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Performance Analysis of Sentul Circuit Roundabout and Alternatif Road Sentul Bogor

M Farid Alfarizi R, Muhammad Isradi, Amar Mufhidin, Widodo Budi Dermawan
Faculty of Engineering, Mercu Buana University Jakarta, Indonesia
isradi@mercubuana.ac.id, farid.alfarizir@gmail.com, amarmufhidin@gmail.com, wbdermawan@gmail.com

Andri Irfan Rifai
Faculty of Engineering and Planning, Batam International University, Indonesia
andri.irfan@uib.ac.id

Joewono Prasetijo
Centre of Excellence for Railway (ICoE-Rel), Universiti Tun Hussein Onn Malaysia
joewono@uthm.edu.my

Abstract

A roundabout is an intersection equipped with circular lanes and has a design specification and is equipped with traffic equipment. The various patterns of movement will intersect each other, causing conflict points at an intersection. This study aims to determine the performance of the Sentul circuit roundabout and the Sentul alternatif road segment. Traffic data was collected for 3 days using the 1997 MKJI method, then made a traffic simulation using the PTV Vissim.The results of the study showed that the highest traffic volume was on Tuesday, November 23, at: the 9725 pcu/hour roundabout and the alternatif sentul total 2 directions 7865 pcu/hour. Sentul circuit roundabout using MKJI 1997 obtained DS values for each link: weaving area 1 (0.81), weaving area 2 (0.81), weaving area 3 (0.86), weaving area 4 (0.77) and alternatif sentul roads: roundabout direction (0.41) , the direction of Bogor (0.45). PTV Vissim the level of service for the sentul circuit roundabout and the alternative sentul: Sentul circuit roundabout: weaving area 1 (e), weaving area 2 (d), weaving area 3 (c), weaving area 4 (f). section alternative sentul: roundabout direction (b) and Bogor direction (b). alternative solution for scenario 1 by restricting heavy vehicles (HV) during rush hour is obtained DS: link 1 (0.69), link 2 (0.64), link 3 (0.72), link 4 (0.62).

Keywords
MKJI 1997, PTV Vissim, Level of Service, Roundabout Performance

1. Introduction

Transportation problems cannot be separated from congestion, delays, and pollution generated from vehicles, both air and sound, which we often encounter every day in several big cities in Indonesia (Aryandi & Munawar, 2014) The most negative impact on road users are time loss, energy wastage, health problems due to vehicle pollution, to stress and a decrease in people's productivity in their activities. Bogor Regency based on the 2020 population census organized by the Badan Pusat Statistik (BPS), recorded a population of 5,427,068 people and for the number of public and non-public motorized vehicles, Bogor Regency is ranked first in Java, this makes Bogor Regency the district with the largest number of public and non-public motorized vehicles and the largest population in the province of West Java (Open Data, 2020). The Bogor Regency Government is implementing the City Beautification Project program to beautify the Cibinong Raya area as the capital of Bogor Regency. This construction is carried out starting from the Sentul International Circuit intersection to Jalan Raya Tegar Beriman. Intersection Sentul International circuit which originally had 2 intersections with 3 arms and 1 intersection with 4 arms was turned into a roundabout.

Human and goods travel needs arise due to the existence of human socio- economic life activities, such as demands for the fulfillment of the needs of goods (food, clothing, and shelter) as well as human needs for social activities (family and community relations) , and non-physical needs (studying, religious activities, recreation, visiting relatives, health activities such as to sports or hospitals) and other activities. (Isradi et al., 2020)

Laws No. 22 On Traffic and Road Transport, (Undang Undang No. 22, 2009), states that at intersections in the form of a roundabout, drivers must prioritize other vehicles coming from the right, which is a traffic

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provision that applies to intersections, with or without traffic lights. The purpose of determining the main rights at the intersection is regularity, clarity of who has the right to first use the road in order to improve traffic safety. Thus, the construction of the roundabout at the Sentul International Circuit intersection is expected to be a solution for time efficiency, traffic convenience, and the safety of road users. So that traffic can run well and as expected by road users.

Therefore, there is a need for research using traffic simulation with PTV Vissim software and Indonesian Highway Capacity Manual, 1997 to determine the degree of saturation (DS), queue length (QL), delays (D) that occur at Roundabouts and Jl. Alternatif Sentul.

