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CHARACTERISTICS OF NON-AB VEHICLES ENTERING THE CITY OF YOGYAKARTA BY VEHICLE TYPE, ORIGIN AND TEMPORAL DISTRIBUTION

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Abstract

Yogyakarta City, one of Indonesia's major tourism destinations, experiences significant traffic pressure from vehicles registered outside the local AB license plate region. This study analyzes the volume, composition, regional origin, temporal distribution, and traffic impacts of non-local vehicles entering the city. Traffic surveys were conducted over three consecutive days (15–17 May 2026) at the four main entrance corridors using the Manual Classified Count (MCC) method. Five vehicle categories were observed, while locally registered AB vehicles were excluded. A total of 16,447 non-local vehicles were recorded. Minibuses (57.4%) and sedans (31.7%) dominated the traffic, indicating tourism travel by families and small groups. Vehicles with plate B accounted for the largest proportion (24.0%), followed by AA (19.8%), H (11.4%), and AD (10.4%), with Central Java contributing approximately 52% of the total traffic. Peak traffic occurred during 08:00–12:00 and 14:00–17:00, reducing the estimated Level of Service (LOS) to D–E. The study recommends adaptive traffic management, park-and-ride facilities, restrictions on large buses in the city center, and Variable Message Signs (VMS).

***Keywords**: Non-Local Vehicles, Traffic Analysis, Peak Hour, Origin-Destination, Transportation Management, Yogyakarta City*

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INTRODUCTION

The city of Yogyakarta is one of Indonesia’s leading tourist destinations, attracting millions of visitors each year. The city’s strengths include its rich culture, historical heritage, surrounding natural attractions, and the presence of higher education institutions, which also drive mobility from various regions [1]. This growth in tourist visits, on the other hand, places significant pressure on the urban transportation system, particularly on the main roads serving as entry points to the city [2]. The complex traffic problems in Yogyakarta cannot be separated from the contribution of motor vehicles originating from outside the region namely, vehicles with license plates other than the AB region code, which is Yogyakarta’s local registration code. This phenomenon periodically spikes sharply during school holidays, major religious holidays, and long weekends, potentially causing a drastic decline in the Level of Service (LOS) on road segments [3].

Studies on the characteristics of non-local vehicles are a critical component of urban transportation planning, particularly in the context of Origin-Destination (O-D) estimation and road network load forecasting [4]. Knowledge regarding the volume, vehicle type composition, and origin distribution of non-local vehicles is necessary for designing targeted traffic management policies, ranging from traffic engineering and integrated parking systems to controlling heavy vehicle access in the city's core areas [5]. Although various studies have been conducted on traffic in the city of Yogyakarta, research that specifically analyzes non-AB vehicles as a distinct category examining their regional origin based on license plate codes, vehicle type composition, and temporal patterns remains very limited [6]. Previous studies generally analyzed overall traffic volume without distinguishing the contribution of vehicles from outside the city [7].

The rapid development of transportation infrastructure in Java, particularly the expansion of the Trans-Java Toll Road network and its connection to the Yogyakarta area, has significantly improved regional accessibility [8]. Reduced travel time has encouraged a greater number of visitors to use private vehicles when traveling to Yogyakarta [9]. While this enhanced connectivity provides economic benefits through increased tourism and commercial activities, it also generates additional traffic demand at the city's main gateways [10]. Consequently, understanding the characteristics of incoming non-local vehicles has become increasingly important for evaluating the impact of regional accessibility on urban traffic performance and for supporting evidence-based transportation planning [11]. This study addresses the existing research gap by examining non-AB vehicles based on their license plate origin, vehicle type composition, and temporal distribution at the main entrances to Yogyakarta. Unlike previous studies that focused primarily on overall traffic volume, this research specifically identifies the contribution of vehicles originating outside the Special Region of Yogyakarta and evaluates their potential impact on traffic conditions during peak periods [12]. The findings are expected to provide practical information for traffic management strategies, including peak-hour operations, parking policy development, access control for large vehicles, and long-term transportation planning in one of Indonesia's major tourism cities [13].

Recent studies have increasingly employed traffic monitoring and big-data approaches to understand vehicle movement patterns in tourism-oriented cities [14]. Temporal distribution analysis combined with origin identification has been widely recognized as an effective approach for evaluating travel demand, congestion patterns, and infrastructure performance [15]. Several recent studies reported that visitor-generated traffic exhibits distinctive peak-hour characteristics influenced by tourism activities, regional accessibility, and holiday travel behavior [16]. Moreover, identifying vehicle origins provides valuable information for designing adaptive traffic management strategies, parking policies, and corridor prioritization. Despite these advances, studies focusing specifically on non-local vehicles identified through license plate origin remain limited, particularly in Indonesian tourist cities [17]. Therefore, this study contributes by integrating vehicle classification, regional origin identification, and temporal distribution into a comprehensive assessment of incoming tourist traffic [18]. Unlike previous studies that mainly examined overall traffic volume, this study simultaneously analyses vehicle type, regional origin based on license plates, and temporal distribution of non-local vehicles entering Yogyakarta [19]. This integrated approach provides more detailed evidence for adaptive traffic management in tourism cities [20].

