P-ISSN : 2598-1277
E-ISSN : 2621-3966

# JOURNAL OF GREEN SCIENCE AND TECHNOLOGY

## ANALYSIS OF THE IMPACT OF TRIP GENERATION AT THE SIDE GATE OF PT NIKOMAS GEMILANG ON ROAD PERFORMANCE USING PKJI 2023

**Ritha Junia Hastuti[1], Muhammad Oka Mahendra[1*]**

*[1] Civil Engineering Department, Universitas Serang Raya, Serang.*
*Corresponding Author's Email: muhammadoka81@gmail.com*
*Corresponding Author's Phone Number: 088211174102*

**ABSTRACT**

Industrial activity is one of the sources of trip generation that can potentially increase traffic volume and affect road segment performance. This study aims to analyze the impact of industrial activity trip generation on the performance of Jalan Raya Serang–Jakarta Km 71 in front of PT Nikomas Gemilang using the 2023 Indonesian Road Capacity Guidelines (PKJI 2023). A quantitative descriptive method was employed, with primary data collected through field surveys conducted on Monday, covering normal hours from 11:00–13:00 WIB and peak hours from 16:00–18:00 WIB. The collected data included road geometry, traffic volume, and side friction, while secondary data were obtained from relevant agencies and a literature review. The results showed that traffic volume was 4,526 PCU/hour during normal hours and 5,769 PCU/hour during peak hours, resulting in industrial activity trip generation of 1,243 PCU/hour. Side friction increased from the Very Low category during normal hours to the Very High category during peak hours. Consequently, road capacity decreased from 7,524 PCU/hour to 6,308 PCU/hour, while the degree of saturation (DS) increased from 0.60 (LOS C) to 0.91 (LOS E). As a mitigation alternative, a simulation was conducted by changing the road type from 4/2 TT (four-lane, two-way undivided road) to 4/2 T (four-lane, two-way divided road) with a median. The simulation results indicated improved road performance, with DS values of 0.62 and 0.69 in each direction, corresponding to Level of Service (LOS) C. The recommended road type modification represents an initial technical scenario based on the PKJI 2023 analysis and does not constitute a final design decision. Its implementation requires further assessment of road geometry, traffic safety, access management, space requirements, and coordination with the National Road management authority before implementation.

**Keywords:** trip generation, road segment performance, PKJI 2023, degree of saturation, level of service (LOS).

### 1. INTRODUCTION

Transportation plays a crucial role in facilitating community mobility, supporting the distribution of goods, and promoting regional economic development [1]. A good transportation system ensures the smooth movement of people and goods, enabling various social and economic activities to proceed effectively [2]. With increasing development and growth of regions and industries, the demand for travel continues to rise [3]. This leads to heavier traffic loads on road sections, requiring road infrastructure that can optimally accommodate vehicle movement [4].

Traffic congestion is a common problem on roads with high activity levels [5]. It generally occurs when the vehicle volume approaches or exceeds the road capacity, causing traffic flow to become unstable [6]. Besides high vehicle volume, congestion can be triggered by lateral obstructions such as vehicles stopping on the road, vehicles entering and exiting an area, pedestrian movement, and public

P-ISSN : 2598-1277
E-ISSN : 2621-3966

transportation activities that pick up and drop off passengers at the roadside [7]. These conditions reduce the effective road capacity and lower the level of traffic service [6].

One area with potential to generate traffic movement is the industrial area [8]. Trip generation refers to the number of trips produced by a land use due to human or economic activities at that location [9]. Industrial areas typically generate a large volume of vehicle movements from employee vehicles, company operational vehicles, logistics vehicles, and public transportation [8]. If this trip generation is not matched by adequate road capacity and effective traffic management, it will negatively impact the performance of surrounding road sections [10].

The increase in industrial activity and rapid regional development has led to a rise in travel demand and traffic load on the road network [11]. This situation requires periodic evaluation of road performance to ensure that road capacity and service levels remain optimal [12]. In this context, road performance analysis is important to identify the level of congestion and potential traffic problems on road segments [13].