2. Literature Review

Congestion has become a common problem and many ways have been done to find a solution. Several solutions to solve the congestion problem have been proposed by several institutions as well as researchers. Among them are by widening roads, adding traffic lanes, engineering one-way traffic circulation, restricting through road medians or barricades that limit turning flows, building fly-over, developing road management through intelligent transportation systems, providing sanctions for violators, and others. etc.. (Rifai et al., 2021)

Intersections are an integral part of all road systems. When driving in the city, people can see that most roads in urban areas usually have intersections, where the driver can decide to continue or turn and change roads. A intersection can be defined as a general area where two or more roads join or intersect, including roads and roadside facilities for the movement of traffic within them.

The purpose of making an intersection is to reduce the potential for conflict between vehicles (including pedestrians) and at the same time provide maximum comfort and ease of movement for vehicles (Khisty, C. J. & Lall, 2005)

In general there are 2 types of intersections:

1. Intersection at Grade
   Intersection at grade is an intersection where two or more roads join in one section, with each road leading out of an intersection. (Khisty, C. J. & Lall, 2005)
2. Interchange
   Interchange is when a traffic lane or road is raised above another road through the use of a bridge or tunnel. This will eliminate conflicts and reduce the volume of traffic in the area and will reduce barriers

Based on Directorate General of Bina Marga, 1997, Weaving is the intersection of two or more traffic flows moving in one direction on a road segment. Where the traffic flow will occur merging, crossing and diverging movements.

According to (Departemen Permukiman Dan Prasaranan Wilayah, 2004) a roundabout is an intersection equipped with circular lanes and has a design specification and is equipped with traffic equipment. The various patterns of movement will intersect each other, causing conflict points at an intersection. The change from signalized or unsignalized intersections to roundabouts can also be based on traffic safety, to reduce the number of traffic accidents between intersecting vehicles. Roundabouts have the advantage of reducing the speed of all intersecting vehicles, and making them aware of the risk of conflict with other vehicles.

3. Research Methodology

The process of conducting research must be carried out with proper and precise analysis. A good analysis requires complete and accurate data or information, as well as a solid foundation. Primary data was obtained by involving the active participation of researchers. Usually, primary data is collected through survey activities, observations, experiments, questionnaires, personal interviews and other media used to obtain field data. This data includes geometric roundabouts and road sections, traffic volume, and environmental conditions around the location obtained by conducting a field survey. (Trilaksono et al., 2019). The time chosen for obtained a traffic survey is during peak hours, In the morning 07.00-09.00 WIB, noon 12.00-13.00 WIB and afternoon 16.00-18.00 WIB. For 3 days on Tuesday, Thursday and Sunday. This secondary data can usually be obtained through books, government publications, internal organization records, reports, journals, to various websites related to the information being searched. This data includes population data and location maps (Pamusti et al., 2017).

The map of the research location can be seen in Figure 1.

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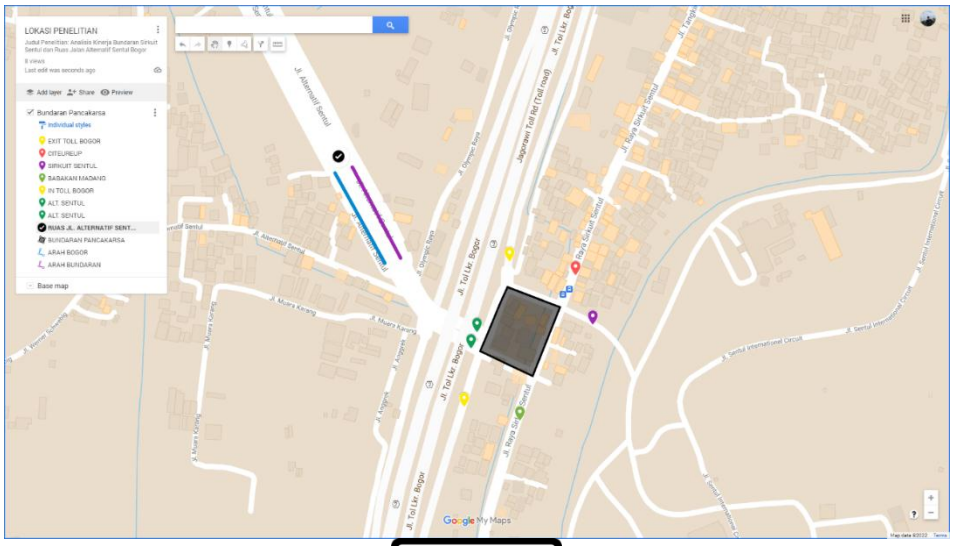