RESEARCH METHODOLOGY

Research Location and Time

The study was conducted at the main entrances to the city of Yogyakarta, covering: (a) the Western Corridor—Wates Road, (b) the Northern Corridor—Magelang Road, (c) the Northeast Corridor—Solo Road, and (d) the Southeast Corridor—Wonosari Road. These four corridors are arterial roads that serve as the main access routes for vehicles from outside the city to the center of Yogyakarta. The survey was conducted over three consecutive days, from May 15–17, 2026, starting at 12:00 a.m. WIB and ending at 12:00 a.m. WIB the following day (a full 24-hour survey). Four observation locations were established at the major entrances to Yogyakarta. Each observation point was continuously monitored for 24 hours over three consecutive days. Traffic data were recorded every 15 minutes, producing 96 observation intervals per day at each location. Consequently, each survey point generated 288 observation intervals, resulting in a total of 1,152 observation intervals across the four corridors. Every observed vehicle was documented according to vehicle type and license plate origin.

Data Collection Methods

Data were collected using the Manual Classified Count (MCC) method with a 15-minute recording interval. Each passing vehicle was recorded based on two main variables: (1) vehicle type, consisting of large buses, medium buses, small buses, minibuses, and sedans; and (2) license plate code, which was used to identify the vehicle's region of origin. Vehicles with AB license plates were consistently excluded from the records as they were considered local vehicles from Yogyakarta. Trained surveyors were stationed at each survey point and used standardized recording forms. Data validity across surveyors was ensured through periodic cross-checks every 2 hours. Each vehicle record was assigned a coding format consisting of three variables: survey location, observation time, and vehicle identification. Vehicle type was coded as MB (Minibus), SD (Sedan), SB (Small Bus), MDB (Medium Bus), and LB (Large Bus). Vehicle origin was identified using the official Indonesian license plate code issued by the National Police. Subsequently, each plate code was grouped into regional categories including Greater Jakarta–Banten, Central Java, East Java, West Java, and Outside Java for statistical analysis.

Research Flowchart

The overall research procedure is illustrated in Figure 1. The study began with determining the survey locations and observation schedule, followed by manual traffic data collection at the four main entrances to Yogyakarta. The collected data were then classified according to vehicle type and license plate origin, validated through quality control procedures, and analyzed to determine vehicle composition, regional distribution, temporal traffic characteristics, and the estimated impact on the Level of Service (LOS).

Methods of Analysis

Data analysis was conducted in the following stages:

1. Survey data tabulation and validation: All raw data were entered into a digital database and validated to eliminate duplicate entries, invalid license plate codes, and unusual zero values.

2. Vehicle composition analysis: Calculating the proportion of each vehicle type relative to the total non-AB volume, including conversion to EMP units using PCE values from MKJI (1997).
3. Analysis of vehicle origin distribution: Grouping non-AB vehicles by license plate code and calculating the frequency and proportion per regional code. Regional grouping is based on province of origin (Greater Jakarta/Banten, West Java, Central Java, East Java, Outside Java).

