



Evaluation of Traffic Performance on the Ciledug–Pabuaran Road Section on Cirebon Regency

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Abstract

Keywords

Traffic Performance; Traffic Volume; Degree of Saturation; Level of Service; Industrial Area; Ciledug–Pabuaran Road.

The growth of industrial areas in East Cirebon Regency has increased transportation activities and traffic volume on the Ciledug–Pabuaran Road, potentially reducing traffic performance. This study aims to evaluate traffic performance on the Ciledug–Pabuaran Road segment and analyze the impact of industrial development on traffic conditions. The research employed a quantitative approach using field surveys and descriptive analysis. Primary data were collected through traffic volume surveys, vehicle speed measurements, and roadside friction observations, while secondary data were obtained from relevant agencies and the Indonesian Highway Capacity Guidelines (PKJI). The analysis included calculations of traffic volume, road capacity, volume-to-capacity ratio (V/C Ratio), and Level of Service (LOS). The results indicate that the average traffic volume reached approximately 16,000 vehicles per day, while the effective road capacity was 1,078 vehicles per hour. The V/C ratio of 1.05 indicates that the road segment operates beyond its capacity (overcapacity). High roadside friction caused by industrial activities contributed to a decline in the Level of Service to categories D–E during peak hours. The study concludes that industrial area development has a significant impact on increasing traffic congestion and reducing road performance. Therefore, mitigation measures such as the implementation of Traffic Impact Analysis (ANDALALIN), industrial access management, and road capacity improvements are necessary to support traffic flow efficiency and road safety.

Introduction

Roads are a crucial element in the transportation system because they function to connect various regions (Indonesian Law No. 38 of 2004 concerning Roads with the Grace of God Almighty President of the Republic of Indonesia, n.d.). Roads play an active role in the development process, where areas with good road facilities generally develop more rapidly than locations that do not have adequate road facilities (Almatar, 2024; Das & Maitra, 2024; Kar et al., 2023). According to (Department of Transportation, Directorate General of Land Transportation in 2010), the total length of roads in West Java Province reached 7. 204 km. The details of the length of the road consist of the length of the national road which reaches 601.8 km, the length of the provincial road is 1. 763 km, and the district roads reach 4. 840 km. From this information, district roads are detected as the longest routes compared to national and provincial roads.

Cirebon Regency is one of the districts in West Java Province. The capital city is located in Sumber District, which borders Cirebon City as well as several other districts such as Indramayu, Kuningan, Majalengka, and Brebes (Central Java). Roads in Cirebon Regency are part of the district road network in West Java. Based on data from the highway office in 2013, the total length of roads in Cirebon Regency is 646.65 km. The Cirebon Regency Transportation Agency in 2015 also stated that roads in this area are included in the category of primary local roads that have a width of between 3 to 7 meters. After the increase in industrial development in the East Cirebon area, especially around Ciledug and Districts (Darmansyah et al., 2014; Dede et al., 2022; Rahayu, 2016; Susiati et al., 2026; Tirtosudarmo, 2012).

Pabedilan, traffic conditions in the area are getting busier. What's more, the number of vehicles in operation continues to increase every day (Supriatna et al., 2020; Aminanto et al., 2024). This situation further worsens traffic congestion in East Cirebon, which borders directly with the Central Java and Kuningan regions (Supriatna et al., 2020; Rahmawati et al., 2025). As is well known, the peak of vehicle density occurs several times a day. It starts from the morning when working hours and when children go to school. Then it will continue during the day along with community activities, and again in the afternoon during the hours after work (Wulandari & Fajri, 2025; Aminanto et al., 2024). Most of the traffic congestion is caused by two- and four-wheeled vehicles, such as motorcycles and employee transport cars in the morning and evening, while the day is filled with people traveling to shopping centers (Wulandari & Fajri, 2025; Buulolo et al., 2023), as well as the existence of intercity bus terminals and stations connecting Kuningan, Brebes, and Cirebon Regency as well as access to the Ciledug toll road (Buulolo et al., 2023; Rahmawati et al., 2025; Prasetyo et al., 2024).