SCAN ME

Figure 1. Research Location

Data processing and analysis is carried out based on the required data and grouped according to the identification of the problem objectives, resulting in an effective and structured solution analysis. The analysis carried out for roundabouts is as follows: Preliminary survey, in order to obtain data on traffic volume, road geometry, environmental conditions. Input traffic condition data, geometric, environmental conditions. Calculating traffic volume. Specifies the geometric parameters of the braid section. Calculate the basic capacity with the help of the drawings in MKJI 1997. Determine the adjustment factor to calculate the capacity of the braided section, namely the adjustment factor for city size, environmental type, side barriers and non-motorised vehicles. After getting the capacity of the existing condition, calculate the performance of the road. Calculate the degree of saturation. Calculating the delay of the circular section of the weaving area. Calculates the probability of queuing for the circular section of the circle and determines Level Of Service (LOS) roads.(Pamusti et al., 2017)

The following are the steps in the sequence of data analysis using PTV Vissim:

Data Primary data and those obtained through field surveys were analyzed. Input secondary data, namely the location map into the software Vissim. The location map serves as a background and description of conditions in the field. Making models link first in order to make connectors. Determine the type of vehicle on2D/3D Models, add and customize the type of vehicle on the Vehicle Types and also Vehicle Classes, set the speed of each vehicle on Desired Speed Distribution, then set Vehicle Compositions in order to display the type of vehicle as desired. Primary data input is the number of vehicle volumes and vehicle composition into the software Vissim. Determine the route of travel on Static Vehicle Routing Decisions. Setting the conflict area or point on the menu Conflict Areas. Select the type of evaluation type and run the simulation. Calibrate using the trial and error method to achieve results that are close to the observation data. Driver behavior parameter values (driving behavior) is changed in accordance with the estimated conditions in the applicable field. Repeating step 8 until the results obtained are close to the results of observations in the field (Ulfah, 2013)

4. Result and Analysis

4.1 Roundabout Traffic Volume

Survey the roundabout using an Action Cam which was recorded for 15 minutes, from a high place to get a good spot for counting. The results of calculations that have been recapitulated during peak hours can be seen on Figure 2.

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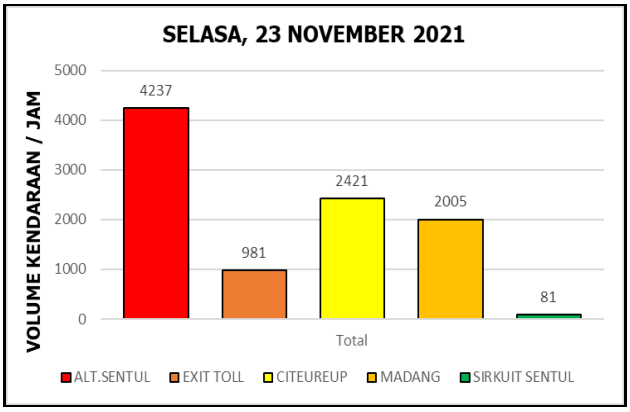

Figure 2. Roundabout Traffic Volume Recapitulation

4.2 Kinerja Bundaran Sirkuit Internasional Sentul

The geometry of roundabout can be seen Figure 3.