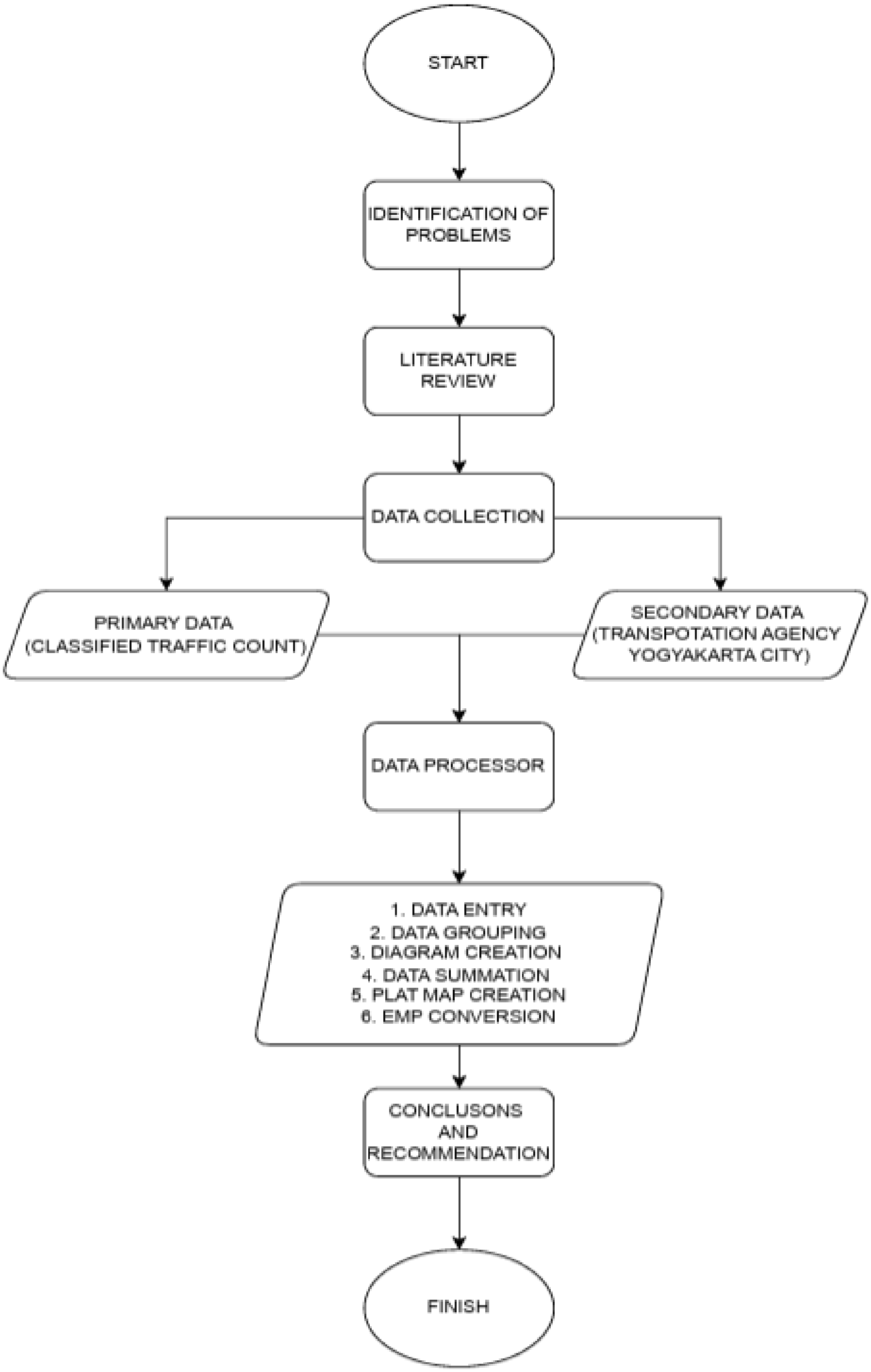

Figure 1. Research Flowchart

4. Temporal analysis: Calculating aggregate volume per 15-minute interval and per hour to identify peak hours, calculating the Peak Hour Factor (PHF), and analyzing the 24-hour temporal distribution.
5. LOS estimation: Estimate the potential reduction in LOS based on the conversion of volume to EMP and comparison with the capacity of urban arterial roads according to MKJI (1997).

Data Quality Control

To ensure data consistency among surveyors, an inter-observer reliability procedure was implemented. Before the field survey, all enumerators received standardized training regarding vehicle classification and license plate identification. During data collection, overlapping observations were conducted every two hours for approximately 15 minutes by two independent surveyors. The observation results were compared, and discrepancies were discussed immediately. Agreement between observers exceeded 95%, indicating high reliability in vehicle classification and origin coding

RESULTS AND DISCUSSION

Total Volume of Non-AB Vehicles

During the three-day survey period, a total of 16,447 non-AB vehicles were recorded entering the city of Yogyakarta through the four main entry corridors. Daily volumes showed a downward trend from day to day: Friday, May 15, 2026, at 6,535 vehicles (39.7%); Saturday, May 16, 2026, at 5,938 vehicles (36.1%); and Sunday, May 17, 2026, at 3,974 vehicles (24.2%). This pattern indicates that the highest volume occurred on Friday, likely due to the arrival of visitors who began their journeys after work hours ended. The decrease on Sunday reflects the outbound flow of vehicles leaving the city. A summary of the volume results is presented in Table 1.

Table 1. Summary of Daily Non-AB Vehicle Volume by Vehicle Type

Vehicle Type	May 15, 2026	May 16, 2026	May 17, 2026	Total (3 Days)	Percentage (%)
Mobil Minibus	3.931	3.345	2.154	**9.430**	57,4%
Saloon Car	1.937	1.944	1.326	**5.207**	31,7%
Small Bus	392	380	378	**1.150**	7,0%
Large Bus	207	183	64	**454**	2,8%
Bus Medium-Sized Bus	68	86	52	**206**	1,3%
TOTAL	**6.535**	**5.938**	**3.974**	**16.447**	**100,0%**

Vehicle Type Composition and EMP Implications

An analysis of the composition of non-AB vehicles shows a predominance of medium-sized private vehicles. Minibuses were the most common type of vehicle, with 9,430 units (57.4%), followed by sedans with 5,207 units (31.7%). Together, these two categories account for 89.1% of the total volume, confirming that the inflow of non-AB vehicles into Yogyakarta is dominated by family-based and small-group tourism trips using private vehicles. Buses of various sizes accounted for 10.9% of the total, with 1,150 small buses (7.0%), 454 large buses (2.8%), and 206 medium-sized buses (1.3%). Although their proportion is relatively small, the presence of large buses has a disproportionate impact on road capacity given their higher EMP value. Converting the volume to EMP units using the MKJI (1997) values yields the following total equivalent traffic loads: minibuses = 9,430 smp, sedans = 5,207 smp, large buses = 545 smp (454 × 1.2), small buses = 920 smp (1,150 × 0.8), and medium buses = 206 smp. The total EMP load from non-AB vehicles was 16,308 smp over the three-day survey period, or an average of 5,436 smp/day.

