Microscopic Analysis of Traffic Performance due to the Construction of LRT Phase 1B Velodrome-Manggarai Zone 2

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Abstract. The construction of Jakarta's LRT Phase 1B aims to reduce urban traffic congestion; however, during its implementation phase, it has caused significant traffic disruptions in surrounding areas. This study aims to evaluate the impact of construction activities on traffic performance and to explore alternative solutions to improve the Level of Service (LOS). The analysis was conducted using the Indonesian Highway Capacity Manual (PKJI) 2023 and microsimulation modeling with PTV VISSIM software. The model was calibrated based on driving behavior parameters and Origin-Destination (O-D) Matrix data, and validated using statistical indicators such as GEH and Mean Absolute Percentage Error (MAPE). The results show that two out of eight observed road segments—Jalan Sultan Agung (DS = 0.973; LOS = E), categorized as directly affected, and Jalan Payakumbuh (DS = 1.073; LOS = F), categorized as indirectly affected—do not meet the minimum service level standard defined by the Ministry of Transportation Regulation KM 14 Year 2006. The calibrated model produced GEH<5 and MAPE<15%, indicating a high degree of accuracy in representing actual conditions. Scenario development, which involved implementing a One-Way System (Sistem Satu Arah/SSA) on Jalan Payakumbuh and redistributing traffic flows based on destination zones, successfully improved network performance. LOS improved to C on Jalan Sultan Agung (Segment B) and to B on Jalan Payakumbuh. The findings of this study are expected to serve as a technical reference for mitigating traffic impacts during construction and for planning more adaptive traffic management strategies.

Keywords: Traffic Performance, Model Calibration, Microsimulation, Origin-Destination Matrix, Jakarta LRT Phase 1B.

1. Introduction

Traffic congestion is a major challenge in megacities like Jakarta, where a high dependence on private vehicles contributes to an average annual travel delay of 89 hours per person in 2024 [1]. These delays are caused by the high population and the fast growth of vehicle numbers, which increase faster than the supply of roads [2]. To solve the traffic congestion problem, the Provincial Government of DKI Jakarta has taken steps to provide and improve public transportation services [3]. One of the public transport projects currently under construction to improve accessibility and support sustainable transportation is the Light Rail Transit (LRT) system [4]. Right now, the government is building Jakarta LRT Phase 1B to improve transport integration at Manggarai Station and to support it as a central station [5].

However, the construction of Jakarta LRT Phase 1B affects traffic performance in the surrounding area, both during construction and after the system starts operating. The project is being built on a main road that connects East–North Jakarta with Central–South Jakarta [5]. Because of the construction, Jalan Sultan Agung has become narrower and only allows one lane, which causes traffic jams near the Pasar Rumput area [6]. Previous studies have examined the impact of large infrastructure

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developments on traffic performance, showing that construction works often lead to reduced levels of service, longer travel times, and increased delays due to lane narrowing [31] [32]. Nevertheless, limited research has specifically evaluated indirectly affected roads surrounding construction zones, particularly in complex urban environments such as Manggarai. This research seeks to address that gap by evaluating the operational performance of roads indirectly influenced by the Jakarta LRT Phase 1B project.

This study aims to analyze the traffic performance on roads that are indirectly affected by the project using the 2023 Indonesian Highway Capacity Guidelines (PKJI 2023) and microscopic simulation with PTV VISSIM software. The VISSIM model was calibrated in detail using the Wiedemann 74 model and local field data to ensure realistic validation of existing conditions. In addition, this study explores an innovative one-way system (SSA) scenario to optimize traffic performance during the construction phase. The originality of this study lies in the integration of PKJI 2023 with PTV VISSIM to determine the Level of Service (LOS) for each road segment by combining capacity values (C) from PKJI calculations with traffic volumes (V) obtained from microscopic simulations. The findings are expected to identify key congestion points and propose effective management strategies to improve traffic flow and service levels during construction.

2. Materials and Methods

1. Materials

The research variables used in this study are based on literature and the required data. These variables consist of independent variables and a dependent variable. The dependent variable observed in this study is traffic performance, which is measured by the degree of saturation and level of service. The independent variables that affect the dependent variable include traffic volume and flow, vehicle speed, road geometry conditions, and driving behavior [7] [8].

Data Sources. The data utilized in this study consists of both primary and secondary sources. Primary data was gathered through direct field surveys, covering aspects such as traffic volume and vehicle speed. Meanwhile, secondary data comprises previously available information relevant to the research, obtained from literature reviews and LRT Phase 1B Traffic Impact Analysis (ANDALALIN) [9].