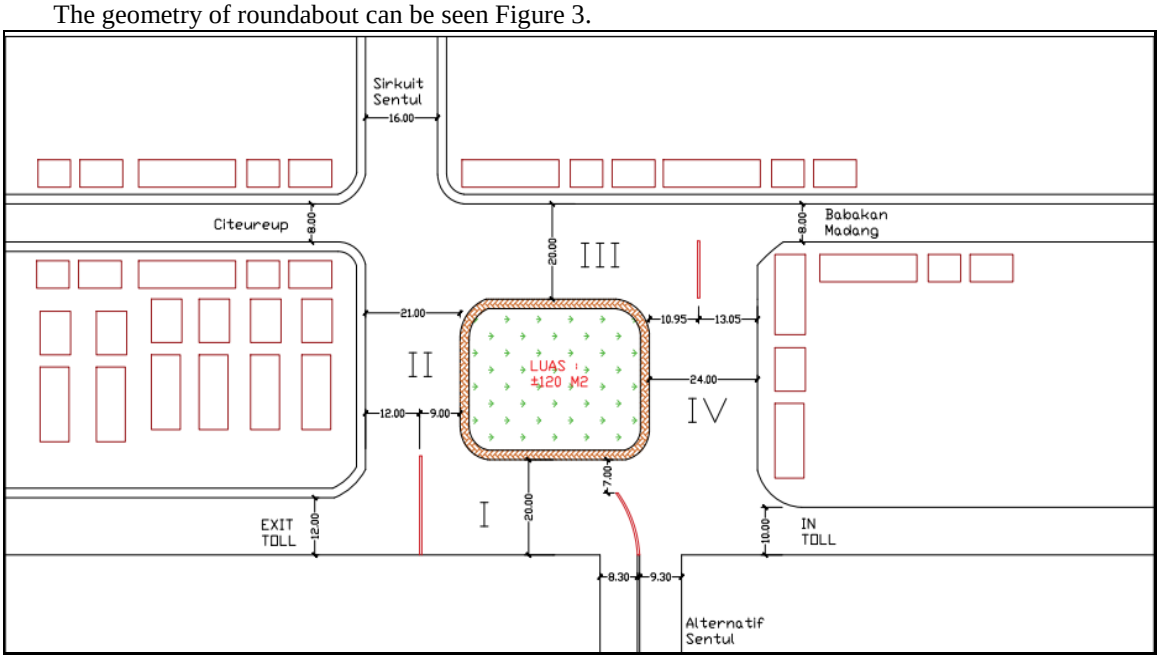

Figure 3. Geometrik Bundaran

1. Capacity of Sentul International Circuit Roundabout

Based on Figure 3, the results for geometric factors using (General Bina Marga, 1997) can be obtained, the values for the geometric parameters of roundabouts can be seen in Table 1.

Table 1. Roundabout Geometry

No	Weaving Area	Entry Width		Average Entry Width	Width Weaving Area	W_E/W_w	Length Weaving Area	W_w/L_w
		Approach 1 W1	Approach 2 W2	W_E	W_w		L_W	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	I - ALT.SENTUL	8,3	7	7,7	20	0,38	35	0,57
2	II - EXIT TOLL	12	9	10,5	21	0,50	29	0,72
3	III - SIRKUIT	8	9	8,5	20	0,43	40	0,50
4	IV - MADANG	13,05	10,95	12,0	24	0,50	37	0,65

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The recapitulation of the calculation of the capacity of each section of the weaving area can be seen in Table 2. The calculation of the capacity of the roundabout can be calculated as in Equation 1:

$$C = 135 \times Ww^{1,3} \times (1 + W_E/Ww)^{1,5} \times (1 - Pw/3)^{0,5} \times (1 + Ww/Lw)^{-1,8} \times F_{CS} \times F_{RSU} \quad (1)$$
$$C = 135 \times 20^{1,3} \times (1 + 0.38)^{1,5} \times (1 - 0.771/3)^{0,5} \times (1 + 0.57)^{-1,8} \times 1.05 \times 0.94 = 4066 \text{ pcu/hour}$$

Table 2. Roundabout Capacity

No	Weaving Area	Factor W_w	Factor W_E/W	Factor P_w	Factor-W_w/L_w	Basic Capacity Co pcu/hour	Factor City Size Adjustment F_{CS}	Circum stance F_{RSU}	Capacity C pcu/hour
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	I	6632	1,626	0,86	0,44	4119	1,05	0,94	4066
2	II	7067	1,837	0,92	0,38	4500	1,05	0,94	4442
3	III	6632	1,701	0,91	0,48	4960	1,05	0,94	4896
4	IV	8406	1,837	0,86	0,41	5388	1,05	0,94	5318

Based on Table 2, it can be calculated the level of road service and recapitulation from the analysis of the degree of saturation, delays and the level of road service (LOS) can be seen in Table 3. The calculation of the degree of saturation can be calculated Equation 2 and delay Equation 3:

$$DS = Q/C \quad (2)$$
$$DS = 3312 / 4066 = 0.81$$

Because the obtained DS> 0.6, then the formula used:

$$DT = 1 / (0,59186-(0,52525 \times DS)) - (1-DS) \times 2 \quad (3)$$

Weaving area I is known to have DS = 0,81, then:

$$DT1 = 1 / (0,59186-(0,52525 \times 0,81)) - (1-0,81) \times 2 = 5,73 \text{ Sec/pcu}$$

Table 3. Derajat Kejenuhan

Weaving Area	Traffic Flow Weaving Q pcu/hour	Capacity C pcu/hour	Degree of Saturation DS	Delay DT Sec/pcu	Level of Service/ LOS
(1)	(2)	(3)	(4)	(5)	(6)
I	3312	4066	0,81	5,73	D
II	3599	4442	0,81	5,63	D
III	4234	4896	0,86	7,00	E
IV	4091	5324	0,77	4,85	D

The degree of saturation with a value of 0.81 is at 0.70 – 0.84, then the level of service is D.