PT Nikomas Gemilang, located on Jalan Raya Serang–Jakarta Km 71, Kibin District, Serang Regency, is one of the largest manufacturing industrial areas in Serang Regency, employing tens of thousands of workers. During shift changes, there is a significant increase in vehicle movement due to entry and exit activities in the industrial area. Additionally, vehicles stopping at the roadside to pick up and drop off passengers, along with high pedestrian activity, increase lateral obstructions and often cause traffic flow delays. These conditions show that industrial activities impact the performance of the Serang–Jakarta Km 71 road segment, necessitating a more in-depth analysis.

Previous studies have generally focused on evaluating road performance or traffic conditions using road capacity analysis, while limited attention has been given to quantifying trip generation caused by industrial activities and its direct influence on road segment performance using the latest Indonesian Road Capacity Guidelines (PKJI 2023). As the updated national guideline replacing previous standards, PKJI 2023 provides a more relevant framework for evaluating current traffic conditions. Therefore, this study addresses this research gap by analyzing industrial trip generation and its impact on road performance during both normal and employee shift-change periods at PT Nikomas Gemilang, one of the largest manufacturing industrial areas in Serang Regency with very high employee and vehicle movement.

Based on these conditions, this study aims to analyze the impact of traffic generation from the industrial activities of PT Nikomas Gemilang on the performance of the Serang–Jakarta Km 71 road segment, using the Indonesian Road Capacity Guidelines (PKJI) 2023 method [14]. The analysis is conducted through calculations of traffic volume, side friction, road segment capacity, degree of saturation, and level of service during both normal and peak hour conditions [15]. The research results are expected to provide an overview of the impact of industrial activities on road performance and serve as a basis for developing alternative solutions to improve traffic flow at the study location.

## 2. RESEARCH METHOD

This study used a descriptive quantitative method with a field survey approach. The analysis was based on the Indonesian Road Capacity Guidelines (PKJI) 2023 for Intercity Road Capacity because the Serang–Jakarta Highway section is a national road with a primary arterial function. Although the four-lane two-way undivided (4/2 TT) road type is not recommended for intercity roads according to PKJI 2023 (Appendix 10.1), the analysis was still conducted to evaluate the existing conditions in accordance with the geometric characteristics of the road segment at the research location.

### 2.1. Data Collection

The research data consisted of primary and secondary data. Primary data were obtained through field surveys conducted on Monday, including observations during normal hours from 11:00 AM to 12:00 PM WIB and peak hours from 4:30 PM to 5:30 PM WIB. The survey periods were selected to compare traffic conditions during normal activities and industrial employee shift changes. The traffic volume data used in the analysis represented the total vehicle volume recorded during the 2-hour observation

P-ISSN : 2598-1277
E-ISSN : 2621-3966

period for each condition, including normal hours and peak hours. The collected data included road geometry, traffic volume, and side friction.

Road geometric data were obtained through direct measurements at the study location as the basis for determining the road capacity. Traffic volume data were collected using the traffic counting method and converted into passenger car units (PCU) using passenger car equivalent (EMP) values based on PKJI 2023. Side friction data were obtained through observations of roadside activities and calculated using weighted frequency according to PKJI 2023 to determine the side friction class.

### 2.2. Trip Generation Analysis

Trip generation analysis was conducted to determine the magnitude of the additional traffic flow caused by industrial activities during employee shift change periods. Traffic generation was calculated as the difference between traffic volume during peak hours and traffic volume during normal hours, where traffic volume during normal hours was assumed to be background traffic not predominantly influenced by industrial activities.

### 2.3. Research Stages

The research stages were carried out systematically, starting from literature study, problem identification, primary and secondary data collection, trip generation analysis, road segment performance analysis based on PKJI 2023, and concluding with conclusion formulation. The research flow is shown in Figure 1.

