2023, Vol. 1, No. 1, pp. 911-924
E-ISSN: 3025-9444

# Analysis of The Impact of on-Street Parking on Traffic Performance on One-Way Streets (Case Study: Gajah Mada Street, Bima City

Isnandi [1]✉, Sharwanda Asfarina [2], M. Deta Zulfikar Rahman [3]
(1,2,3) Civil Engineering Study Program, Faculty of Engineering and Computer Science, Muhammadiyah University of Bima, Bima, Indonesia

**Abstract:** *The continuous growth of population and motor vehicle ownership in Bima City has not been balanced by adequate road infrastructure development, causing traffic congestion, especially on strategic one-way national roads such as Jalan Gajah Mada, where on-street parking activities reduce the effective road width and disturb traffic flow. This study aims to identify the traffic volume passing through Jalan Gajah Mada and to analyze the influence of on-street parking on the traffic performance of this one-way road segment. A quantitative descriptive method was applied, collecting primary data through three days of field surveys covering morning, midday, and afternoon periods, then analyzed using the Indonesian Highway Capacity Manual (MKJI) 1997 to calculate traffic volume, side friction, free flow speed, road capacity, degree of saturation, and level of service. Results indicate the highest peak-hour volume reached 877.1 pcu/hour on Monday afternoon, dominated by motorcycles, with parking and stopping vehicles (PSV) contributing the largest weighted side friction frequency (200 of 417.3), classifying the segment as medium side friction. This condition reduced free flow speed to 42.12 km/hour and road capacity to 2,161 pcu/hour, producing a degree of saturation of 0.41 with level of service B, indicating stable flow despite noticeable parking-related friction. In conclusion, on-street parking measurably affects traffic performance, though current conditions remain within tolerable capacity. Local authorities are recommended to enforce stricter parking regulations, including peak-hour on-street parking prohibition and provision of off-street alternatives, to prevent future performance decline. Further research should extend observation periods and include forecasting simulations.*

**Article history:**
Received: 14 July 2026
Revised: 28 July 2026
Accepted: 29 July 2026
Published: 30 July 2026

**Keywords:**
*Level of Service, Mkji 1997, One-Way Road, On-Street Parking, Traffic Performance*

This is an open-access article under the CC-BY-SA License.

***How to cite***: Isnandi, I., Asfarina, S., & Rahman, M. D. Z. (2026). Analysis of The Impact of on-Street Parking on Traffic Performance on One-Way Streets (Case Study: Gajah Mada Street, Bima City. *RESWARA: Journal of Engineering Research*, *4*(3), 911–924. https://doi.org/10.70716/reswara.v4i3.743

## INTRODUCTION

Bima City, as one of the urban areas that continues to develop, shows characteristics of traffic movement that are not much different from other cities in Indonesia, namely a fairly high level of mobility accompanied by a tendency to congestion during peak hours, both in the morning and evening. This phenomenon is triggered by the increasing intensity of the movement of people, goods, and services to meet the needs of the community, as well as closer interaction with the surrounding areas. As a result, the volume of traffic on the city's main roads has increased significantly over time.

The continuous increase in the population of Bima City has also encouraged a surge in the number of motor vehicle ownership. Unfortunately, this growth is not accompanied by the provision of adequate road infrastructure capacity. The gap between the rate of vehicle growth and the availability of street space, coupled with the uneven distribution of urban activity centers, is the root of various urban traffic problems, such as declining vehicle speeds, the occurrence of long queues, and

✉ *Corresponding author:* ***isnandipai@gmail.com***
*Copyright © 2026, the author(s)*

the emergence of traffic flow delays (Mawardin, 2022). One of the classic problems that is often encountered in urban areas is the use of road bodies as vehicle parking lots (Alwan et al., 2021).

The practice of parking on the road body or what is commonly called *on-street parking* It is an activity that is commonly found in areas with high activity intensity, such as trade centers, office areas, and other public facilities. The lack of adequate parking availability, combined with the high frequency of community activities, encourages motorists to park their vehicles on the edge of even part of the road. This kind of condition directly causes a reduction in the effective width of the road, so that the road capacity decreases and traffic performance is disrupted (Al Fikri et al., 2021; Oktopianto et al., 2021). A number of previous studies have proven that the existence of parking activities on the road body has a considerable influence on the capacity and level of service of a road, because its existence interferes with the continuity of traffic flow that should run smoothly (Prayudha et al., 2022; Warpani, 2002).

Similar problems are also often found on other urban roads that function as centers of economic and social activities. Irregular parking activities, including those arising from shuttle activities in the school environment and community visits to crowded centers, have been proven to increase roadside obstacles so that they have an impact on reducing the performance of the road section (Paays et al., 2019; Wijanarko & Ridlo, 2019). The findings indicate that the management of the parking system is a crucial component of traffic management in urban environments that cannot be ignored (Ariesandi et al., 2020; Zulvia et al., 2022).

One of the roads that has a strategic role in Bima City is Jalan Gajah Mada, which has the status of a national road with the implementation of a one-way system (Putra et al., 2021). This section plays an important role in serving traffic movements in the city, considering that its location is in an area with relatively dense trade and service activities. The implementation of a one-way system on this road section is basically intended to improve the smooth flow of traffic while minimizing the potential for conflict between vehicles (Mawardin, 2022). However, in reality, there are still many vehicles parked on the road, so it has the potential to reduce the effectiveness of the implementation of the one-way system (Paikun et al., 2021; Paisal et al., 2022).