Level of Service “D” means the flow is unstable, where almost all drivers are limited in speed, the traffic volume is almost close to road capacity but still acceptable. Level of Service "E” means the traffic volume is approaching or at its capacity, the flow is unstable and often stops.

4.3 Traffic Volume Alternatif Sentul Road

Survey the traffic volume using an Hand Tally Counter which was for 15 minutes, The results of calculations that have been recapitulated during peak hours can be seen on Figure 4.

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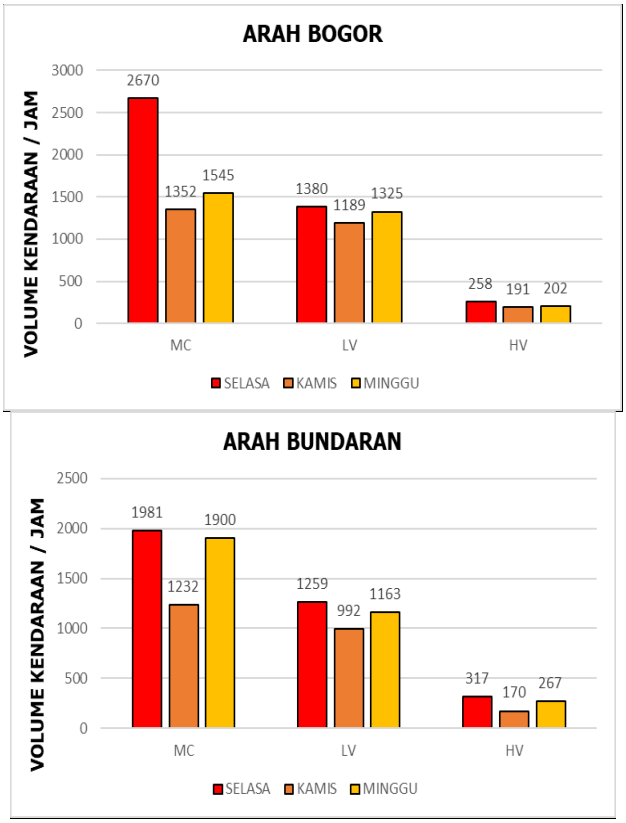

Figure 4. Alternatif Sentul Road Traffic Volume Recapitulation

4.4 Performance of Alternatif Sentul Road

The geometry of Alternatif Sentul can be seen Figure 5.

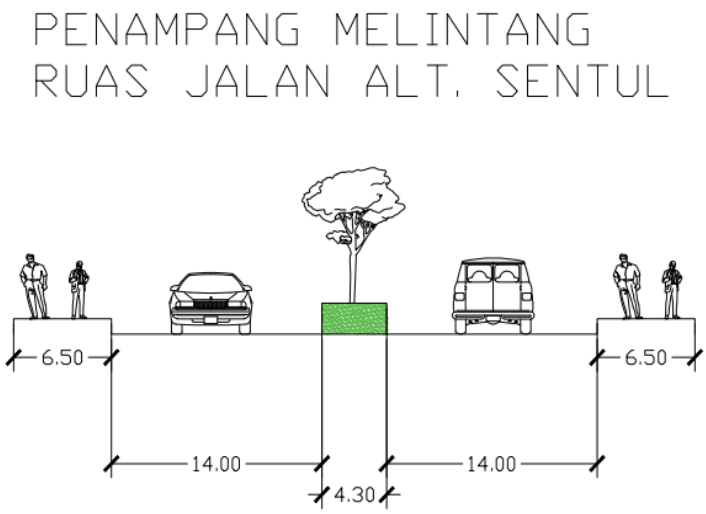

Figure 5. Geometrik Ruas Jalan

1. Capacity of Alternatif Sentul Road

Jl. Alternatif Sentul is a 6 Lane 2 Way road with a median (6/2D), with Medium side barriers which means it is an industrial area with shops on the side of the road and city size > 3 million.