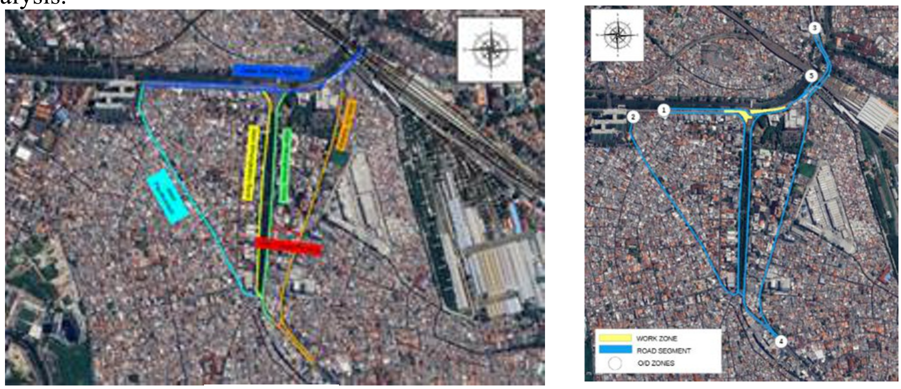
Table 1. Data Sources

No.	Data Type	Data Description	Data Category	Sources
1	Traffic Flow and Volume	Number of vehicles entering and exiting the observed road segments	Primary	Traffic Counting Survey
2	Road Geometry Data	Road width, shoulder width, median width	Primary	Direct Measurement, Google Earth
3	Road Condition	Side friction along the road and land use conditions	Primary	Visual Observation
4	Vehicle Speed	Travel time and travel distance	Primary	Spot Speed Survey
5	Vehicle Composition	Vehicle types: Light Vehicle (LV), Motorcycle (MC), Heavy Vehicle (HV)	Primary	Traffic Counting Survey
6	Traffic Peak Hour	The highest traffic volume recorded during specific times on the observed road segments	Primary	Traffic Counting Survey

No.	Data Type	Data Description	Data Category	Sources
7	Map of the LRT Phase 1B Construction Area	Map of the LRT Phase 1B Construction Areauas jalan dan kondisi tata kota di area sekitar pembangunan LRT Fase 1B	Secondary	Google Maps, LRT Phase 1B Traffic Impact Analysis (ANDALALIN)

Software and Tools. This study uses modeling through software, PTV VISSIM, as part of the traffic simulation process. Traffic simulation based on transportation modeling is an effective approach to analyze traffic operations because it produces outputs that are relatively close to real-world conditions. VISSIM is a stochastic, time-step, microscopic simulation software package developed by PTV AG, Germany [10]. It operates using four different vehicle behavior models developed by Wiedemann: (a) car-following, (b) lane changing, (c) lateral behavior, and (d) following [11]. The use of simulation software is especially useful when developing scenarios to optimize traffic conditions.

Study Area. This study was conducted in the area of the Jakarta LRT Phase 1B construction project, located in the Manggarai area and focuses on analyzing the impact of the construction on surrounding road segments that are not directly affected by the project. In this study, the observation area is divided into five (5) zones, based on the research boundary and the locations where vehicles enter and exit the area. The boundary of the study area includes road segments around the construction site of LRT Phase 1B Zone 2, which are affected by traffic management measures implemented by the Jakarta Transportation Agency. **Fig. 1** illustrates the study area surrounding the Jakarta LRT Phase 1B construction site in Velodrome–Manggarai Zone 2. **Fig. 1(a)** shows the project location and main observed roads, while **Fig. 1(b)** presents the division into five O/D zones. Road that are directly affected by the construction, namely Jalan Sultan Agung, as well as road segments that are indirectly affected, including Jalan Payakumbuh, Jalan Minangkabau Timur, Jalan Minangkabau Barat, Jalan Padang Panjang, and Jalan Dr. Saharjo. These roads are divided into 16 individual segments for analysis.



(a) **(b)**

(c)

Fig. 1. (a) Study Area (b) Origin-Destination Matrix Zones (c) Project Area (Work Zone)

2. Methods

This study employs a quantitative descriptive approach using both microscopic traffic analysis methods to evaluate traffic performance in the study area. The research begins with field data collection, followed by traffic performance analysis based on national guidelines and simulation modeling using VISSIM software. The methodology outlines the steps taken from data acquisition, data processing, calibration, and validation of the simulation model, to the development and assessment of traffic management scenarios. Each procedure is described systematically to ensure the accuracy and reproducibility of the study outcomes.