The existence of parking activities on the road body on a one-way system road section has different consequences when compared to two-way roads, because the effect works directly on the effective width of the traffic lane as well as the capacity of the road section as a whole. Based on these considerations, a study is needed that specifically examines the extent to which parking activities on the road body affect traffic performance on one-way roads, with Jalan Gajah Mada Bima City as the object of the study. This study has important value both empirically, in providing a real picture of actual traffic conditions, and technically, as a consideration for local governments in formulating parking management policies and traffic engineering in the area. On the basis of this presentation, this study was directed to analyze the effect of parking on the road body on traffic performance on the one-way national road section, by taking a case study on Jalan Gajah Mada, Bima City (Arrang & Rangan, 2020; Mastuti et al., 2021).

Although various previous studies have examined the effect of *on-street parking* on road performance, most have focused on two-way road sections, while specific studies on national roads with *a one-way system* system are still limited, even though the effect of parking on effective width and *degree of saturation* The two types of roads differ significantly. The novelty of this study lies in the comprehensive analysis of side obstacles based on MKJI 1997 which reveals the dominance of

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

parking/stopping vehicles as the main contributor to *side friction*, as well as presenting empirical evidence of traffic performance on Jalan Gajah Mada, Bima City, which has never been studied before.

Referring to the description of the problem above, this study was compiled to answer two basic questions, namely how large the volume of vehicle traffic crossing the Jalan Gajah Mada section of Bima City, and how the presence of parking on the road body affects traffic performance on the road section (Hanafi et al., 2023). In line with the formulation of the problem, this study aims to identify the volume of vehicle traffic crossing Jalan Gajah Mada, Bima City, as well as to determine the influence of careless parking activities on the road body on traffic performance on the road section that is the object of the research, by referring to the guidelines of the Indonesian Road Capacity Manual (MKJI) 1997.

Theoretically, this research is expected to be able to contribute to the development of science in the field of civil engineering, especially in the study of transportation regarding the influence of parking activities on road bodies on traffic performance (Kriswardhana et al., 2020; Kurniawan & Maani, 2019). The results of this study can later be used as an academic reference for future studies that raise similar topics, as well as enriching scientific treasures related to traffic management and urban parking. As for practically, the results of this research are expected to be used by the local government and related agencies as a consideration in formulating a more effective parking management policy in the Jalan Gajah Mada area, Bima City (Hobbs, 2016). Through the availability of empirical data, it is hoped that appropriate solutions can be formulated to reduce the negative impact of parking activities on the road, improve the smooth flow of traffic, as well as realize a more orderly, safe, and comfortable urban transportation system for all levels of society.

## RESEARCH METHOD

### Research Location

This study took place on the section of Jalan Gajah Mada, Bima City, West Nusa Tenggara Province, with the coverage of a 200-meter segment that was chosen because it reflected a point with a relatively dense intensity of vehicle movement. The selection of the location was based on the consideration that the section is the main corridor that supports the mobility of Bima City residents, while the high volume of vehicles combined with the habit of parking on the side of the road also erodes the effective width of the pavement so that it risks reducing capacity and reducing the level of road service. On that basis, the Jalan Gajah Mada section is considered representative to examine the relationship between parking activities on the road body and traffic performance. Field data collection was carried out for three days with two observation ranges, namely morning, noon, and evening, which were chosen on the consideration that the period included *peak hours* so as to be able to describe the conditions of traffic flow and parking intensity in the most representative way.

### Research Data

The data collected in this study includes two categories, namely primary data and secondary data. Primary data was obtained directly from field observations, including the volume of vehicle flows on the Jalan Gajah Mada section, the number of vehicles parked on the road body, side obstacles that appeared at the study site, as well as road geometric conditions such as the width of the pavement and the number of lanes. The secondary data was collected from related agencies and other supporting sources, including maps of study locations sourced from *Google Maps*, population data of Bima City, as

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

well as literature on road capacity and traffic analysis referring to the Indonesian Road Capacity Manual (MKJI, 1997), in addition to references from books, scientific articles, and previous studies relevant to the theme of parking on the road body and traffic performance.

Data collection was carried out through three complementary approaches. The field survey was carried out by directly observing traffic conditions on the Jalan Gajah Mada section to obtain data on vehicle volume, parking activities on the road body, and side obstacles that arise. Observation was carried out by directly observing the movement of passing vehicles and those parked on the road body at the study location. Documentation is taken through taking photos of existing road conditions, parking activities, and traffic situations as a data booster of survey results. The approach used in this study is quantitative descriptive analysis, namely by collecting traffic data in the field which is then processed through calculations based on the Indonesian Road Capacity Manual (MKJI, 1997). This approach is aimed at revealing the relationship between parking activities on the road body and traffic performance on the section under study, through a series of stages in the form of initial observation of the location, survey of vehicle volume, identification of parking activities on the road body, collection of data on side obstacles, processing and analysis of data using the MKJI method (1997), to the formulation of conclusions from the results of the analysis.

**Data Analysis Methods**

The data analysis in this study is guided by the Indonesian Road Capacity Manual (MKJI, 1997), by utilizing road geometric data, traffic volume, and side obstacles from field surveys. The analysis stage begins with the calculation of traffic volume, conversion of units into passenger cars (junior high school/hour), and determination of peak hours based on the highest volume observed. Furthermore, an assessment of the side obstacles was carried out to determine the class, followed by the calculation of free *flow speed* (FV), road capacity (C), degree of saturation (DS), and road service level (LOS) referring to MKJI (1997). The series of analysis results was used to evaluate traffic performance as well as reveal the influence of careless parking on the road body on traffic performance on the Jalan Gajah Mada section, Bima City.