The recapitulation of the calculation of the capacity of Alternatif Sentul can be seen in Table 2. The calculation of the capacity of the roundabout can be calculated as in Equation 1:

$$C = C_O \times F_{CW} \times FC_{SP} \times FC_{SF} \times FC_{CS} \ldots \quad (4)$$

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C = 4950 x 1.08 x 1 x 0.94 x 1.04 = 5248 pcu/hour

Table 4. Road Segment Capacity

Direction	Basic Capacity Co	Adjustment Factor for Capacity				Capacity
		Lane Width	Separation Direction	Circum stance	City Size	C
	Pcu/hour	F_{CW}	FC_{SP}	FC_{SF}	FC_{CS}	Pcu/hour
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bogor	4950	1,08	1	0,944	1,04	5248,49
Bundaran	4950	1,08	1	0,944	1,04	5248,49

Based on Table 4, it can be calculated the level of road service and recapitulation from the analysis of the degree of saturation, speed and the level of road service (LOS) can be seen in Table 5. The calculation of the degree of saturation Equation 3:

DS = Q/C (5)
DS = 2351 / 5248 = 0.45

Table 5. Degree of Saturation

Direction	Traffic Flow Q	Degree of Saturation DS	Speed	Level Of Service LOS
	Pcu/hour		km/jam	
(1)	(2)	(3)	(4)	(5)
Bogor	2351	0,45	43	C
Bundaran	2135	0,41	40	B

Level of Service "B" means In the steady flow zone, the driver has sufficient space to switch motion (maneuver) Level of Service "C" means that in this zone the stable flow of the driver is limited in having speed

4.5 PTV VISSIM

Traffic simulation modeling using PTV Vissim student version software, requires data such as geometric data, peak hour traffic flow data, vehicle speed and a map of the research location. The resulting output is in the form of a performance or operational intersection. In carrying out traffic simulations in Vissim, calibration is needed for accurate results so that they are similar to existing conditions. (Putri & Irawan, 2015)

Calibrate on vissim is the process of forming the appropriate parameter values so that the model can replicate the traffic to the closest possible conditions. The calibration process can be carried out based on the behavior of the driver of the observed area. The method used is trial and error with reference to previous studies regarding calibration and validation using Vissim. Validate on Vissim is the process of testing the correctness of the calibration by comparing the results of observations and simulation results. The validation process is carried out based on the amount of traffic flow volume and queue length. he method used is to use the basic formula *Chi-squared* in the form of statistical formulas *Geoffrey E. Havers (GEH)* (Ulfah, 2013)

The validation calculation can be seen in equation 6.

$$GEH=(qsimulated-q\ observed)20.5\ x\ (qsimulated+q\ observed) \quad \textbf{(6)}$$

dimana :
qsimulated = Modeling Traffic Flow Volume (veh/hour)
qobserved = Existing Traffic Flow Volume (veh/hour)

1. Simulation Result of Sentul International Circuit Roundabout

The results of the performance analysis Sentul Intenational Circuit Roundabout using PTV Vissim 21 can be seen in Table 6 and the comparison can be seen in Table 7.

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Table 6. Result Simulation PTV Vissim Roundabout

Weaving Area	Qlen Max	Delay	LOS
I	103,34	42,60	E
II	194,01	29,72	D
III	160,39	15,09	C
IV	119,23	124,61	F

Table 7. Comparison MKJI 1997 dan *PTV Vissim* Roundabout

Weaving Area	MKJI 1997			*PTV VISSIM*		
	Queue	*Delay*	*LOS*	*Qlen Max*	*Delay*	*LOS*
I	44-19	5,73	D	103,34	42,6	E
II	43-19	5,63	D	194,01	29,72	D
III	52-23	7	E	160,39	15,09	C
IV	37-16	4,85	D	119,23	124,61	F

The significant difference in delay is due to differences in the characteristics of PTV Vissim and (MKJI, 1997b)in the analysis, and there are also differences in parameters to determine LOS at intersections, where in (MKJI, 1997a) LOS is determined based on the degree of saturation (DS) and for PTV Vissim is determined based on delay which refers to on HCM 2000 (Board & R., 2000).