Primary Data Collections. Primary data collection obtained through direct observation requires proper techniques to ensure that the collected data is valid and matches the research needs.

1. Vehicle Volume

   Vehicle volume data was collected through a traffic counting survey using CCTV cameras installed in the observation area. The observation covered light vehicles (LV), heavy vehicles (HV), and motorcycles (MC), and was conducted for two hours with a 15-minute counting and recording interval during peak hours [12].

2. Vehicle Speed Data

   Vehicle speed data was collected through a spot speed survey using a speed gun. A total of 30 samples were taken for each vehicle type, with a minimum total of 100 samples. Speed data was collected during off-peak hours to capture free-flow traffic conditions [13] [14].

3. Road Conditions

   Road segment survey was conducted to observe the condition of road segments, focusing on side frictions and road geometry, which would later be used in the analysis process.

Origin-Destination (OD) Matrix. This study uses the Furness method to create an Origin-Destination Matrix (ODM). The Furness method helps to arrange the number of trips between different zones by adjusting the trip distribution based on the growth of origin and destination zones [15]. The steps are done by multiplying the trip values with the growth factors of each zone, one after another [16]. The process repeats until the total number of trips in the matrix is very close to the actual number of trips in each

(1)

zone, with a difference of less than 0.0001 or 0.01%. The final ODM shows how people travel between zones and is used in the traffic simulation model.

$$T_{ij} = t_{ij}\ x\ \frac{O/D_{ij}Actual}{O/D_{ij}Model} \quad (1)$$

T_{ij}	Expected trip from zone i to zone j (model)
t_{ij}	Base trips from zone i to zone j (actual)
O/D_{ij}	Trip generation and attraction values for each zone

Existing Traffic Performance Conditions Analysis. The analysis of existing traffic performance was carried out using the PKJI 2023 method [17]. The parameters used to evaluate traffic performance include:

1. Capacity (C): Road capacity refers to the maximum traffic volume that can be accommodated on a specific road segment for one hour under certain conditions, including geometry, environment, and traffic flow.
2. Degree of Saturation (DS): The degree of saturation reflects the quantity of service and represents the ability of the road to handle traffic flow.
3. Level of Service (LOS): The level of service is a quantitative and qualitative measure that describes the operational condition of traffic based on Ministerial Decree (KM) No. 14 Tahun 2006 [18].

The minimum standard for level of service values for each type of road segment refers to Ministerial Decree (KM) No. 14 Tahun 2006 [19]. If a road segment has a level of service below the minimum standard, improvements are needed to adjust the road capacity to match the existing traffic flow.

Table 2. Minimum Standard Level of Service

Road Class & Type		Minimum LOS Value
Primary	Arterial	B
	Collector	B
	Local	C
Secondary	Arterial	C
	Collector	C
	Local	D
	Residential	D

Microsimulation Using PTV VISSIM. In this study, traffic performance analysis also uses the VISSIM microsimulation method to observe vehicle movements and to support the development of optimal traffic management scenarios [20]. The VISSIM microsimulation modeling in the study area was conducted by creating the road network and inputting road geometry data, traffic volume, vehicle composition, desired speed, travel routes, and driver behavior settings. The simulation was executed at least five times using different random seed values, and the results were averaged for validation purposes [21]. The total simulation time was set to 4500 seconds, with the first 900 seconds used as a warm-up period to stabilize the traffic network, followed by 3600 seconds dedicated to performance evaluation [22].

Model Calibration. This study uses Various Measures of effectiveness (MOEs) in the form of traffic volume and average speed on each road segment during the model calibration process [8][23]. The parameter used for calibration is driving behavior, which helps adjust the simulation model to better reflect existing conditions. The VISSIM model applies a psycho-physical approach developed by Wiedemann, which suggests that driver behavior varies depending on traffic conditions at a specific location. This study uses the Wiedemann-74 model, which is suitable for simulating urban roads [24].

The method used in this calibration process is trial and error by using the range of driving behavior parameter values from previous studies conducted in areas within Indonesia.