**Research Procedure**

This study procedure was prepared systematically, starting with the determination of the title and the search of literature as a theoretical basis based on the Indonesian Road Capacity Manual (MKJI, 1997), scientific journals, and related books, followed by the determination of the location on the Jalan Gajah Mada section which has the character of a one-way national road with high traffic and parking intensity. The next stage is initial observation to map problems in the field, especially related to parking on the road body and its impact on traffic performance, followed by the collection of primary and secondary data as described in the previous subchapter. The data was then processed and analyzed referring to MKJI (1997) through the stages of calculating traffic volume, conversion to junior high school, determination of road capacity, degree of saturation, *level of service*, and free flow speed, the results of which were used to assess the influence of parking on the road body on traffic performance. This procedure ends with the drawing of conclusions and the formulation of suggestions based on the findings of the analysis, so that the flow of the study can be traced sequentially and systematically.

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

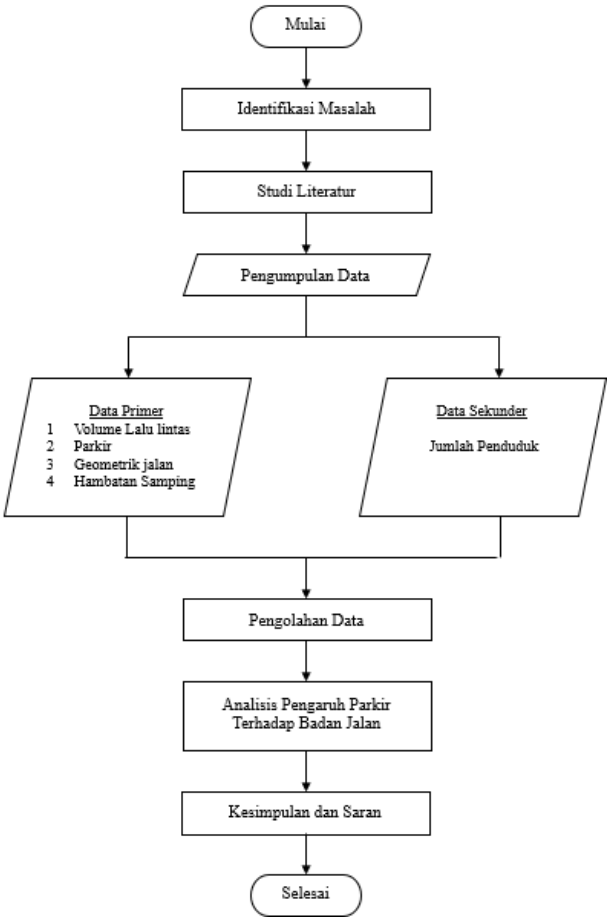


Figure 1. Research Flow Diagram

## RESULTS AND DISCUSSION

### Results

#### *Characteristics of Location and Geometric Conditions of Road Sections*

The location of the research is on the section of Jalan Gajah Mada, Bima City, which is a national road status connecting between provincial areas. This section plays an important role in supporting community mobility and the distribution of goods and services, so that the level of utilization by various types of vehicles is relatively high, especially in a certain period of time that is congested. The high intensity of movement on this section is inseparable from the existence of commercial areas, offices, and public service facilities scattered along the side of the road, so that the function of the road is not only as a vehicle route between regions, but also as a center of economic and social activities of the local community.

In more detail, the left and right sides of Jalan Gajah Mada are dominated by rows of shops, trade areas, higher education institutions, health service units in the form of Muhammadiyah Hospitals, and informal traders who sell on the roadside. The combination of these various activities causes a large enough attraction and movement that contributes to the high *volume* of traffic, especially during *peak hours* or peak hours. The existence of these facilities also makes this road section vulnerable to the use of road bodies for purposes other than vehicle traffic, for example as a parking lot for vehicles for store

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

visitors, hospital patients, and students, which ultimately affects the effectiveness of the movement space of passing vehicles.

The results of field measurements show that this road section has a *type of 2/1 TT* or two one-way lanes without a median separator, with an overall road body width of 6 meters, a width of each lane of 3 meters, a shoulder width of 1 meter on each side, and an observation segment length of 200 meters (0.2 km). These geometric characteristics are one of the main variables in calculating road capacity based on the guidelines *of the Indonesian Road Capacity Manual* (MKJI) 1997, considering that the effective width of the available traffic lanes will greatly determine the amount of capacity adjustment factors and the speed of free flow of vehicles passing through the section.

Table 1. Geometric Data of Jalan Gajah Mada

| Parameters | Value |
|---|---|
| **Road type** | 2/1 TT (undivided) |
| **Width** | 6 meters |
| **Column width** | 3 meters |
| **Road shoulder width** | 1 meter |
| **Length of observation segment** | 200 m (0.2 km) |

Primary data collection was carried out for three consecutive days, namely Monday, Tuesday, and Wednesday, with three observation sessions on each day, covering the morning period (07.00–09.00 WITA), the afternoon period (12.00–14.00 WITA), and the afternoon period (16.00–18.00 WITA). The time division is intended so that traffic movement patterns can be recorded representatively, considering that the characteristics of vehicle flow tend to be different in each session due to variations in community activities around the location. The selection of weekdays as the survey time is also based on the consideration that office, trade, and educational activities on that day are taking place in full, so that the data obtained can reflect traffic flow conditions on normal days more accurately than if the survey was conducted on weekends or holidays.