2. Simulation Result of Alternatif Sentul Road

The results of the performance analysis Alterntif Sentul road using PTV Vissim 21 can be seen in Table 8 and the comparison can be seen in Table 9

Table 8. Result Simulation PTV Vissim Roundabout Alternatif Sentul Road

No.	Direction	*DELAY*	*SPEED*	*VOLUME*	*LOS*
1	Bundaran	4,86%	45,57	3637,17	B
2	Bogor	3,31%	45,65	4245,11	B

Table 9. Comparison MKJI 1997 dan PTV Vissim Alternatif Sentul Road

No.	Direction	MKJI 1997			*PTV VISSIM*			Validasi GEH	DESC.
		SPEED	*VOLUME*	*LOS*	*SPEED*	*VOLUME*	*LOS*		
1	Bundaran	40	3557	B	45,57	3637,17	B	1,333	Approved
2	Bogor	43	4308	C	45,65	4245,11	B	0,963	Approved

4.6 Roundabout Alternative Solution

Scenario 1:

Diversion of operating hours for heavy vehicles (HV) during peak hours at 06.00 - 08.00 WIB and 16.00 - 18.00 WIB. The purpose of this traffic regulation is to improve services by reducing traffic delays at the roundabout because of the large number of heavy vehicles (HV) maneuvering for weaving, blocking the approach so that it closes the lane of vehicles that want to pass. By diverting heavy vehicle operating hours (HV) during peak hours, it can improve road service at the Sentul circuit roundabout and also improve driver safety, the results can be seen in Table 10.

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Table 10. Scenario 1 Sentul International Circuit Roundabout

Weaving Area	Traffic Flow Weaving (Q) pcu/hour	Capacity (C) pcu/hour	Degree of Saturation (DS)	Delay (Sec/pcu)	LOS
I	2825	4101	0,69	3,72	C
II	2837	4451	0,64	3,17	C
III	3517	4851	0,72	4,19	D
IV	3305	5335	0,62	2,99	C

5. Conclusion

Based on the results of the analysis, it can be concluded:

1. Based on the results of a traffic survey for 3 days at 07.00 – 09.00, 12.00 – 13.00, and 16.00 – 18.00 Wib. The highest traffic volume was found on Tuesday, November 23 from 16.00 – 18.00 WIB : Roundabout 9725 Veh/hour and Alternatif Sentul Road 2 directions 7865 Veh/hour.
2. Sentul International Circuit Roundabout using the MKJI 1997 obtained DS values for each weaving area: Weaving Area 1 (0.81), Weaving Area 2 (0.81), Weaving Area 3 (0.86), Weaving Area 4 (0.77). So, for the level of road service, it is categorized: Weaving Area 1 (D), Weaving Area 2 (D), Weaving Area 3 (E), Weaving Area 4 (D). And Sentul Alternatif Roads: Direction Roundabout (0.41), Direction Bogor (0.45). Then the Road level of service is categorized: Direction Roundabout (B) and Direction Bogor (C).
3. The results of the simulation software with PTV Vissim obtained the Service Level for the Sentul International Circuit Roundabout and the Alternatif Sentul: Sentul International Circuit Roundabout: Weaving Area 1 (E), Weaving Area 2 (D), Weaving Area 3 (C), Weaving Area 4 (F). and Alternatif Sentul Road: Direction Roundabout (B) and Direction Bogor (B).
4. The results of scenario 1 by restricting heavy vehicles (HV) at peak hour obtained DS: Weaving Area 1 (0.69), Weaving Area 2 (0.64), Weaving Area (0.72), Weaving Area (0.62). Then the level of service is categorized: Weaving Area 1 (C), Weaving Area 2 (C), Weaving Area 3 (D), Weaving Area 4 (C).

References

Board, & R., N. R. C. (U. S.). T. (2000). Highway Capacity Manual. *In National Research Council, Washington, DC*.

Departemen Permukiman Dan Prasaranan Wilayah. (2004). *Perencanaan Bundaran Untuk Persimpangan Sebidang*.

General Bina Marga, D. (1997, February 25). *Highway Capacity Manual Project (HCM)." Indonesian Road Capacity Manual (MKJI)*. PT Bina Karya. https://www.slideshare.net/MiraPemayun/mkji-manual-kapasitas-jalan-indonesia

Isradi, M., Retnaningtyas, P., Sumiyati, Hidayat, A., & Indriany, S. (2020). Analysis of The Impact of Traffic Development Apartment. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, *August*, 3593–3599.

Khisty, C. J., & Lall, B. K. (2005). *Transportation Engineering an Introduction 3rd Edition*.

MKJI. (1997a). *Indonesian Road Capacity Manual (MKJI)*. Public Works Department.

MKJI. (1997b). *Manual Kapasitas Jalan Indonesia (MKJI)*. Departemen Pekerjaan Umum.