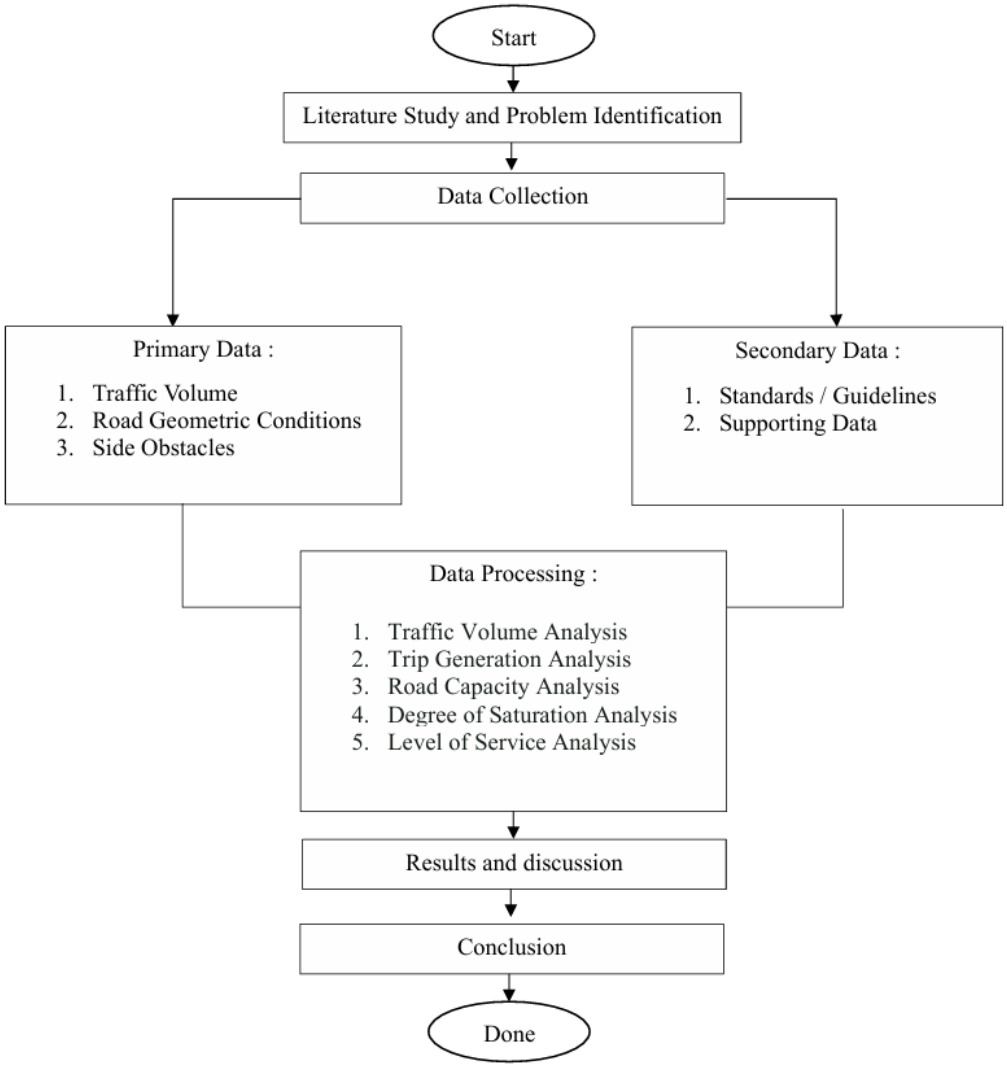


**Figure 1.** Flowchart

P-ISSN : 2598-1277
E-ISSN : 2621-3966

## 3. RESULTS AND DISCUSSION

The research was conducted on the Jalan Raya Serang–Jakarta Km 71 road segment, in front of PT Nikomas Gemilang, Kibin District, Serang Regency, Banten Province, Indonesia. This stretch of road is one of the main routes connecting the Serang area with Jakarta and facilitates vehicle movement toward the surrounding industrial area. The segment under review is the area around the main gate of the Nikomas Gemilang Factory. At this location, there are activities involving the entry and exit of employee vehicles, as well as public transportation serving worker mobility. These conditions have the potential to cause traffic congestion, especially during peak hours. The research location is shown in Figure 2.


Source: Google Earth.

**Figure 2.** Research Location Map

### 3.1. Road Geometric Conditions

The geometric characteristics of the road are among the parameters used in the performance analysis of road segments based on PKJI 2023. Geometric data were obtained through field surveys at the research location to determine the road function, road status, road class, and road segment type, which serve as the basis for capacity calculations and traffic performance evaluations. The results of the geometric characteristics identification of the Jalan Raya Serang–Jakarta Km 71 road segment in front of PT Nikomas Gemilang are presented in Table 1.