*Traffic Volume and Side Barriers Analysis*

The calculation of traffic volume is carried out by converting the number of motor vehicles into passenger car units (SMP) using different *passenger car equivalence* values (emp) for each vehicle class, namely 1.0 for light vehicles (LV), 1.3 for heavy vehicles (HV), and 0.4 for motorcycles (MC). This conversion process is important to do considering that the characteristics of the movement space of each type of vehicle are different, so equalization is needed so that the total flow can be objectively compared in the same unit. Without this conversion process, the comparison between vehicle types will be biased, considering that one unit of heavy vehicles basically requires much more road space than one motorcycle, even though the number of units of both is calculated equally.

Based on the recapitulation of data during three days of observation, the highest traffic flow consistently occurred in the afternoon session, especially near 17.00 to 18.45 WITA. This condition indicates that after-work, after-school, and afternoon shopping activities are the main driving factors for the surge in vehicle flows in this time frame. In contrast, the lowest *volume* was observed at the beginning of the morning period, reflecting community activities that have not yet fully taken place. A similar pattern was found consistently on the three days of observation, which shows that the characteristics of the movement of people around Jalan Gajah Mada have a fairly clear regularity of

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

time, namely increasing gradually since morning, experiencing a relative decrease during the day due to a pause in activity, then a sharp spike in the afternoon.

If examined further, the largest contribution to the total *volume* in almost all observation sessions came from two-wheeled motor vehicles (MC), which far exceeded light vehicles (LV) and heavy vehicles (HV). The dominance of motorcycles is a common characteristic that is commonly found on roads in urban areas of Indonesia, including Bima City, considering that motorcycles are considered a more flexible and economical mode of transportation for the community. However, because the *emp value* of motorcycles is relatively small, its contribution to the total flow in junior high school units is not as large as its proportion in units of vehicles per hour, so light vehicles still have a significant influence on traffic load in junior high units/hour.

Table 2. Recapitulation of Peak Traffic Flow Hours During Three Days of Observation

| Yes | Day | Peak Hour Interval | Current Volume (smp/h) |
|---|---|---|---|
| 1 | Monday | 17.15–18.15 WITA | 877,1 |
| 2 | Tuesday | 17.45–18.45 WITA | 875 |
| 3 | Wednesday | 17.45–18.45 WITA | 873,9 |

The data in Table 2 shows that the highest peak volume value of the entire observation day occurred on Monday at 17.15–18.15 WITA with a magnitude of 877.1 smp/hour, while the lowest value in the peak hour range was recorded on Wednesday at 873.9 smp/hour. The relatively small difference between days shows that the pattern of traffic density on this section tends to be stable and repeats every day, so that the peak hours of Monday are used as a reference in the next stage of performance analysis because it represents the maximum flow condition. The consistency of the peak hour value between days also indicates that the pattern of community activity around the Jalan Gajah Mada section is relatively homogeneous from day to day, not significantly affected by the difference in weekdays.

In addition to *vehicle volume*, this study also measures *side obstacles* or disturbances of activities on the side of the road that can affect the smooth flow of traffic. Four types of incidents observed include pedestrians crossing or walking on road bodies (PED), vehicles parked or stopped (PSV), vehicles entering and exiting the land on the side of the road (EEV), and slow-moving vehicles (SMV). Each type of event has a different weight of influence on road performance, so the raw frequency needs to be multiplied by the weight factor of each before being added to the total weighted frequency value. The weighting reflects the real level of disturbance caused by each type of incident to the smooth flow of the flow, where parked or stopped vehicles are considered to cause the greatest disturbance compared to other types of side obstacles, as they directly reduce the effective width of the traffic lanes available to moving vehicles.

Table 3. Weighted Frequency of Side Obstacles at Peak Hours

| Incident Type | Symbols | Weight Factor | Frequency of Occurrence (per hour, 200 m) | Weighted Frequencies |
|---|---|---|---|---|
| **Pedestrian** | PED | 0,5 | 58 | 29 |
| **Parking/vehicle stops** | PSV | 1 | 200 | 200 |
| **Vehicles in and out** | EEV | 0,7 | 269 | 188,3 |
| **Slow vehicles** | SMV | 0,4 | 0 | 0 |

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

| | |
|---|---|
| **Total** | **417,3** |

The total value of the weighted frequency of 417.3 was then converted into the classification of the side resistance class based on the 1997 MKJI guidelines. The range of values 300–499 in the classification is categorized as an area with industrial activities accompanied by a row of shops on the roadside, which is included in the *medium* or *medium* (M) side obstacle class. These results confirm that the side disturbances on the Jalan Gajah Mada section, although quite felt due to the high parking activities and the entry and exit of vehicles from commercial land, have not reached a level that greatly disrupts the main flow of traffic.

Table 4. Classification of Side Obstacles Class Based on MKJI 1997

| Weighted Frequencies | Special Conditions | Side Obstacle Class |
|---|---|---|
| **< 100** | Settlements, almost without activity | Very low (VL) |
| **100–299** | Settlements, some public transportation | Low (L) |
| **300–499** | Industrial area with shops on the side of the road | Medium (M) |
| **500–899** | Commercial area with high roadside activities | Height (H) |
| **> 900** | Commercial areas with very high market activity | Very high (VH) |

The findings at this stage show that the PSV factor (parked and stopping vehicle) contributes the largest weighted frequency compared to the other three types of obstacles, which is 200 out of a total of 417.3, or almost half of the total value of side obstacles recorded. This confirms that the practice of parking on the road body is the dominant contributor to side disturbances on the road, in line with the focus of the problems raised in this study. This condition is also strengthened by the considerable contribution of vehicles in and out (EEV), which is 188.3, so that overall it can be concluded that activities directly related to vehicles stopping, both for parking and for the purpose of entering and exiting land on the side of the road, are the main source of side obstacles on the Jalan Gajah Mada section, much more dominant than disturbances from pedestrians and slow-moving vehicles.