1. Road Segment at Jalan Ciwastra in Bandung [25]
2. Road Segment at Jalan Imam Bonjol Denpasar in Bali [26]
3. Road Segment at Malioboro Area in Daerah Istimewa Yogyakarta (DIY) [27]
4. Road Segment at Jalan Diponegoro in DKI Jakarta [28]

Model Validation. Validation of the microscopic traffic flow simulation model in VISSIM is carried out to ensure that the developed simulation model can accurately represent real-world conditions. This study uses the GEH validation test to evaluate the MOE parameter of traffic volume, with a target GEH value of less than 5 (GEH<5), which indicates that the model is acceptable. In addition, the MOE parameter for vehicle speed is validated using the MAPE test, with a target value of less than 15% (MAPE<15%), indicating that the model is considered reliable [27].

$$GEH = \sqrt{\frac{(q_{simulated} - q_{observerd})^2}{0,5\ x(q_{simulated} - q_{observerd})}} \quad (2)$$

$q_{simulated}$ Simulated traffic flow volume data (vehicles/hour)
$q_{observerd}$ Observed traffic flow volume data (vehicles/hour)

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{(O_i - E_i)^2}{O_i}\right| \quad (3)$$

n Number of data points
O_i Observed data
E_i Model output data

5. Results

1. Road Segment Performance Using PKJI 2023

Table 3. Result of Analysis Road Segment Performance by PKJI 2023

Roadway Name	Road Segment	Traffic Flow (Q)	Road Capacity (C)	Degree of Saturation (DS)	Level of Service (LOS)
Sultan Agung 1	A	1204.7	2971.60	0.405	LOS_B
	B	1498.5	1540.06	0.973	LOS_E
	C	1911.1	2971.60	0.643	LOS_C
	D	1094.4	3488.40	0.314	LOS_A
Sultan Agung 2	E	1094.4	1537.48	0.712	LOS_C
	F	1889.7	2971.60	0.636	LOS_C
	G	1889.7	5232.60	0.361	LOS_B
Dr. Saharjo 1	H	1889.7	3224.83	0.586	LOS_C
	I	2064.6	3224.83	0.640	LOS_C
Dr. Saharjo 2	J	1860.35	2715.10	0.685	LOS_C
		2067.25	2715.10	0.761	LOS_C
Minangkabau Timur	K	2276.75	4465.15	0.510	LOS_B
	L	881.3	3329.77	0.265	LOS_A
	M	706.4	3329.77	0.212	LOS_A
Padang Panjang	N	174.9	2940.32	0.059	LOS_A
Minangkabau Barat	O	1498.5	4235.94	0.354	LOS_A
Payakumbuh	P	1380.15	1285.76	1.073	LOS_F

The results of the traffic performance analysis using PKJI 2023 in Table 3 show that the highest degree of saturation occurs on Jalan Payakumbuh, with a value of 1.073 and a Level of Service (LOS) of F. Referring to the minimum acceptable LOS values in Table 2, it can be seen that Sultan Agung 1 Road (Segment B) and Payakumbuh Road have levels of service below the standard set by Minister of Transportation Regulation KM No. 14 Tahun 2006. This indicates that these road segments require improvements through traffic management and engineering measures or by increasing road capacity.

2. Origin-Destination (OD) Matrix

After conducting eight trials by adjusting the coefficients in the base matrix within a value range of 0 to 1 and with sensitivity analysis, the base matrix that best represents the number of vehicles on each route according to existing conditions is presented in **Table 4**.

Table 4. Base Matrix

O/D	1	2	3	4	5	Oi (Model)	Oj (Aktual)
1	0.00	0.00	0.50	0.01	1.00	1.5	3388
2	1.00	0.00	0.90	0.25	1.00	3.2	1772
3	1.00	1.00	0.00	1.00	0.00	3.0	5217
4	0.30	1.00	0.90	0.00	1.00	3.2	4631
Di (Model)	2.3	2.0	2.3	1.3	3.0		15008
Dj (Aktual)	3466	1672	2997	4930	1943	15008	

The iteration process was carried out 35 times using the Furness method to achieve a balance between the number of vehicles in the OD matrix model (ODM) and the actual traffic volume. The ODM shown in **Table 5** already represents the vehicle volume for each travel route, with a difference ratio of 0.0001 between the model and the existing condition. The vehicle volume on each travel route will be used in the VISSIM modeling process, specifically under the static route choice method.