**Table 1.** Road Geometric Conditions

| No. | Classification | Condition |
|---|---|---|
| 1 | Road Function | Arterial |
| 2 | Road Class | I |
| 3 | Road Status | National |
| 4 | Road Type | 4/2 TT |

P-ISSN : 2598-1277
E-ISSN : 2621-3966

Source: Authors' Analysis, 2026.

The study road segment is classified as a Primary Arterial road with National status and Class I road. This road segment accommodates long-distance traffic movement with a relatively high vehicle volume. The road type at the research location is 4/2 TT (four lane, two-way undivided), consisting of four traffic lanes without a median.

**Table 2.** Road Segment Data

| Street Name | Jalan Raya Serang–Jakarta Km 71 |
|---|---|
| Road Type | 4/2 TT |
| Pavement Type | Asphalt |
| Width of West Lane | 7.00 m |
| Width of East Lane | 7.00 m |
| Lane Width | 3.50 m |
| Shoulder Width | 1.00 m |

Source: Authors' Analysis, 2026.

The road segment data were obtained to identify the physical characteristics and existing condition of the road, which were used as parameters in the road capacity analysis.

### 3.2. Traffic Volume

Traffic volume was calculated based on the number of vehicles passing according to their types: passenger cars (PC), medium vehicles (MV), large buses (LB), large trucks (LT), and motorcycles (MC) during normal and peak hours. The number of vehicles was then converted into passenger car units (PCU) using the EMP values to standardize the units for all vehicle types.

**Table 3.** Traffic Flow Data

| Vehicle Type | EMP | Normal Hours (vehicles/h) | Normal Hours (PCU/h) | Peak Hours (vehicles/h) | Peak Hours (PCU/h) |
|---|---|---|---|---|---|
| PC | 1.0 | 947 | 947 | 1,288 | 1,288 |
| MV | 1.2 | 687 | 824 | 501 | 601.2 |
| LB | 1.6 | 54 | 87 | 79 | 126.4 |
| LT | 1.6 | 608 | 973 | 153 | 244.8 |
| MC | 0.25 | 6,781 | 1,696 | 14,036 | 3,509 |
| Total | | 9,077 | 4,526 | 16,057 | 5,769 |

Source: Authors' Analysis, 2026.

Based on the calculations, the traffic volume during normal hours was 4,526 PCU/hour, while it increased to 5,769 PCU/hour during peak hours. This increase indicated denser traffic conditions during employee shift changes. The difference of 1,243 PCU/hour was used as an estimated additional trip generation during the shift-change period. However, this value did not necessarily represent traffic generated solely by industrial activities, as it may also have been influenced by general traffic, commuter trips, interregional traffic, and other roadside activities surrounding the study area.

### 3.3. Side Friction

Side friction was identified from observations of pedestrian activities, stopped or parked vehicles, vehicles entering and exiting, and slow-moving vehicles. Each type of side friction was multiplied by a weight factor according to PKJI 2023, to obtain a weighted frequency used to determine the category of side friction. The results of the weighted side friction calculations during normal and peak hours are presented in Table 4 and Table 5.

P-ISSN : 2598-1277
E-ISSN : 2621-3966

**Table 4.** Side Friction During Normal Hours

| Incident Type | Weight | Incident Frequency | Weighted Frequency |
|---|---|---|---|
| Pedestrians | 0.6 | 20 | 12 |
| Parking or Stopped Vehicles | 0.8 | 10 | 8 |
| Vehicles Entering/Exiting | 1.0 | 25 | 25 |
| NMV | 0.4 | 10 | 4 |
| Total | | | 49 |

Source: Authors' Analysis, 2026.

**Table 5.** Side Friction During Peak Hours

| Incident Type | Weight | Incident Frequency | Weighted Frequency |
|---|---|---|---|
| Pedestrians | 0.6 | 85 | 51 |
| Parking or Stopped Vehicles | 0.8 | 115 | 92 |
| Vehicles Entering/Exiting | 1.0 | 250 | 250 |
| NMV | 0.4 | 120 | 48 |
| Total | | | 441 |

Source: Authors' Analysis, 2026.

The weighted frequency of side friction during normal hours was 49, which falls into the **Very Low** category, while during peak hours, it increased to 441, classified as **Very High**. This increase was influenced by the higher activity of vehicles entering and exiting the industrial area during employee shift changes.