*Road Performance Analysis*

The final stage of analysis was carried out by calculating three main indicators of road performance, namely the speed of free flow (*Free Flow Speed*), road capacity, and degree of saturation, which are then used to determine the level of road service or *Level of Service* (TRUE). These three indicators are interrelated with each other and together provide a comprehensive picture of the extent to which the existing condition of the road section is able to accommodate the existing traffic load without causing a significant decrease in service quality (Law of the Republic of Indonesia, 2004).

The free flow speed is calculated by considering the basic speed of light vehicles, adjustment factors due to the effective width of the traffic lane, side obstacle factors, and city size factors. With a basic free flow (FVo) speed of 55 km/h, a lane width adjustment factor (FVw) of -3 km/h, a side drag factor (FFVsf) of 0.9, and a city size factor (FFVcs) of 0.9, a freeflow velocity value of 42.12 km/h was obtained. This value describes the maximum speed that a light vehicle can theoretically achieve under conditions of traffic flow that is not disturbed by other vehicles. The decrease in the FVo value due to the factor of adjusting the width of the lane and side obstacles shows that the relatively narrow road geometric conditions combined with fairly high roadside activities also reduce the potential speed of vehicles passing on the section.

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

The capacity of the road section is calculated based on the basic capacity of 2,900 smp/hour which is then adjusted for the lane width factor (FCw) of 0.92, the directional separation factor (FCsp) of 1 considering that the road is one-way, the side obstacle factor (FCsf) of 0.9, and the city size factor (FCcs) of 0.9. The result of the multiplication of the four factors of adjustment to the basic capacity resulted in a road capacity value of 2,161 smp/hour. This capacity value reflects the maximum capacity of the road section in the current geometric conditions and roadside environment, and is the main reference in assessing whether the existing traffic load is still within safe limits or is approaching the saturation point.

Table 5. Summary of Free Flow Speed and Road Capacity Analysis Results

| Parameters | Value |
|---|---|
| **Basic free current speed (FVo)** | 55 km/h |
| **Bandwidth adjustment factor (FVw)** | -3 km/h |
| **Side barrier factor (FFVsf)** | 0,9 |
| **City size factor (FFVcs)** | 0,9 |
| **Free current speed (FV)** | **42.12 km/h** |
| **Basic capacity (Co)** | 2,900 smp/hour |
| **Bandwidth factor (FCw)** | 0,92 |
| **Directional separating factor (FCsp)** | 1 |
| **Side barrier factors (FCsf)** | 0,9 |
| **City size factor (FCcs)** | 0,9 |
| **Road capacity (C)** | **2,161 junior high schools/hour** |

With the knowledge of the *traffic volume* at peak hours of 877.1 smp/hour and the capacity of the road section of 2,161 smp/hour, the *degree of saturation* can be calculated through a comparison between the two values, so that a figure of 0.41 is obtained. This figure shows that the traffic load borne by the road section is still far below its capacity limit, so the flow of vehicles in existing conditions has not caused significant congestion. However, it should be underlined that the value of this degree of saturation is also influenced by the magnitude of side obstacles due to parking activities on the road body, so that if the parking practice is allowed to continue to increase without adequate regulation, there is a potential for an increase in the value of the degree of saturation in the future as the volume of vehicles increases.

Based on the saturation degree value of 0.41, the service level of Jalan Gajah Mada section can be classified in category B, as presented in the following table. The category was obtained by matching the saturation degree value with the classification range that had been set in the guidelines of the Directorate General of Highways in 1997, where the range of 0.21 to 0.44 was classified as service level B with the characteristics of a steady flow even though there were few obstacles (Directorate General of Highways, 1997).

Table 6. Classification of Road Service Level (*Level of Service*)

| Degree of Saturation (DS) | Level of Service | Traffic Flow Conditions |
|---|---|---|
| **0,00–0,20** | A | Free current, high speed |
| **0,21–0,44** | **B** | **Stable current, little resistance** |
| **0,45–0,74** | C | Stable current, limited start speed |
| **0,75–0,84** | D | Unstable near-unstable current |
| **0,85–1,00** | E | Unstable current, close to capacity |
| **> 1.00** | F | Congestion, blocked currents |

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

Category B in the results of the classification indicates that the condition of traffic flow on the Jalan Gajah Mada section is still relatively stable, with the driver having relatively adequate flexibility in determining the driving speed, although the influence of other vehicles around him can be felt even though it is not yet significantly disturbing. These findings provide an idea that although parking activities on the road body also contribute to the level of side obstacles in the medium category, these conditions have not lowered the level of road services to the critical category. However, considering the contribution of PSV which dominates the total side obstacles, it is necessary to be aware that if there is no arrangement of parking activities on the road body, the condition of the service level which is currently still relatively stable has the potential to experience a decrease in quality in the future along with the growth in the number of vehicles and the intensity of activities along the road.

Thus, it can be concluded that the effect of parking on the road body on traffic performance on the Jalan Gajah Mada section is real and measurable, as shown by the large contribution of PSV to the total value of side obstacles, but overall the influence is still within the limits that can be tolerated by the current available road capacity. These findings are an important basis for related parties to consider a more organized parking management policy along the Jalan Gajah Mada section, in order to maintain traffic performance at a good level of service in the long term.