Table 5. Origin-Destination Matrix

O/D	1	2	3	4	5	Oi (Model)	Oi (Aktual)	Fi
1	0	0	1629	435	1325	3388	3388	1
2	810	0	186	691	84	1772	1772	1
3	1115	298	0	3804	0	5217	5217	1
4	1541	1374	1182	0	534	4631	4631	1
Dj (Model)	3466	1672	2997	4930	1943		15008	
Dj (Aktual)	3466	1672	2997	4930	1943	15008		
Fj	1	1	1	1	1			

3. Microsimulation Existing Scenario

The model was adjusted to match existing conditions by calibrating the driving behavior until the model was considered valid based on the GEH test and MAPE test, GEH < 5 and MAPE < 15%. The calibration in this study was conducted in two stages: the first utilized parameter ranges from previous studies in Indonesia, and the second involved a trial-and-error process to refine each driving behavior component based on those studies.

First Calibration. The first calibration were made based on the application of driving behavior parameters from previous studies conducted in Indonesia [25] [26] [27] [28]. The initial simulation results showed that some vehicles were unable to enter the model due to the simulation time ending, making the simulation results invalid, as the input vehicle volume did not match existing conditions. In addition, anomalies occurred in which vehicles overlapped or passed through one another during movement. The researcher conducted a trial-and-error process within the parameter range of driving behavior, based on previous studies, to identify sensitive parameters that could address these issues. The results showed that all vehicles were able to enter the simulation model. However, the validation tests still indicated some GEH values greater than 5 and MAPE values greater than 15%. Furthermore, overlapping and crashing behavior among vehicles was still observed when stopping and during movement, as shown in **Fig. 2.**

Fig. 2. Visualization of Overlapping Vehicle

Second Calibration. The second stage of driving behavior parameter calibration was carried out by modifying and detailing the parameters from previous studies to address issues of vehicle overlapping and collisions. Detailed adjustments for each vehicle type in the Wiedemann 74 car-following and lateral behavior parameters were essential, considering the differences in driving behavior between two-wheeled vehicles and vehicles with more than four wheels in the traffic conditions observed in the study area. These differences greatly affect the distance between vehicles, both when stationary and in motion, in order to prevent stacking or crashing. Detailed adjustments of lateral parameters for each vehicle type proved to be highly sensitive in aligning the model conditions with actual field conditions. Settings such as overtake on same lane, observe adjacent lane(s), and lateral distance standing & driving helped ensure that vehicles did not collide while moving. The parameters look ahead and look back minimum distance in the following component played a crucial role in preventing sudden or irrational behavior when detecting the vehicle in front, thus avoiding collisions or overlaps in the simulation [29].

Table 6. Vehicle Volume Validation by Second Calibration

Roadway Name	Road Segment	Vehicle Volume Output (veh/hour)								Average	Error (%)	GEH Test	Information
		Survey	R 1 (45)	R 2 (49)	R 3 (52)	R 4 (56)	R 5 (60)	R 6 (62)	R 7 (72)				
Jalan Sultan Agung 1	A	3388	3347	3263	3423	3317	3369	3344	3359	3346	1.24	0.72	ACCEPTED
	B	3466	3572	3464	3487	3505	3380	3440	3572	3489	0.65	0.38	ACCEPTED
	C	5504	5394	5161	5372	5266	5298	5346	5393	5319	3.38	2.53	ACCEPTED
	D	2997	3307	3251	3291	3185	3237	3305	3269	3264	8.89	4.76	ACCEPTED
Jalan Sultan Agung 2	E	5217	5566	5463	5537	5524	5608	5496	5547	5534	6.08	4.33	ACCEPTED
	F	2997	3298	3248	3285	3179	3229	3300	3263	3257	8.69	4.66	ACCEPTED

	G	5217	5600	5483	5551	5536	5619	5513	5574	5554	6.45	4.59	ACCEPTED
Jalan Dr. Saharjo 1	H	5217	5525	5405	5484	5479	5559	5460	5506	5488	5.20	3.71	ACCEPTED
	I	5836	6103	6015	6102	6038	6116	6045	6074	6070	4.02	3.04	ACCEPTED
Jalan Dr. Saharjo 2	J	4631	4824	4648	4600	4641	4622	4671	4827	4690	1.28	0.87	ACCEPTED
		4930	4833	4835	4981	4873	5018	4808	4879	4890	0.82	0.58	ACCEPTED
Jalan Minangkabau Timur	K	6101	6246	6015	6055	6013	6012	6128	6234	6100	0.01	0.01	ACCEPTED
	L	2735	2707	2600	2677	2634	2560	2654	2703	2648	3.19	1.68	ACCEPTED
	M	2116	2017	1904	1946	1968	1910	2011	2036	1970	6.90	3.23	ACCEPTED
PP	N	619	675	686	724	661	654	644	659	672	8.61	2.10	ACCEPTED
Jalan Minangkabau Barat	O	3466	3553	3482	3492	3538	3394	3449	3547	3494	0.80	0.47	ACCEPTED
Jalan Payakumbuh	P	1672	1743	1672	1648	1625	1756	1695	1733	1696	1.44	0.58	ACCEPTED
		1772	1812	1787	1762	1804	1694	1703	1782	1763	0.48	0.20	ACCEPTED