Table 2. EMP Values and Traffic Loads for Non-AB Vehicles

Vehicle Type	EMP Value	Volume (units)	EMP Load (smp)	% EMP Load	LOS Impact
Mobil Minibus	1,0	9.430	9.430	57,8%	Tinggi
Saloon Car	1,0	5.207	5.207	31,9%	Sedang-Tinggi
Small Bus	0,8	1.150	920	5,6%	Sedang
Large Bus	1,2	454	545	3,3%	Tinggi*
Bus Medium-Sized Bus	1,0	206	206	1,3%	Sedang
TOTAL	**-**	**16.447**	**16.308**	**100,0%**	**-**

Distribution of Vehicle Origins

An analysis of license plate codes identified 47 different region codes among the non-AB vehicles surveyed, reflecting the very wide range of origins of vehicles entering the city of Yogyakarta. The top five license plate codes accounted for 65.4% of the total non-AB volume. Plates with the “B” prefix, representing the Jabodetabek region (Jakarta, Bekasi, Tangerang), dominated with 3,954 units (24.0%), indicating the significant flow of traffic from the nation’s economic hub to Yogyakarta. Second place was held by the AA license plate (Magelang/Kedu) with 3,255 vehicles (19.8%), reflecting the geographical proximity and good land transportation connectivity between the Kedu-Magelang corridor and Yogyakarta. Plate H (Semarang) ranked third with 1,875 vehicles (11.4%), followed by plate AD (Surakarta/Solo) with 1,708 vehicles (10.4%), and plate K (Pati/Kudus) with 716 vehicles (4.4%).

The regional breakdown shown in Table 3 reveals a predominance of vehicles from Central Java (license plates AA, H, AD, K, R, G), with an estimated combined volume of approximately 8,462 units (51.5%). The Greater Jakarta/Banten area (license plates B and A) accounted for approximately 4,155 units (25.3%). East Java (license plates L, AE, S, N, W, AG) accounts for approximately 2,266 units (13.8%), while West Java (license plates D, F, E, Z, T) accounts for approximately 1,362 units (8.3%). Vehicles from outside Java (including license plates DK/Bali, BH/Jambi, BM/Pekanbaru, KT/Samarinda, and DD/Makassar) accounted for the remaining 1.1%. This distribution pattern confirms that Yogyakarta has an appeal that extends across the entire island of Java and even to regions outside Java. Geographical proximity is a dominant factor, but the city’s appeal as a center for tourism and education drives visits from farther distances, including the Greater Jakarta area (Jabodetabek), which is the largest source of visitors.

Table 3. Top 20 Non-AB Vehicle License Plate Codes

TOP 20 MOST COMMON LICENSE PLATE CODES			
License Plate Code	**Region**	**Total**	**%**
B	Jakarta/Bekasi/Tangerang	3954	24.0%
AA	Magelang	3255	19.8%
H	Semarang	1875	11.4%
AD	Surakarta/Solo	1708	10.4%
K	Pati/Kudus	716	4.4%
R	Banyumas/Purwokerto	594	3.6%
L	Surabaya	578	3.5%
D	Bandung	467	2.8%
F	Bogor	463	2.8%
AE	Kediri	352	2.1%
G	Pekalongan	314	1.9%
S	Bojonegoro	264	1.6%
N	Malang	246	1.5%
E	Cirebon	234	1.4%
A	Banten	201	1.2%
Z	Garut/Tasikmalaya	186	1.1%
W	Sidoarjo/Gresik	175	1.1%
AG	Blitar/Tulungagung	164	1.0%
T	Purwakarta	157	1.0%