## Discussion

### *Volume of Vehicle Traffic Crossing the Gajah mada Road Section, Bima City*

The results of the observation over three days showed that the traffic volume on the Jalan Gajah mada section experienced quite sharp fluctuations between time periods, with a relatively consistent pattern on the three days of the survey. The lowest volume consistently appears in the morning period, while the highest volume always occurs in the afternoon period before night, namely at 17.15–18.15 WITA for Monday at 877.1 smp/hour, at 17.45–18.45 WITA for Tuesday at 875 smp/hour, and at the same hour for Wednesday at 873.9 smp/hour. The similarity in the amount of peak volume on the three days indicates that the pattern of community movements around the road section is routine and repetitive, not incidental, so that the afternoon hours can be categorized as *fixed peak hours* in this segment. This pattern is in line with the characteristics of mixed areas dominated by trade, office, and educational activities, as mentioned in the location overview, where hours after work and afternoon shopping activities are stacked on top of each other, resulting in a greater accumulation of vehicle flows than other periods.

When examined in terms of vehicle composition, motorcycles (MC) dominate the traffic flow significantly compared to light vehicles (LV) and heavy vehicles (HV) in almost all observation intervals, especially in the afternoon period. This dominance shows the typical characteristics of small and medium-sized cities in Indonesia, where motorcycles are the main mode of transportation for the community due to their flexibility and lower operational costs. Although the volume of vehicles (kend/hour) of motorcycles is much higher, the equivalent value of passenger cars (*emp*) by 0.4 causes its contribution to the flow in junior high units/hour to be not as large as its physical volume, but remains the main contributor to the total traffic flow. This condition is different from the findings Sihombing & Darmiyanti (2022) on the Jalan Walanda Maramis section which has a much larger capacity due to different road characteristics, thus emphasizing that the amount of traffic volume of a road section is highly dependent on the type of road, effective width, and activity patterns of the surrounding area. With a peak volume of 877.1 smp/hour which is then compared to the capacity of

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

the analysis of 2,161 smp/hour, it can be concluded that in terms of quantity of traffic flow on Jalan Gajah mada has not exceeded the capacity of the road, but the pattern of flow concentration in the afternoon still needs to be a concern in traffic management in the future, especially if there is an addition of side obstacles such as parking on the road body.

***The Effect of Parking on the Road Body on Traffic Performance on the Gajah mada Road Section, Bima City***

The results of the analysis of side obstacles during peak hours show that parking and stopping vehicle (PSV) activities are the largest contributors to the frequency of side obstacle weights, which is 200 out of a total of 417.3, far exceeding the contribution of pedestrians, vehicles entering and exiting, and slow vehicles. The large proportion of PSVs indicates that parking on the road body is the dominant factor that forms the class of moderate side obstacles (*Medium*) on the road (Tamin, 2000). These findings reinforce the results of the study Bau et al. (2023) on Jalan Sulawesi, Makassar City, which states that the increase in parking activities is directly proportional to the increase in the degree of saturation and the decrease in the level of road services, and in line with the Bahri et al. (2018) which confirms that parking on the road body plays a significant role as a side obstacle that reduces the performance of the road section (Budiharjo et al., 2021; Seran & Klau, 2022).

Quantitatively, the existence of parking on the road body also reduces the speed of vehicle free flow through the side obstacle adjustment factor (FFVsf) and capacity correction factor (FCsf) by 0.9, so that the road capacity is corrected from a base value of 2,900 smp/hour to 2,161 smp/hour. The reduction in capacity due to this side obstacle then has an impact on the value of the degree of saturation of 0.41 with a service level (LOS) B, which illustrates that the flow is still relatively stable even though the influence of side friction begins to be felt by the driver. When compared to research Seran & Klau (2022) which recorded a degree of saturation of 0.77 (LOS E) in the existing condition of Jalan Cak Doko, and Gustari et al. (2023) who found that the LOS decreased from C to D due to parking on Jalan Sutomo, the condition of Jalan Gajah mada was relatively better. This difference is mainly due to the geometric characteristics of a one-way road with a relatively large base capacity so that it is able to absorb parking disturbances without directly pushing the flow to a saturated condition (Romney, 2018; Septiansyah & Wulansari, 2018). However, the high proportion of PSVs to the total side barriers indicates that if parking intensity continues to increase in line with the growth of trade activities along the road, the potential for capacity reduction and a shift in service levels to a lower category, as found in previous studies, is very likely to occur if it is not balanced with stricter parking arrangements, such as the implementation of parking bans during peak hours as Recommended by Seran & Klau (2022) or relocation of parking points as carried out by Bahri et al. (2018).

***Research Limitations***

This study has a number of limitations that need to be stated honestly. First, in terms of survey duration, primary data collection was only carried out for three working days (Monday-Wednesday) with three observation sessions per day, so it was not able to capture variations in traffic flows on weekends, holidays, or *seasonal fluctuations* due to weather changes, certain events, or congested periods such as holidays. Second, the scope of the research location is limited to one 200-meter segment on the Jalan Gajah Mada section, causing the results of the *analysis of the degree of saturation* and *level of service* (LOS) to be generalized for the entire national road section as well as other one-

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

way road sections with different geometric and socio-economic characteristics. Third, the free *flow speed* and road capacity values are calculated based on the guidelines of *the Indonesian Road Capacity Manual* (MKJI, 1997) which is quite old, so that the adjustment factors in it have the potential to be less representative of current traffic conditions and vehicle composition. These limitations open up opportunities for further research to extend the duration of the survey, expand the coverage of the road segment, and consider updating more advanced road capacity analysis methods.

