	0.45 m
3		*Multiplicative part of safety distance*	3 m	1 m
4	*Lateral*	*Desired position at free flow*	*Middle of Lane*	*Any*
5		*Distance standing*	1 m	0.3 m

No.	*Type of Driving Behavior*	Parameter of *Driving Behaviour*	Score	
			Default VISSIM	Calibration
6		*Distance driving*	1 m	0.5 m

Source: Analysis, 2021

Driving behavior set to adapt the characteristics of drivers in Indonesia. With these characteristics, the results obtained are the same as the conditions in the field. After making changes to the Driving behavior, validation is needed to determine the validity of the output issued by VISSIM. Validation is carried out in the form of regression which is shown as follows.

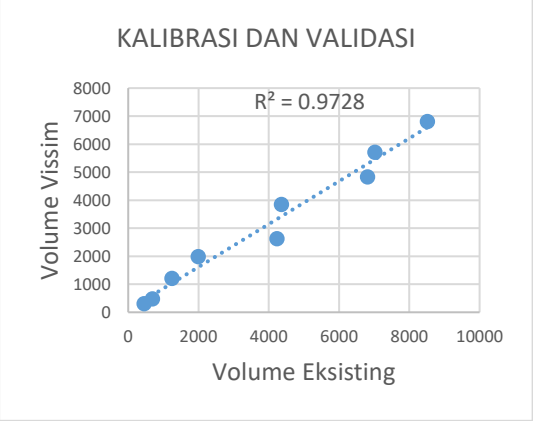

Figure 3. Validation of VISSIM model with regression (r^2)

Source: Analysis, 2021

Based on the output results in the existing conditions, the results for the queue length are shown in the table and graph as follows:

Table 7. Queue length calculation using VISSIM

No.	Line	Queue length (m)
1	Jl. Thamrin U-S	461.69
2	Jl. Sudirman S-U	482.13

Source: Analysis, 2021

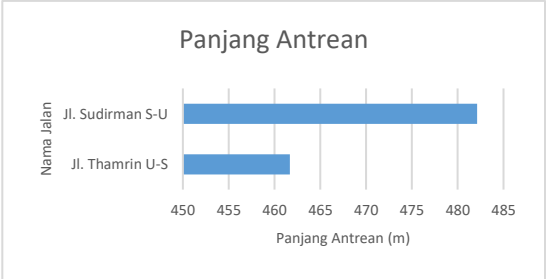

Figure 4. Graph of queue length in existing condition

In the queue length that occurs, it can be seen that for the Jl. Sudirman SU is higher than Jl. Thamrin N-S. The vehicle must intersect with Jl. Sudirman so that the length of the vehicle queue that occurs is higher on that road segment. In the existing condition, it can be concluded that the HI roundabout experiences high traffic density.

Projection Alternative Analysis

Based on the existing conditions, projections will be made for the next 5 years. Projections that are carried out directly provide an alternative to the research. This is to provide solutions and an overview of the consequences of the projections along with the alternatives to be analyzed. With these projections and alternatives, the best conditions can be seen in breaking down traffic density at that location. The technique for making projections is to assume traffic growth of 1% per year and make projections for the next 5 years. The proposed alternative is in the form of widening and underpass. The alternative for road widening and underpass is shown in the queue length table as follows.

Table 9. Result of queue length using VISSIM with road widening and underpass

No.	Line	Queue Length (m)	
		Widening	*Underpass*
1	Jl. Thamrin U-S	407.10	0.00
2	Jl. Sudirman S-U	444.98	356.20

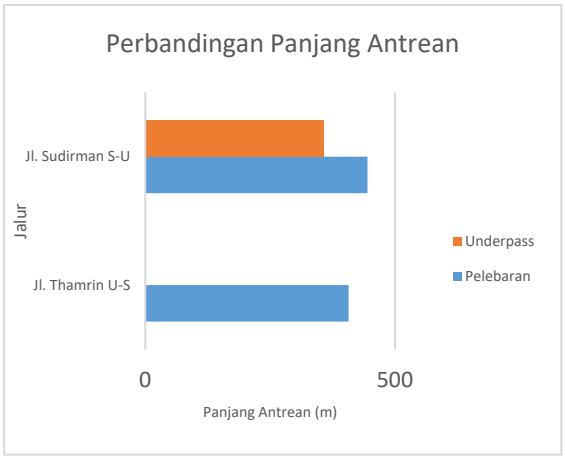

Figure 5. Queue length comparison graph

The queue length between road widening and underpass with 1% growth with projections for the next 5 years, shows queue length with underpass is good ones. There was no traffic jam in Jl. Thamrin because the vehicle had already passed the underpass. Jl. Sudirman is experiencing long queues due to vehicles from Jl. Sudirman which leads to Jl. Imam Bonjol had to wait for a vehicle from Jl. Thamrin with the result that long queues still occur.

The image of the road widening and underpass based on the VISSIM simulation as follows.

Figure 6. Road Widening Alternative

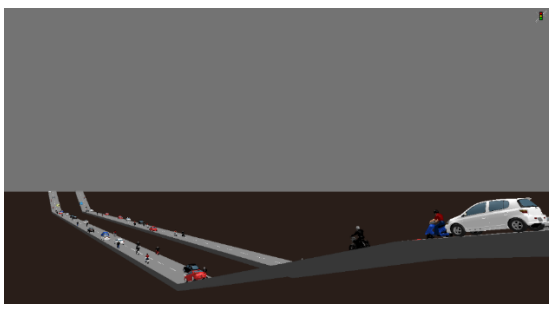

Figure 7. Underpass alternative

5. CONCLUSION

This research delivers several conclusions

1. In the existing condition, the queue length at the roundabout at the Selamat Datang monument on the Jl. Thamrin N-S is 461.69 m and on Jl. Sudirman SU is 482.13 m.
2. With projections for the next 5 years with vehicle growth of 1%, the queue length is obtained with an alternative underpass on the Jl. Thamrin N-S is 0.0 m and on Jl. Sudirman S-N is 356.20 m.
3. As an alternative, road widening along with the projection results, the queue length on the Jl. Thamrin N-S is 407.10 m and on Jl. Sudirman S-N is 444.98 m.
4. Jl. Sudirman is experiencing long queues due to vehicles from Jl. Sudirman which leads to Jl. Imam Bonjol had to wait for a vehicle from Jl. Thamrin with the result that long queues still occur.

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