### 3.4. Road Segment Capacity

The capacity of a road segment was calculated as the basis for evaluating the segment's performance. The calculation used the basic capacity and adjustment factors according to the characteristics of the road segment. It was calculated using the equation (1).

$$C = C_o \times F_{CL} \times F_{CPA} \times F_{CHS} \qquad (1)$$

where:
C = Segment capacity, PCU/hour
Co = Basic capacity, PCU/hour
FCL = Lane width correction factor
FCPA = Directional separation adjustment factor
FCHS = Side friction adjustment factor

**Table 6.** Road Segment Capacity Calculation Results

| Condition | $C_o$ | $FC_l$ | $FC_{pa}$ | $FC_{hs}$ | $C$ |
|---|---|---|---|---|---|
| Normal Hours | 7,600 | 1.00 | 1.00 | 0.99 | 7,524 |
| Peak Hours | 7,600 | 1.00 | 1.00 | 0.83 | 6,308 |

Source: Authors' Analysis, 2026.

P-ISSN : 2598-1277
E-ISSN : 2621-3966

The capacity value obtained was 7,524 PCU/hour during normal hours, and 6,308 PCU/hour during peak hours. The difference was caused by the increase in the side friction category from Very Low to Very High, which reduced the FCHS value and thus decreased the road segment capacity.

### 3.5. Degree of Saturation

The degree of saturation (DS) is the ratio between traffic volume and road segment capacity. The DS value is used to describe the level of road capacity utilization and serves as the basis for determining the road's level of service (LOS). The calculation used Equation (2).

$$DS = \frac{Q}{C} \quad (2)$$

where:

DS = Degree of saturation
Q = Traffic volume, PCU/hour
C = Road segment capacity, PCU/hour

Normal Hour $DS = \frac{4526}{7524} = 0.60$

Peak Hour $DS = \frac{5769}{6308} = 0.91$

**Table 7.** Comparison of Degree of Saturation Values

| Condition | Volume (PCU/hour) | Capacity (PCU/hour) | DS | LOS | Traffic Flow Condition |
|---|---|---|---|---|---|
| Normal Hours | 4,526 | 7,524 | 0.60 | C | Smooth, stable flow |
| Peak Hours | 5,769 | 6,308 | 0.91 | E | Congested, unstable flow |

Source: Authors' Analysis, 2026.

The degree of saturation (DS) during normal hours was 0.60 with a service level of LOS C, while during peak hours it increased to 0.91 with a service level of LOS E. These results indicate that the increase in traffic volume during peak hours reduces the road segment performance. LOS C indicates that traffic flow remains stable with relatively good driving conditions, while LOS E condition during peak hours indicates that traffic flow is approaching the road segment capacity, with very limited vehicle maneuvering space, reduced speeds, and unstable traffic conditions where a small increase in traffic volume may cause significant congestion.

### 3.6. Handling Recommendation

Based on the analysis of the existing conditions, a simulation of mitigation recommendations was conducted by reducing side friction and changing the road type to 4/2 divided (4/2 T) with a median. The reduction in side friction was simulated through the optimization of public transport stopping areas within the PT Nikomas Gemilang industrial area, the installation of no-parking signs in front of the factory gate, and the regulation of vehicle entry and exit during employee shift changes.

The proposed mitigation alternatives in this study represent technical scenarios based on the PKJI 2023 analysis to evaluate the potential improvement in road segment performance. These scenarios are not intended as final designs but rather as preliminary alternatives that require further assessment of technical and geometric aspects, road safety, access management, implementation feasibility, and coordination with the agency responsible for managing the National Road. Subsequently, a simulation of the road type modification was conducted to evaluate its effect on road capacity and performance. The simulation results are presented in Table 8.

P-ISSN : 2598-1277
E-ISSN : 2621-3966

**Table 8.** Recommended Road Performance

| Direction | C (PCU/hour) | Q (PCU/hour) | DS |
|---|---|---|---|
| Direction 1 | 4,400 | 2,719.5 | 0.62 |
| Direction 2 | 4,400 | 3,049.9 | 0.69 |

Source: Authors' Analysis, 2026.