## CONCLUSION

This study shows that Jalan Gajah Mada, Bima City, with type 2/1 TT, has the highest peak volume of 877.1 smp/hour on Monday afternoon, dominated by motorcycles, with a *consistent peak hour* pattern for three days of observation. Parking *and stopping vehicles* (PSVs) were shown to be the largest contributors to side obstacles (200 out of 417.3), classifying this segment in the medium side obstacle class. This reduces the *free flow speed* to 42.12 km/h and the road capacity to 2,161 smp/h, resulting in a *degree of saturation* (DS) of 0.41 with *a level of service* (LOS) category B. Although traffic performance is still relatively stable, the dominance of PSV indicates vulnerability to performance degradation in the future. *The limitation of* this study lies in the duration of the survey which is only three working days without taking into account seasonal variations, holidays, or weather conditions, so the generalization of results is limited. *The implication* of these findings is the need to raise awareness that the abandonment of illegal parking on the road has the potential to accelerate the decline in LOS as vehicle volume grows, thus becoming an important basis for traffic management policies and parking space arrangements in similar commercial areas.

Based on these findings, it is recommended that the local government and related agencies immediately implement stricter parking regulations, such as prohibiting *on-street parking*, especially during peak hours in the afternoon, as well as providing alternative parking spaces (*off-street parking*) for shops, educational institutions, and Muhammadiyah Hospitals so as not to burden the effective space of the road. Enforcement of rules in the form of parking prohibition signs and routine patrols also needs to be improved to prevent the return of illegal parking practices. In addition, socialization to business actors and the surrounding community regarding the impact of careless parking on smooth traffic needs to be encouraged on an ongoing basis. For *further research*, it is recommended to extend the duration of observation to include weekends, holidays, and seasonal variations to obtain a more comprehensive picture of traffic flows, as well as to simulate projected traffic volume in the next few years using *forecasting* methods to anticipate potential LOS declines. Follow-up research can also examine the effectiveness of parking management policies through a *before-after study* approach to measure the real impact of interventions on road performance.

## ACKNOWLEDGMENT

The acknowledgment section should be written in Lato font, size 11 pt, single spacing, and without additional spacing between paragraphs. This section is optional and may be included if the author wishes to express appreciation to individuals or institutions that contributed significantly to the research, writing, or funding of this study. Acknowledgments may include funding agencies (if any), research collaborators, affiliated institutions, supervisors, or other contributors who supported the

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

research and publication process. The names of the authors should not appear in this section. The acknowledgment should be formal, concise, and proportional to the level of contribution.

## REFERENCES

Al Fikri, A. Y., Septiari, A., Rizani, M. D., & Ariawan, D. (2021). Pengaruh parkir pada badan jalan MT. Haryono terhadap kinerja ruas jalan. *Jurnal Teknik Sipil Giratory UPGRIS*, *2*(1), 24–30. https://doi.org/10.26877/giratory.v2i1.9452

Alwan, M. R., Erwan, K., & Kadarini, S. N. (2021). Analisis dampak parkir terhadap kinerja lalu lintas di ruas jalan sekitar Mall Matahari Kota Pontianak. *JeLAST: Jurnal Teknik Kelautan, PWK, Sipil, dan Tambang*, *8*(1). https://doi.org/10.26418/jelast.v8i1.44619

Ariesandi, J. A., Resita, R., & Salsbabila, Z. (2020). Kebijakan transportasi umum (angkot) untuk menanggulangi kemacetan jalan. *Jurnal Kebijakan Publik*, *11*(2), 77–82. https://doi.org/10.31258/jkp.v11i2.7905

Arrang, A. T., & Rangan, P. R. (2020). Arus lalu lintas, kapasitas dan tingkat pelayanan ruas jalan dalam Kota Rantepao. *Journal Dynamic Saint*, *5*(1), 874–883. https://doi.org/10.47178/dynamicsaint.v5i1.955

Bahri, S., Saputra, R., & Afrizal, Y. (2018). Analisis pengaruh kendaraan parkir di badan jalan sebagai hambatan samping terhadap kinerja ruas Jalan Mahoni Kota Bengkulu. *Jurnal Inersia*, *10*(2), 69–74.

Bau, Q. D., Asrib, A. R., & Zainal, A. S. R. (2023). Pengaruh parkir pada badan jalan terhadap kinerja ruas Jalan Sulawesi di Kota Makassar. *Jurnal HPJI (Himpunan Pengembangan Jalan Indonesia)*, *9*(2), 141–152. https://doi.org/10.26593/jhpji.v9i2.7011.141-152

Budiharjo, A., Sahri, A., & Purwanto, E. (2021). Kajian manajemen lalu lintas kawasan central business district (CBD) di Kota Tegal. *Jurnal Keselamatan Transportasi Jalan (Indonesian Journal of Road Safety)*, *8*(1), 38–52. https://doi.org/10.46447/ktj.v8i1.291

Direktorat Jenderal Bina Marga. (1997). *Manual Kapasitas Jalan Indonesia (MKJI)*. https://habib00ugm.wordpress.com/wp-content/uploads/2010/07/mkji.pdf

Gustari, S., Lubis, M., & Malik, M. H. (2023). Pengaruh parkir pada badan jalan terhadap kinerja ruas Jalan Sutomo Kota Medan. *Jurnal Aspirasi Teknik Sipil*, *1*(2), 58–64. https://doi.org/10.35438/aspal.v1i2.14

Hanafi, F. G., Putri, F. A., & Sriharyani, L. (2023). Penilaian hambatan samping pada ruas jalan Kota Bandar Lampung. *JUMATISI: Jurnal Mahasiswa Teknik Sipil*, *4*(2), 309–317. https://doi.org/10.24127/jumatisi.v4i2.5210

Hobbs, F. D. (2016). *Traffic planning and engineering*. Pergamon.