Open Data. (2020). *Data Pengunjung Museum Menurut Jenis Museum di Provinsi DKI Jakarta*. https://data.jakarta.go.id/dataset/pengunjungmuseummenurutjenismuseum%0Adkijakarta

Pamusti, G., Herman, & Maulana, A. (2017). Kinerja Simpang Jalan Jakarta-Jalan Supratman Kota Bandung dengan Metode MKJI 1997 dan Software PTV Vissim 9. *Reka Racana*, *3*(3), 52–62.

Putri, N. H., & Irawan, M. Z. (2015). Mikrosimulasi Mixed Traffic Pada Simpang Bersinyal Dengan Perangkat Lunak Vissim. *The 18th FSTPT International Symposium*.

Rifai, A. I., Surgiarti, A., Y., Isradi, M., & Mufhidin, A. (2021). Analysis of Road Performance and the impact of Development in Pasar Minggu, Jakarta (Case Study of Jalan Lenteng Agung - Tanjung Barat). *ADRI International Journal of Civil Engineering*, *6*(1), 68–74.

Trilaksono, A., Suyono, R. S., & Azwansyah, H. (2019). Evaluasi dan Perencanaan Bundaran Jalan Syahrir-Jalan Selayar-Jalan Prof M Yamin-Jalan Dr Sutomo Dengan Menggunakan Simulasi Vissim. *Universitas Tanjungpura Pontianak*, 1–11.

Ulfah, M. (2013). Mikrosimulasi Lalu Lintas Pada Simpang Tiga Dengan Software Vissim. *Journal of Chemical Information and Modeling*, *01*(01), 1689–1699.

Undang Undang No. 22. (2009). *Tentang Lalu Lintas Dan Angkutan Jalan*. *3*.

Biography

Muhammad Isradi., born in Kandangan on 18 August 1972. He is the secretary of the Civil Engineering department at Mercu Buana University. He earned a degree in Civil Engineering from Universitas Muhammadiyah Malang in 1998 with the thesis entitled "One-Way Flat Plate Planning at Ratu Plaza Madiun. He then obtained a Master's degree in Civil Engineering, Transportation Concentration from Brawijaya University in 2001 with a thesis entitled "Family Movement Awakening Model in Sawojajar Housing Area, Malang". He also teaches several subjects such as Pavement Planning, Geometric Road Planning, Transportation Planning and Environmental Engineering.

M Farid Alfarizi R, born in Bogor 08 December 1999. He was an Assistant Lecture in Building Materials and Alternate Materials, and he has won bronze medal on international concrete competition in Germany 2019. He will achieve a Bachelor's degree in Civil Engineering at Mercu Buana University in 2022.

Amar Mufhidin., born in Majalengka, 16 June 1991. He is a lecturer in several study programs: pavement planning, road geometric planning, and transportation planning. He gained a degree in Civil Engineering from Universitas Pendidikan Indonesia and a Masters in Civil Engineering with a concentration in the field of transportation from Institut Teknologi Bandung. He has a pavement expertise certificate from the Indonesia's Construction Services Regulatory Agency. He is also still active in road planning projects in Indonesia.

Widodo Budi Dermawan, born on 2 July 1970. Universitas Katolik Parahyangan 1994, Fuel Filling System at Soekarno Hatta Airport, MSCE, 1996 University of Wisconsin at Madison. Track-based multi-class dynamic traffic assignment model, road safety interest research, accident prediction model, intelligent transportation system, teaching at UMB; Transportation Engineering, Geometric Design.

Dr.-Ing. Joewono Prasetijo, born in Pontianak, 18 October 1969. He gained an Engineer degree in Civil Engineering at Tanjungpura University, Pontianak, Indonesia in 1993. He then obtained a Master of Science degree in Road and Transportation Engineering from Delft University of Technology, Netherlands in 1996. He obtained his Doctor Ingenieur degree from Ruhr-Universität Bochum, Germany in 1996. Now, he is Head of Industry - Centre of Excellence for Railway (ICoE-Rel), Universiti Tun Hussein Onn Malaysia.

Andri Irfan Rifai. is a Senior Lecturer of Civil Engineering and Planning. He completed the PhD at the Universitas Indonesia & Universidade do Minho with Sandwich Program Scholarship from the Directorate General of Higher Education and LPDP scholarship. He has been teaching for more than 19 years and much active in applying his knowledge in Indonesia's project construction. His research interest ranges from the pavement management system to advanced data mining techniques for transportation engineering. He has published more than 50 papers in journals and 2 books