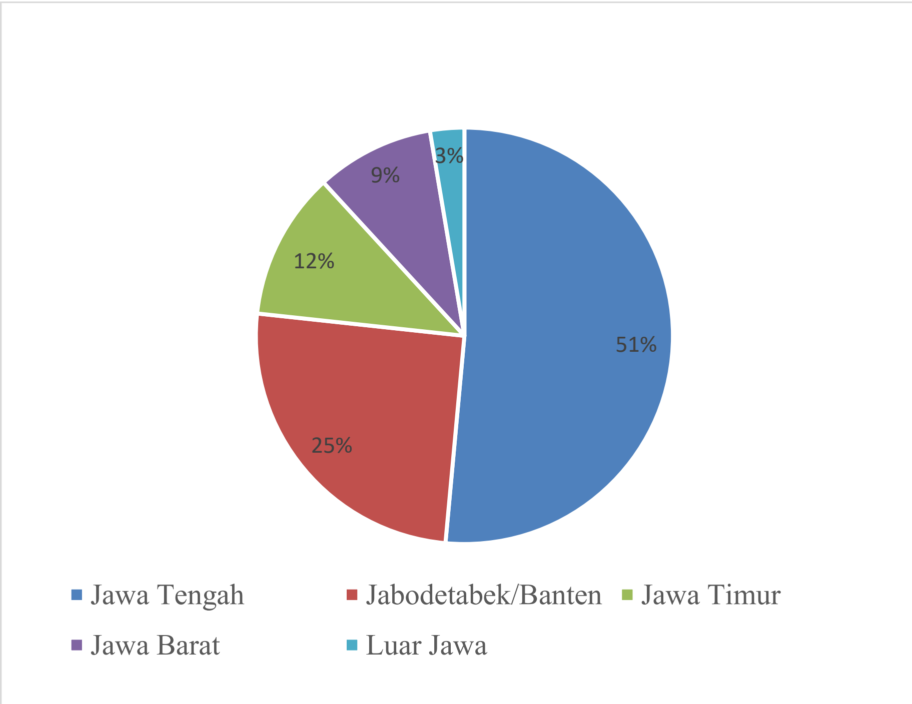

Figure 2. Percentage Distribution of Vehicles by Region

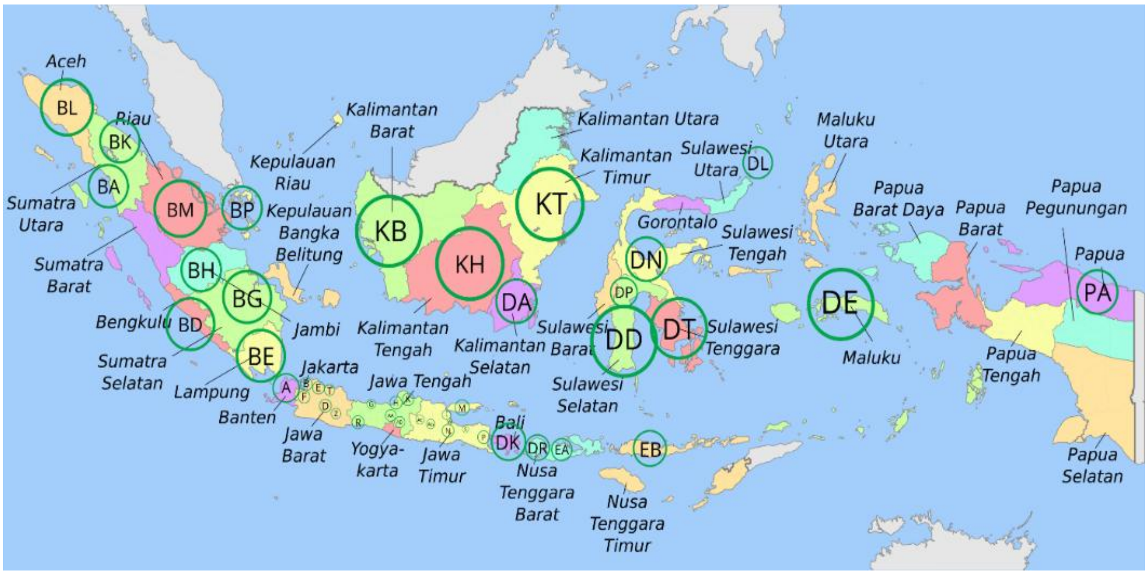

Figure 3. Map of License Plate Code Distribution for Each Region Within the Special Region of Yogyakarta

Temporal Characteristics and Peak Time Analysis

An analysis of the 24-hour temporal distribution of non-AB vehicle volume revealed a distinctive pattern with two clear peak periods. The lowest volume occurred in the early morning between 02:00 and 04:00 WIB, averaging 65–79 vehicles per 15 minutes. Volume began to rise steadily starting at 04:30 WIB, then surged sharply starting at 08:00 WIB. The first peak (morning–afternoon) lasted from 08:00 to 12:00 WIB, with volumes ranging from 189 to 273 vehicles per 15-minute interval. The first absolute peak was recorded during the 10:15–11:15 WIB interval with 266 vehicles and the 10:45–11:00 WIB interval with 273 vehicles. This period corresponds to a wave of tourists who traveled the previous night from the Greater Jakarta area or departed at dawn from Central Java. The second peak (afternoon–evening) occurred between 14:00–17:00 WIB, with a volume of 194–283 vehicles per 15-minute interval. The second-highest peak was recorded between 14:00–14:15 WIB at 283 vehicles, which was the highest volume recorded during the entire survey period. This period is likely related to a wave of visitors departing in the afternoon from the Greater Jakarta area via the Trans-Java Toll Road.

Table 4. Summary of Hourly Traffic Volume and Non-AB Traffic Density Status

ANALYSIS OF PEAK HOUR TRAFFIC FOR NON-AB VEHICLES							
Vehicle volume per 15 minutes | May 15–17, 2026							
Hours	**Minibus**	**Saloon Car**	**Small Bus**	**Large Bus**	**Medium Bus**	**Total**	**Status**
00:00	47	29	5	4	1	86	🟢 Normal
00:15	50	30	6	5	0	91	🟢 Normal
00:30	44	34	10	1	2	91	🟢 Normal
00:45	46	36	7	5	1	95	🟢 Normal
01:00	57	30	9	3	3	102	🟢 Normal
01:15	51	34	7	2	0	94	🟢 Normal
01:30	41	26	9	0	2	78	🟢 Normal
01:45	43	31	4	0	0	78	🟢 Normal