Kriswardhana, W., Widanar, M. S., Arifin, S., & Sulistyono, S. (2020). Model hubungan arus, kecepatan, dan kepadatan di jalan empat lajur dua arah. *Teras Jurnal: Jurnal Teknik Sipil*, *10*(1), 89–99. https://doi.org/10.29103/tj.v10i1.273

Kurniawan, W., & Maani, K. D. (2019). Implementasi kebijakan pembangunan infrastruktur jalan di Kecamatan Tabir Selatan Kabupaten Merangin dengan menggunakan model Donald Van Metter dan Carl Van Horn. *Jurnal Manajemen dan Ilmu Administrasi Publik (JMIAP)*, *1*(4), 67–78. https://doi.org/10.24036/jmiap.v1i4.95

Mastuti, R., Chalik, A., Kurniawan, T. S., & Natasha, N. (2021). Dampak pembangunan jalan desa terhadap kondisi sosial masyarakat. *Jurnal Pemberdayaan Komunitas MH Thamrin*, *3*(2), 112–120. https://doi.org/10.37012/jpkmht.v3i2.555

Mawardin, A. (2022). Analisis efektivitas jalan satu arah (Studi kasus Jalan Sultan Hasanuddin–Jalan Gajah Mada Kota Bima). *Spektrum Sipil*, *9*(1).

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*

Oktopianto, Y., Shofiah, S., Rokhman, F. A., Wijayanthi, K. P., & Krisdayanti, E. (2021). Analisis daerah rawan kecelakaan (black site) dan titik rawan kecelakaan (black spot) Provinsi Lampung. *Borneo Engineering: Jurnal Teknik Sipil*, *5*(1), 40–51. https://doi.org/10.35334/be.v5i1.1777

Paays, I. F., Amahoru, J., & Waas, R. (2019). Pengaruh parkir pada badan jalan terhadap kinerja ruas Jalan Raya Pattimura Kecamatan Sirimau Kota Ambon. *Manumata: Jurnal Ilmu Teknik*, *5*(2), 47–55.

Paikun, P., SP, R. W. A., Destaman, F., & Winardi, D. (2021). Road geometric feasibility in Road Sagaranten–Tegalbuleud Km. BDG 175+100. *ASTONJADRO*, *10*(1), 117–134. https://doi.org/10.32832/astonjadro.v10i1.4213

Paisal, P., Matarru, A., Primawati, E. R., Yulianti, Y., & Akbar, M. (2022). Dampak *on-street parking* terhadap kinerja jalan. *Jurnal Teknik Sipil: Rancang Bangun*, *8*(2), 144–149. https://doi.org/10.33506/rb.v8i2.1985

Prayudha, M. I., Riani, D., & Desriantomy, D. (2022). Analisis tingkat kondisi jalan menggunakan metode *Surface Distress Index* di Kota Palangka Raya (Studi kasus: Jalan Rajawali). *Spektrum Sipil*, *9*(2), 180–186.

Putra, N. M., Silitonga, S. P., & Robby, R. (2021). Analisis sisa umur rencana jalan berdasarkan pertumbuhan lalu lintas di Kota Palangka Raya. *Jurnal Teknika: Jurnal Teoritis dan Terapan Bidang Keteknikan*, *4*(2), 155–164. https://doi.org/10.52868/jt.v4i2.2729

Romadhona, P. J. (2018). Solusi jalan satu arah di Kota Yogyakarta. *TEKNIK*, *39*(1), 25–31.

Septiansyah, M. V. M., & Wulansari, D. N. (2018). Analisa kinerja ruas Jalan Medan Merdeka Barat, DKI Jakarta. *Jurnal Kajian Teknik Sipil*, *3*(2), 110–115. https://doi.org/10.52447/jkts.v3i2.1354

Seran, E. N. B., & Klau, M. J. (2022). Pengaruh parkir di badan jalan terhadap kinerja ruas Jalan Cak Doko. *Eternitas: Jurnal Teknik Sipil*, *2*(1), 40–49. https://doi.org/10.30822/eternitas.v2i1.1756

Sihombing, S. M., & Darmiyanti, L. (2022). Analisis pengaruh hambatan samping terhadap kinerja kapasitas lalu lintas pada Jalan Ir. H. Juanda Bekasi Timur. *Jurnal Sipil Krisna*, *8*(2), 30–37. https://doi.org/10.61488/sipilkrisna.v8i2.166

Tamin, O. Z. (2000). *Perencanaan dan pemodelan transportasi.* Penerbit ITB.

Undang-Undang Republik Indonesia. (2004). *Undang-Undang Republik Indonesia Nomor 38 Tahun 2004 tentang Jalan.* https://peraturan.bpk.go.id/Details/40785/uu-no-38-tahun-2004

Warpani, S. P. (2002). *Pengelolaan lalu lintas dan angkutan jalan.* Penerbit ITB.

Wijanarko, I., & Ridlo, M. A. (2019). Faktor-faktor pendorong penyebab terjadinya kemacetan: Studi kasus kawasan Sukun Banyumanik Kota Semarang. *Jurnal Planologi*, *14*(1), 63.

Zulvia, A., Rizani, M. D., & Suwandi, P. A. P. (2022). Analisa karakteristik parkir dan pengaruh *on-street parking* terhadap kinerja lalu lintas (Studi kasus pada ruas Jalan Kartini Kota Salatiga). *Jurnal Teknik Sipil Giratory UPGRIS*, *3*(2), 66–71. https://doi.org/10.26877/giratory.v3i2.14505

*Copyright © 2026, the author(s). This is an open access article under the CC-BY-SA License.*