Table 7. Vehicle Speed Validation by Second Calibration

Roadway Name	**Road Segment**	**Vehicle Speed Output (km/hour)**								**Average**	**Error (%)**	**MAPE Test (%)**	**Information**
		Survey	**R1 (45)**	**R2 (49)**	**R3 (52)**	**R4 (56)**	**R5 (60)**	**R6 (62)**	**R7 (72)**				
Jalan Sultan Agung 1	A	38.15	41.04	41.40	40.82	41.22	41.00	40.94	41.10	41.08	7.67	7.67	ACCEPTED
	B	33.53	31.29	32.10	32.12	31.73	32.32	31.18	31.79	31.79	5.18	5.18	ACCEPTED
	C	33.53	33.38	33.79	33.66	33.71	33.84	33.73	33.40	33.64	0.35	0.35	ACCEPTED
	D	33.53	34.12	34.68	34.08	33.55	33.84	34.13	34.12	34.07	1.63	1.63	ACCEPTED
Jalan Sultan Agung 2	E	38.15	36.45	36.39	36.35	36.35	36.24	36.32	36.37	36.35	4.71	4.71	ACCEPTED
	F	33.53	30.95	31.18	30.79	30.85	30.88	31.28	30.79	30.96	7.66	7.66	ACCEPTED
	G	38.15	36.62	36.70	36.64	36.87	36.66	36.72	36.76	36.71	3.77	3.77	ACCEPTED
Jalan Dr. Saharjo 1	H	41.36	38.89	38.94	38.69	39.07	38.55	38.48	38.69	38.76	6.29	6.29	ACCEPTED
	I	33.53	30.20	30.10	29.87	30.19	30.74	30.61	30.23	30.28	9.70	9.70	ACCEPTED

Roadway Name	Road Segment	Vehicle Speed Output (km/hour)								Average	Error (%)	MAPE Test (%)	Information
		Survey	R1 (45)	R2 (49)	R3 (52)	R4 (56)	R5 (60)	R6 (62)	R7 (72)				
Jalan Dr. Saharjo 2	J	41.41	38.91	38.13	39.47	39.02	39.32	38.97	38.70	38.93	5.99	5.99	ACCEPTED
		33.53	31.10	30.82	30.43	31.23	31.60	30.93	31.04	31.02	7.48	7.48	ACCEPTED
Jalan Minangkabau Timur	K	33.53	37.35	38.43	38.41	37.76	37.72	37.98	37.28	37.85	12.89	12.89	ACCEPTED
	L	38.81	33.75	33.19	33.89	33.83	34.10	34.19	33.46	33.77	12.98	12.98	ACCEPTED
	M	38.81	41.33	41.28	42.15	41.60	41.78	41.61	40.79	41.50	6.95	6.95	ACCEPTED
Jalan Padang Panjang	N	23.24	23.83	23.52	23.49	23.65	23.71	23.70	23.47	23.62	1.66	1.66	ACCEPTED
Jalan Minangkabau Barat	O	38.81	38.28	38.50	38.32	37.67	38.39	38.44	37.92	38.22	1.53	1.53	ACCEPTED
Jalan Payakumbuh	P	38.81	37.70	38.12	37.96	38.01	37.99	37.57	37.58	37.85	2.48	2.48	ACCEPTED
		23.24	21.67	21.46	21.49	21.53	21.54	21.65	21.50	21.55	7.27	7.27	ACCEPTED

Table 6 and **Table 7** shows that the simulation results, conducted with 7 runs using different random seed values [30]. The error values shown in both tables represent the percentage difference between the simulation results and the observed data. Based on the validation tests conducted on the average values from each simulation, it was found that all road segments met the commonly accepted thresholds for PTV VISSIM calibration (GEH < 5 for volume, MAPE < 15% for speed), ensuring the reliability of the model for subsequent scenario analysis. In addition, the visual validation results indicate that the driving behavior in the model is already in accordance with the existing conditions, as illustrated in **Table 8** [7].