Basic capacity (Co) = 4,400 PCU/hour per direction (according to the 4/2 T road type).

Because:

FCL = 1.00
FCPA = 1.00
FCHS = 1.00

**Table 9.** Comparison of Existing and Recommended Conditions

| Parameter | Existing Condition | Recommendation Direction 1 | Recommendation Direction 2 |
|---|---|---|---|
| Road Type | 4/2 TT | 4/2 T | 4/2 T |
| Side Friction | Very High | Low | Low |
| Traffic Volume (PCU/hour) | 5,769 | 2,719.5 | 3,049.9 |
| Capacity (PCU/hour) | 6,308 | 4,400 | 4,400 |
| Degree of Saturation (DS) | 0.91 | 0.62 | 0.69 |
| Level of Service (LOS) | E | C | C |

Source: Authors' Analysis, 2026.

Based on the simulation of changing the road type to 4/2 divided (4/2 T) with a median, the analysis was conducted for each direction in accordance with the provisions of PKJI 2023. The calculation results show that the capacity in each direction is 4,400 PCU/hour. With traffic volumes of 2,719.5 PCU/hour in Direction 1 and 3,049.9 PCU/hour in Direction 2, the resulting degrees of saturation are 0.62 and 0.69, respectively, both of which correspond to Level of Service (LOS) C. These results indicate that changing the road type to a 4/2 divided road can improve road segment performance compared with the existing condition, which has a degree of saturation of 0.91 (LOS E).

The change from 4/2 undivided (4/2 TT) to 4/2 divided (4/2 T) with a median was selected because the median functions to separate traffic flows in opposite directions, reduce vehicle conflicts, and increase road capacity. However, its implementation requires additional space (at least 1–2 m for the median), rearrangement of access points for entering and exiting the industrial area, and coordination with the national road management authority. Therefore, this recommendation represents an initial technical scenario that requires further feasibility studies.

## 4. CONCLUSION

Based on the analysis using the 2023 Indonesian Road Capacity Guidelines (PKJI 2023), industrial activities at PT Nikomas Gemilang generate 1,243 PCU/hour of trip generation, calculated as the difference between traffic volumes during peak and normal hours. The increase in vehicle volume during employee shift changes causes side friction to increase from the Very Low to the Very High category, resulting in a reduction in road capacity to 6,308 PCU/hour, with a degree of saturation (DS) of 0.91 and Level of Service (LOS) E, indicating traffic conditions approaching saturation and an unstable flow.

Based on these findings, a change in road type from 4/2 TT (four-lane, two-way undivided road) to 4/2 T (four-lane, two-way divided road with a median) is recommended as a mitigation alternative. The simulation results indicate improved road performance, with DS values of 0.62 and 0.69 (LOS C) for each direction. Thus, changing the road type has the potential to increase capacity and improve traffic

P-ISSN : 2598-1277
E-ISSN : 2621-3966

operating conditions along Jalan Raya Serang–Jakarta Km 71. However, this recommendation remains a technical scenario that requires further assessment before implementation.

## REFERENCES

[1] Zulpahmi, R. Setiawan, and I. Jayadi, "Analysis of the Impact of Urbanization on Transportation Infrastructure Capacity Using a Dynamic Simulation Model Approach," *Indonesian Journal of Engineering*, vol. 5, no. 1, 2024.

[2] M. Hidayat, D. D. Permadi, and R. T. Oktriadi, "Traffic Congestion Analysis and Ten-Year Traffic Condition Forecasting Using the PKJI 2023 Method: Case Study of the Siliwangi Cicurug–Benda Road," *Jurnal Teknik Sipil MACCA*, vol. 10, no. 1, 2025.

[3] E. P. Arief, S. N. Kadarini, and E. T. Mukti, "Analysis of the Level of Service Index on Jalan Khatulistiwa in Pontianak," *Jurnal Teknik Sipil*, vol. 25, no. 2, 2025.

[4] A. Alyani, S. Mayuni, and Sumiyattinah, "Performance Analysis of the Jalan Pemuda Ngabang Section Using the PKJI 2023 Method," *Jurnal Teknik Sipil*, vol. 24, no. 4, 2024.