02:00	40	26	5	2	2	75	Normal
02:15	41	20	4	2	0	67	Normal
02:30	42	29	3	2	3	79	Normal
02:45	35	24	4	2	0	65	Normal
03:00	42	26	3	3	0	74	Normal
03:15	35	31	3	0	0	69	Normal
03:30	35	23	7	2	0	67	Normal
03:45	40	26	5	1	0	72	Normal
04:00	38	25	8	5	1	77	Normal
04:15	44	20	3	4	2	73	Normal
04:30	59	40	10	5	0	114	Normal
04:45	45	28	11	5	2	91	Normal
05:00	55	36	15	9	3	118	Normal
05:15	57	42	15	3	1	118	Normal
05:30	62	47	11	6	0	126	Normal
05:45	63	31	13	8	0	115	Normal
06:00	68	40	13	3	4	128	Normal
06:15	68	62	9	5	2	146	Normal
06:30	62	47	12	3	1	125	Normal
06:45	80	53	8	3	5	149	Normal
07:00	87	46	8	4	2	147	Normal
07:15	82	60	7	6	0	155	Normal
07:30	97	49	12	6	3	167	Normal
07:45	97	57	9	4	3	170	Normal
08:00	158	73	9	3	0	243	Dense
08:15	147	56	9	2	1	215	Normal
08:30	154	60	16	2	2	234	Dense
08:45	126	49	12	2	0	189	Normal
09:00	146	53	9	3	4	215	Normal
09:15	162	71	6	4	3	246	Dense
09:30	157	58	11	4	2	232	Dense
09:45	170	65	14	3	2	254	**Very Crowded**
10:00	151	71	10	5	3	240	DenseT
10:15	165	77	9	4	4	259	**Very Crowded**
10:30	164	73	17	7	5	266	**Very Crowded**
10:45	157	88	14	10	4	273	**Very Crowded**
11:00	163	72	17	8	3	263	**Very Crowded**
11:15	166	81	10	3	1	261	**Very Crowded**
11:30	151	75	15	3	1	245	Dense
11:45	168	78	15	3	1	265	**Very Crowded**
12:00	98	78	22	4	7	209	Normal
12:15	133	71	12	7	0	223	Dense
12:30	129	76	14	3	3	225	Dense
12:45	129	77	18	3	2	229	Dense
13:00	118	65	15	4	0	202	Normal
13:15	110	56	10	7	3	186	Normal
13:30	114	71	12	4	3	204	Normal

13:45	117	70	15	5	4	211	Normal
14:00	124	137	17	2	3	283	**Very Crowded**
14:15	118	57	13	4	2	194	Normal
14:30	131	65	14	4	2	216	Normal
14:45	133	93	15	6	0	247	Dense
15:00	117	62	16	5	3	203	Normal
15:15	143	44	10	5	2	204	Normal
15:30	115	64	9	6	2	196	Normal
15:45	165	72	11	5	6	259	**Very Crowded**
16:00	138	77	18	14	1	248	**Very Crowded**
16:15	138	76	16	7	4	241	Dense
16:30	139	78	12	2	3	234	Dense
16:45	128	68	14	11	1	222	Dense
17:00	150	63	17	3	3	236	Dense
17:15	125	68	10	8	2	213	Normal
17:30	119	65	13	7	2	206	Normal
17:45	105	54	9	7	9	184	Normal
18:00	117	69	20	8	3	217	Normal
18:15	109	74	18	5	7	213	Normal
18:30	117	63	12	8	2	202	Normal
18:45	94	70	19	6	4	193	Normal
19:00	116	72	13	8	2	211	Normal
19:15	93	70	21	14	4	202	Normal
19:30	94	57	14	7	3	175	Normal
19:45	113	64	19	9	1	206	Normal
20:00	104	57	16	15	4	196	Normal
20:15	77	52	13	10	2	154	Normal
20:30	85	54	12	5	6	162	Normal
20:45	92	60	22	5	3	182	Normal
21:00	93	62	11	3	6	175	Normal
21:15	86	47	16	3	0	152	Normal
21:30	85	44	18	2	2	151	Normal
21:45	75	49	16	3	2	145	Normal
22:00	89	39	14	3	4	149	Normal
22:15	79	48	26	2	1	156	Normal
22:30	78	41	20	5	2	146	Normal
22:45	71	42	10	10	2	135	Normal
23:00	78	36	11	3	0	128	Normal
23:15	69	30	12	2	0	113	Normal
23:30	61	30	7	5	0	103	Normal
23:45	61	32	10	1	0	104	Normal

The Peak Hour Factor (PHF) values shown in Table 4, which range from 0.83 to 0.98 during peak periods, indicate that non-AB vehicle traffic is relatively evenly distributed during peak hours and is not concentrated in a single time interval. This exacerbates traffic conditions because congestion lasts longer than it would if traffic surged briefly and then subsided.

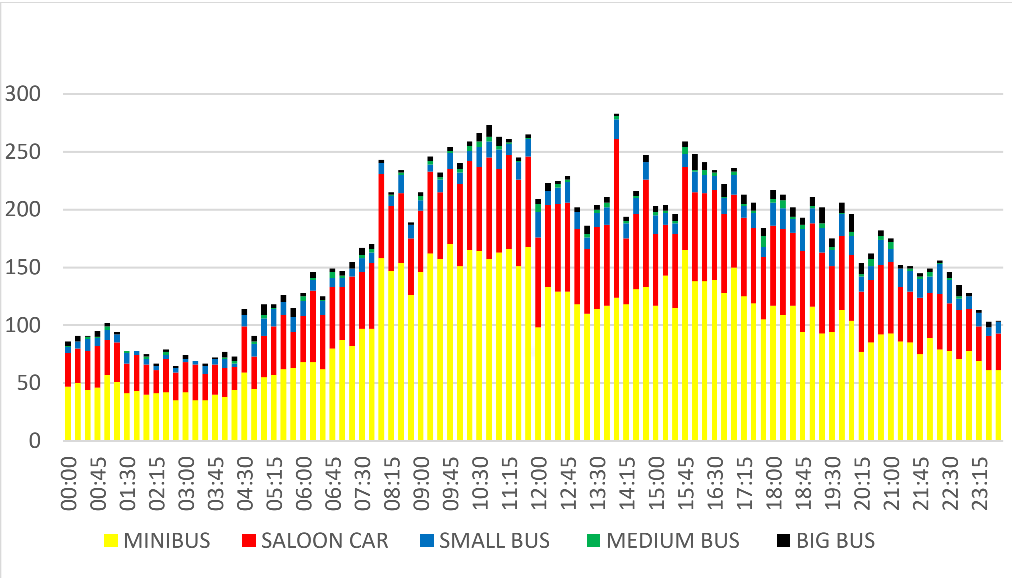

Figure 4. Vehicle Volume and Peak Hour (PEAK HOUR) Chart

Estimated Impact on Level of Service (LOS)