Table 8. Comparison of the Visual Condition of the Model and The Actual Condition

Exsisting Conditions Visualization | **Simulation Conditions Visualization by VISSIM**

Sultan Agung 2 Road

Dr. Saharjo 2 Road

The results of the calibrated driving behavior parameters used in this study are presented in **Table 9**.

Table 9. Driving Behavior Parameter Used

Parameter Grouping	Parameter	Default VISSIM	Used Calibration
Following	Look ahead distance min. (m)	0	15
	Look ahead distance max. (m)	250	200
	Number of Interaction Objects	4	4
	Look back distance min. (m)	0	10
	Look back distance max. (m)	150	100
Car Following	Wiedemann 74-Average standstill distance (m)	2	
	a. Motor cycle (MC)		0.3
	b. Light Vehicle (LV) / Passenger Car		0.5
	c. Medium Vehicle		0.6
	d. Heavy Vehicle (HV) / Large Bus		0.8
	e. Heavy Vehicle (HV) / Large Truck		0.8
	Wiedemann 74-Additive part of safety distance	2	
	a. Motor cycle (MC)		0.3
	b. Light Vehicle (LV) / Passenger Car		0.5
	c. Medium Vehicle		0.6
	d. Heavy Vehicle (HV) / Large Bus		0.6
	e. Heavy Vehicle (HV) / Large Truck		0.6
	Wiedemann 74-Multiplic. Part of safety distance	3	
	a. Motor cycle (MC)		0.5
	b. Light Vehicle (LV) / Passenger Car		0.7
	c. Medium Vehicle		0.8
	d. Heavy Vehicle (HV) / Large Bus		0.8
	e. Heavy Vehicle (HV) / Large Truck		0.8
Lane Change	Waiting time before diffusion (s)	60	180
	Minimum headway (front/rear), (m)	0.5	0.6
	Saftey Distance Diffusion Factor	0.6	0.4
Lateral	Desired position at free flow	middle of lane	
	a. Motor cycle (MC)		any
	b. Light Vehicle (LV) & Medium Vehicle		middle of lane
	c. Heavy Vehicle (HV)		middle of lane

Parameter Grouping	Parameter	Default VISSIM	Used Calibration
	Overtake on same lane	not selected	
	a. Motor cycle (MC)		left & right
	b. Light Vehicle (LV) & Medium Vehicle		left & right
	c. Heavy Vehicle (HV)		right
	Observe Adjacent Lane(s)	not selected	
	a. Motor cycle (MC)		not selected
	b. Light Vehicle (LV) & Medium Vehicle		selected
	c. Heavy Vehicle (HV)		selected
	Collision time gain (s)	2	1
	Minimum Longitudinal Speed (km/h)	1	2
	Minimum Lateral Distance Standing (0 km/h), (m)	0.2	
	a. Motor cycle (MC)		0.2
	b. All Vehicle		0.3
	Minimum Lateral Distance Driving (50 km/h), (m)	1	
	a. Motor cycle (MC)		0.5
	b. All Vehicle		0.8

4. Microsimulation

Scenario optimization was carried out through the implementation of traffic management and engineering based on Regulation PM No. 96 Tahun 2015, with the aim of improving the level of service on Jalan Sultan Agung 1 (Segment B) and Jalan Payakumbuh. The scenario development process involved the application of a One-Way System (SSA) on Jalan Payakumbuh, both in the northbound and southbound directions. Table 10 presents trial-and-error optimization scenarios applying a One-Way System (SSA) on Jalan Payakumbuh in Northbound and Southbound directions. The results of the two scenarios showed that only the Northbound scenario improved LOS on critical segments (Jalan Sultan Agung 1, Segment B; Jalan Payakumbuh) by diverting flows to Zone 5, reducing direct congestion. The Southbound scenario showed minimal improvement and shifted congestion to other roads. However, the implementation of this Northbound SSA scenario affected several surrounding roads, leading to a decrease in their level of service.