[5] H. Hidayat, A. F. Arifin, and M. S. Siregar, "Road Segment Performance Analysis Using the Indonesian Road Capacity Guidelines (PKJI 2023)," *Jurnal Teknik Sipil MACCA*, vol. 10, no. 1, pp. 15–24, 2025.

[6] A. Alyani, S. Mayuni, and Sumiyattinah, "Performance Analysis of the Jalan Pemuda Ngabang Section Using the PKJI 2023 Method," *Jurnal Teknik Sipil*, vol. 24, no. 4, pp. 530–541, 2024.

[7] S. Dayudinata, A. Efendy, A. Fitrayudha, and Isfanari, "Unsignalized Intersection Performance Analysis Based on PKJI 2023," *Jurnal Konstruksi*, vol. 24, no. 1, pp. 221–231, 2026.

[8] M. A. Rahayu, E. P. Raharjo, A. D. Dwipayana, and I. M. Suraharta, "Identification of Key Factors Influencing Trip Generation and Attraction for Industrial Activities," *Jurnal Teknologi Transportasi dan Logistik*, vol. 3, no. 1, pp. 23–32, 2022.

[9] M. R. Hidayat, A. R. N. Fauzi, and M. Azhar, "Analysis of the Impact of Building Development on Road Network Performance," *Media Ilmiah Teknik Sipil*, vol. 14, no. 1, 2026.

[10] M. W. Yusuf, J. Jasman, and I. Fadly, "Road Segment Performance Study Using PKJI 2023," *Sultra Civil Engineering Journal*, vol. 6, no. 2, 2025.

[11] M. A. Putra, S. H. Wibowo, and R. F. A. Nugroho, "Impact of Industrial Area Development on Increased Traffic Volume in Urban Areas," *Jurnal Teknik Sipil Indonesia*, vol. 12, no. 2, 2024.

[12] R. Kurniawan and D. P. Sari, "Urban Road Segment Performance Evaluation Based on PKJI 2023," *Jurnal Transportasi dan Infrastruktur*, vol. 9, no. 1, 2025.

[13] Y. Pratama, A. S. Hidayat, and F. L. Saputra, "Road Level of Service Analysis in High-Activity Areas Using the PKJI 2023 Method," *Jurnal Teknik Sipil dan Perencanaan*, vol. 13, no. 2, 2025.

[14] Direktorat Jenderal Bina Marga, *Indonesian Road Capacity Guidelines (PKJI) 2023*, Kementerian PUPR, 2023.

[15] R. Kurniawan and D. P. Sari, "Road Segment Performance Evaluation Using the PKJI Approach in Urban Areas," *Jurnal Teknik Sipil Indonesia*, vol. 11, no. 1, 2024.

[16] S. I. Putrinur and M. O. Mahendra, "Analysis of the Effect of Traffic Performance on Vehicle Operating Costs Using the MKJI 1997 Method," *Jurnal Konstruksi*, vol. 23, no. 1, pp. 67–75, 2025, doi: 10.33364/konstruksi/v.23-1.2281.

[17] M. O. Mahendra and R. M. Silalahi, "Comparative Analysis of Traffic Performance Using PKJI 2023 and VISSIM at the Serdang Intersection," *PADURAKSA: Jurnal Teknik Sipil Universitas Warmadewa*, vol. 14, no. 2, pp. 240–249, 2025.

[18] M. A. Zakiudin, M. O. Mahendra, and H. Wiguno, "Traffic Performance Evaluation at an Unsignalized Intersection Using the PKJI 2023 Method (Case Study: Jl. Mayor Muslich–Jl. Empat Lima Intersection, Serang City, Banten)," *PADURAKSA: Jurnal Teknik Sipil Universitas Warmadewa*, vol. 15, no. 1, pp. 65–72, 2026.

[19] Holiansyah and M. O. Mahendra, "Toll Booth Requirement Analysis Based on Queueing Theory and Traffic Volume Projections," *Jurnal Konstruksi*, vol. 23, no. 2, pp. 92–103, 2025, doi: 10.33364/konstruksi/v.23-2.2432.

[20] A. N. Oktaviani and M. O. Mahendra, "Evaluation of Multimodal Transportation Integration Facilities at Serang Station," *Journal of Infrastructure Planning and Engineering*, vol. 4, no. 2, pp. 72–82, 2025.