Based on the conversion of volume to EMP and the assumption that the capacity of a two-lane, two-way undivided urban arterial road (2/2 UD) is 2,900 smp/hour according to MKJI (1997), the volume-to-capacity ratio (V/C ratio) for the peak hour of 10:00–11:00 is estimated to reach 0.72 if only the contribution of non-AB vehicles is taken into account. If the volume of local (AB) vehicles—which can reasonably be estimated to be equivalent to or greater than the non-AB volume—is added, the total V/C ratio during peak hours could exceed 0.85–0.90, indicating a Level of Service (LOS) ranging from D (near capacity) to E (unstable). This situation is consistent with the traffic congestion frequently reported at the entrance to the city of Yogyakarta on certain days.

Discussion

The findings of this study are consistent with a study (Wardani & Ilonka, 2022) that reported similar patterns in tourist cities in Central Java, where non-local vehicles dominated the inflow on weekends, peaking between 09:00 and 11:00. However, unlike their findings, which showed a single peak, this study identified two distinct traffic peaks, likely due to greater diversity in visitors' points of origin in Yogyakarta visitors from nearby areas (Central Java) arrive earlier in the morning, while those from farther away (the Greater Jakarta area via the Trans-Java Toll Road) arrive in the afternoon. The dominance of vehicles from Magelang/Kedu (AA license plates), which ranked second after Jabodetabek, is a significant finding. Historically, the socioeconomic ties between Yogyakarta and the Kedu region have been very close; however, the volume recorded in this study provides strong quantitative evidence of the intensity of these ties.

This situation also implies the need for special attention to the Northern Corridor (Jl. Magelang) as the section with the highest traffic load from short-distance vehicle ori From a transportation management perspective, the relatively small proportion of large buses (2.8%) which nonetheless have a significant impact aligns with the argument [20] that managing large vehicles at tourist destinations requires an asymmetric approach the implementation of policies that are not proportional to volume but proportional to impact. Restricting large buses' access to the city center and providing intermediate terminals are relevant recommendations. The finding regarding the volume of non-AB vehicles during the early morning hours (00:00–04:00 WIB), which remains quite significant (an average of 80–100 vehicles per 15 minutes), is information that has not been widely documented in the local transportation literature. This situation indicates the existence of overnight trips from long distances—particularly from the Greater Jakarta area (Jabodetabek) that utilize the Trans-Java toll road to arrive in Yogyakarta in the early morning. This pattern has operational implications for the traffic management system, which has traditionally focused on daytime operating hours

CONCLUSION

The research findings show that vehicles with non-AB license plates entering the city of Yogyakarta are predominantly private vehicles, particularly minibuses and sedans, reflecting the high mobility of tourists and travelers from outside the region. During the survey period, a total of 16,447 non-AB vehicles were recorded, with the majority originating from the Jabodetabek region, followed by the Kedu and Semarang regions. Regionally, vehicles from Central Java contributed the most to the flow of vehicles entering the city of Yogyakarta. Vehicle arrival patterns showed two peak periods: 08:00–12:00 WIB and 14:00–17:00 WIB. During these periods, traffic congestion is expected to increase, causing the road service level on several major arterial roads to drop to categories D–E. These findings indicate that non-local vehicle traffic has a significant impact on traffic performance at the entry points to the city of Yogyakarta.

Based on these results, the implementation of more adaptive traffic management is necessary, particularly along major corridors and during peak vehicle arrival times. The development of park-and-ride facilities, the provision of real-time traffic information via Variable Message Signs (VMS), and the regulation of access for large vehicles to tourist areas can serve as measures to reduce congestion in the city center. In addition, coordination among stakeholders needs to be strengthened so that the management of vehicle traffic from outside the region can be carried out in an integrated manner. Further research is recommended during peak tourism periods, such as national holidays and vacation seasons, by including surveys on travel destinations and utilizing GPS data or floating car data so that a more comprehensive analysis of non-AB vehicle movement patterns can be conducted.

REFERENCES

[1] Á. Török, G. Pauer, and T. Berta, "Analysing the Impact of Road Information System on Traffic Safety," *Procedia Eng.*, vol. 187, pp. 712–721, 2017, doi: 10.1016/j.proeng.2017.04.445.

[2] S. Shokry, A. Alrashidi, M. E. S. El-Bany, and A. M. Darwish, "Impact of road geometry on school-area traffic congestion using regression and machine learning analysis: lessons from six Saudi cities," *Transp. Res. Interdiscip. Perspect.*, vol. 34, no. October, p. 101686, 2025, doi: 10.1016/j.trip.2025.101686.

[3] S. Singh and S. M. Santhakumar, "Empirical analysis of impact of multi-class commercial vehicles on multi-lane highway traffic characteristics under mixed traffic conditions," *Int. J. Transp. Sci. Technol.*, vol. 11, no. 3, pp. 545–562, 2022, doi: 10.1016/j.ijtst.2021.07.005.