Table 10. Scenario Optimization Trial and Error

Northbound Direction SSA	**Southbound Direction SSA**

The northbound SSA scenario was developed by diverting traffic heading to Zone 3 through Zone 5. The traffic diversion was implemented to prevent vehicle congestion on Jalan Sultan Agung 2 as a result of the one-way system (SSA) implementation.This traffic diversion affected the changes in the Origin-Destination Matrix (ODM) for the destination zones, as shown in **Table 11.**

Table 11. O-D Matrix for Scenario Optimization

O/D	1	2	3	4	5	Oi (Model)
1	0	0	1223	434	1731	3388
2	810	0	0	691	271	1772
3	1116	297	0	3803	0	5217
4	1542	1375	588	0	1125	4631
Dj (Model)	3468	1673	1811	4928	3128	15008

The simulation results of the scenario optimization showed an improvement on Jalan Sultan Agung 1 (Segment B) from LOS E to LOS C, and on Jalan Payakumbuh from LOS F to LOS B. However, one road segment—Jalan Sultan Agung 1 (Segment C)—remained below the minimum service level standard. This was caused by an increase in traffic load due to the implementation of the northbound SSA on Jalan Payakumbuh, and the inability to widen the road due to the presence of the LRT Jakarta Phase 1B construction zone. This condition presents a limitation of this study, as modifications to the existing road conditions on certain segments could not be applied due to the ongoing LRT Jakarta Phase 1B construction.

Table 12. Level of Service Result from Scenario Optimization

Roadway Name	**Road Segment**	**Level of Services Existing**		**Optimization Scenario**
		PKJI 2023	**Simulation by VISSIM**	
Sultan Agung 1	A	LOS_B	LOS_B	LOS_C
	B	LOS_E	LOS_E	LOS_C
	C	LOS_C	LOS_C	LOS_D
	D	LOS_A	LOS_A	LOS_A
Sultan Agung 2	E	LOS_C	LOS_C	LOS_C
	F	LOS_C	LOS_C	LOS_C
	G	LOS_B	LOS_B	LOS_B
Dr. Saharjo 1	H	LOS_C	LOS_C	LOS_C
	I	LOS_C	LOS_C	LOS_B
Dr. Saharjo 2	J	LOS_C	LOS_C	LOS_C

		LOS_C	LOS_C	LOS_C
Minangkabau Timur	K	LOS_B	LOS_B	LOS_B
	L	LOS_A	LOS_A	LOS_A
	M	LOS_A	LOS_A	LOS_A
Padang Panjang	N	LOS_A	LOS_A	LOS_A
Minangkabau Barat	O	LOS_A	LOS_A	LOS_A
Payakumbuh	P	LOS_F	LOS_F	LOS_B

6. Discussion

The LOS improvement in the Northbound SSA scenario is primarily due to reduced direct traffic load on critical segments through strategic rerouting, while the Southbound scenario failed to produce similar results due to capacity limitations on alternative roads. Implementing temporary one-way systems combined with dynamic traffic signal adjustments could be adopted as a standard practice in large-scale infrastructure projects to minimize disruption. The findings provide practical insights for traffic management in urban work zones, demonstrating how targeted one-way systems combined with zone-based traffic redistribution can improve LOS during major infrastructure projects. This study has several limitations, including data collection restricted to peak hours, the inability to apply road widening due to ongoing construction, and the absence of driver behavior data outside the study area. Future studies could integrate real-time traffic data and dynamic route choice models to capture the adaptive behavior of drivers under changing traffic management schemes.

7. Conclusion

This study evaluated traffic performance in the LRT Phase 1B Zone 2 construction area using the Indonesian Highway Capacity Guidelines (PKJI) 2023 and microsimulation by PTV VISSIM. The analysis showed that two out of eight road segments did not meet the minimum standards for Degree of Saturation (DS) and Level of Service (LOS) as stated in KM 14 of 2006, namely Jalan Sultan Agung 1 (Segment B) (DS = 0.973, LOS E) and Jalan Payakumbuh (DS = 1.073, LOS F). Simulation modeling using VISSIM produced traffic volume and speed values that were validated against field data using GEH <5 and MAPE <15%. Calibration was done through the Origin-Destination Matrix (ODM) and driving behavior parameters to ensure the model accurately represented actual conditions. An optimal scenario was then modeled by applying a One-Way System (SSA) northbound on Jalan Payakumbuh and diverting traffic volumes to certain zones. This scenario improved Level of Services (LOS) Jalan Sultan Agung 1 (Segment B) from LOS E to LOS C and Jalan Payakumbuh from LOS F to LOS B. However, due to existing site constraints, such as road widening being unfeasible, Jalan Sultan Agung 1 (Segment C) still failed to meet the minimum LOS requirement, remaining at LOS D.

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