[4] Q. Zhang and Q. Tong, "The economic impacts of traffic consumption during the COVID-19 pandemic in China: A CGE analysis," *Transp. Policy*, vol. 114, pp. 330–337, 2021, doi: 10.1016/j.tranpol.2021.10.018.

[5] K. Kurte, S. Ravulaparthy, A. Berres, M. Allen, and J. Sanyal, "Regional-scale spatio-temporal analysis of impacts of weather on traffic speed in chicago using probe data," *Procedia Comput. Sci.*, vol. 155, no. 2018, pp. 551–558, 2019, doi: 10.1016/j.procs.2019.08.076.

[6] A. Nadi, S. Sharma, J. W. C. van Lint, L. Tavasszy, and M. Snelder, "A data-driven traffic modeling for analyzing the impacts of a freight departure time shift policy," *Transp. Res. Part A Policy Pract.*, vol. 161, no. July 2020, pp. 130–150, 2022, doi: 10.1016/j.tra.2022.05.008.

[7] S. Hamdan, O. Jouini, A. Cheaitou, Z. Jemai, T. A. Granberg, and B. Josefsson, "Air traffic flow management under emission policies: Analyzing the impact of sustainable aviation fuel and different carbon prices," *Transp. Res. Part A Policy Pract.*, vol. 166, no. September, pp. 14–40, 2022, doi: 10.1016/j.tra.2022.09.013.

[8] P. Lin, Y. He, M. Pei, and R. Yang, "Data-driven spatial-temporal analysis of highway traffic volume considering weather and festival impacts," *Travel Behav. Soc.*, vol. 29, no. March, pp. 95–112, 2022, doi: 10.1016/j.tbs.2022.06.001.

[9] P. Xu, F. Corman, and Q. Peng, "Analyzing Railway Disruptions and Their Impact on Delayed Traffic in Chinese High-Speed Railway," *IFAC-PapersOnLine*, vol. 49, no. 3, pp. 84–89, 2016, doi: 10.1016/j.ifacol.2016.07.015.

[10] R. Thiesmeier, M. Skyving, J. Möller, and N. Orsini, "A probabilistic bias analysis on the magnitude of unmeasured confounding: The impact of driving mileage on road traffic crashes," *Accid. Anal. Prev.*, vol. 191, no. March, 2023, doi: 10.1016/j.aap.2023.107144.

[11] J. Ambros and M. Šípek, "How does the novelty effect influence speed impacts? An exploratory meta-analysis of five types of traffic calming measures," *Transp. Res. Interdiscip. Perspect.*, vol. 37, no. May, 2026, doi: 10.1016/j.trip.2026.102037.

[12] T. Tao, Y. Liu, Z. Sheng, and S. Qian, "Impact of traffic stress on mode choice: A data-driven analysis in Maryland," *Travel Behav. Soc.*, vol. 43, no. September 2025, p. 101206, 2026, doi: 10.1016/j.tbs.2025.101206.

[13] D. Di Monda, G. Bovenzi, A. Montieri, V. Persico, and A. Pescapè, "Analyzing the impact of shifts in encrypted mobile-app traffic on multimodal few-shot learning," *Comput. Networks*, vol. 276, no. November 2025, p. 111935, 2026, doi: 10.1016/j.comnet.2025.111935.

[14] A. M. Fathollahi-fard, "Scheduled service network redesign in freight transportation : Joint demand and service selection under disruption," vol. 191, no. June, 2026.

[15] K. Salomo, "Less parking , more life ? Promises and challenges of urban parking-space repurposing . Evidence from a controlled before-after quasi-experimental study in Berlin," vol. 212, no. July 2025, 2026.

[16] S. N. Hussain, K. Hewage, M. Zahid, and R. Sadiq, "Green mobility with battery electric buses : a review of transition and circularity integration," *Travel Behav. Soc.*, vol. 45, no. May 2025, p. 101300, 2026, doi: 10.1016/j.tbs.2026.101300.

[17] J. Liao, C. Li, and Y. Chai, "Relaxing or imposing constraints ? Exploring the associations between digitalization and space-time flexibilities in Qinghe , Beijing ☆," *J. Transp. Geogr.*, vol. 135, no. June, p. 104728, 2026, doi: 10.1016/j.jtrangeo.2026.104728.

[18] T. Inoue, M. Hitosugi, T. Okuno, and N. Ishiguro, "Transportation Research Interdisciplinary Perspectives Effective measures for evaluating safe driving ability with a driving simulator and eye movement tracking," *Transp. Res. Interdiscip. Perspect.*, vol. 38, no. May, p. 102051, 2026, doi: 10.1016/j.trip.2026.102051.

[19] E. Journal, "No Employees Lecturers Non Lectures 1 Universitas Janabadra Jl Khudori 2 IKIP PGRI Jl KRT Kertodiningrat 3 UAD Jl Wates purworejo Private Colleges Address," vol. 3, no. 1, pp. 41–54, 2019.

[20] N. C. Kresnanto, W. H. Putri, and C. Author, "TRANSPORT DEMAND MANAGEMENT STRATEGY ASSESSMENT BASED ON EXPERT JUDGMENT," vol. 4, no. 2, pp. 795–807, 2023.