The novelty of this research lies in its comprehensive analysis of traffic performance on the Ciledug–Pabuaran road section using PKJI 2023, specifically focusing on the impact of industrial area development. Unlike prior studies that often analyze road performance in isolation, this research examines the direct relationship between industrial development and traffic performance parameters, including volume, capacity, V/C ratio, and level of service. The research also considers the specific characteristics of the Ciledug–Pabuaran corridor, including its role as a primary local road connecting multiple regencies and its exposure to side obstacles from industrial activities. This approach provides a more complete understanding of the mechanisms through which industrial development affects traffic conditions.

The development of industrial estates in the East Cirebon Regency area has a significant impact on increasing traffic density on the Ciledug-Pabuaran Road section. The increasing volume of vehicles every day has the potential to cause new traffic problems, so preventive measures are needed so that traffic flows are kept smooth and do not interfere with community activities along the route. This study is focused on evaluating the performance of road sections on traffic flow from the Ciledug-Pabuaran direction and vice versa due to the existence of industrial estates, as well as identifying the magnitude of the impact of traffic caused. In addition, this study also emphasizes the importance of coordination and continuous monitoring through collaboration between local governments, industrial companies, and the community in planning development based on traffic

data. The discussion of the research was limited to the calculation of vehicle volume, road capacity, saturation level, and road service level without discussing the road network as a whole. The purpose of this research is to identify the performance of road sections, determine the impact of traffic due to industrial areas, and determine the appropriate type of handling of traffic problems that occur. The results of the research are expected to be a policy reference for local governments and industrial companies in the preparation of Traffic Impact Analysis (Andalalin), as well as a reference for further research related to the evaluation of traffic impacts on industrial estates and other activity centers.

Research Methods

This research was conducted on the Ciledug - Pabuaran road section located in East Cirebon Regency, West Java Province, Indonesia. This road section is an integral part of the district road network with the primary local road classification, as regulated in (Indonesian Law no. 38 OF 2004 CONCERNING ROADS, n.d.). Based on the latest data from the Cirebon Regency Transportation Agency in 2022, the total road length in Cirebon Regency reached 712.45 km, an increase from 646.65 km in 2013, with the Ciledug - Paabuaran section having a length of about 15-20 km and a road width ranging from 3-7 meters. This location was chosen because it is strategically located as the main link between the East Cirebon area and Kuningan Regency (West Java) and Brebes Regency (Central Java), becoming an important route for product distribution and community mobility.

This road section crosses areas with high economic activity, including industrial estates in Ciledug and Pabedilan Districts. The East Cirebon industrial estate has experienced significant growth with an investment value of Rp 25 trillion according to (BKPM NO. 2 OF 2023, n.d.), involving more than 50 manufacturing and logistics companies. This can increase the volume of daily traffic, especially during peak hours, with an estimated growth of motor vehicles in West Java of 8-10% per year according to BPS 2023 data.

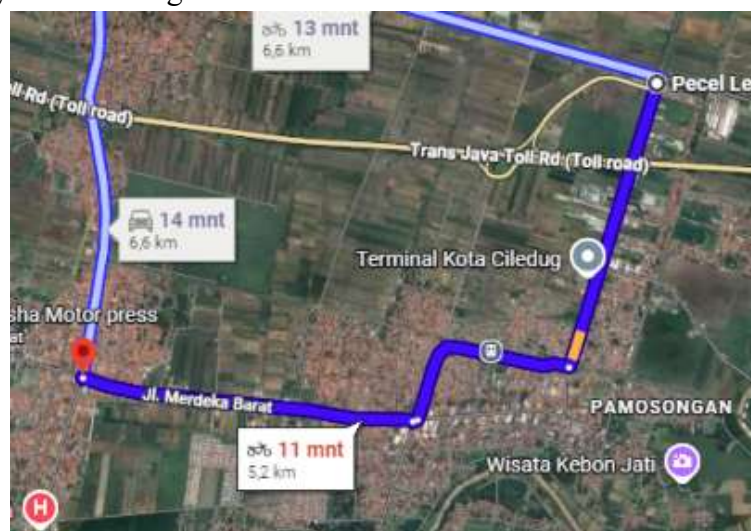


Figure 1 Research Location Jl. Merdeka Barat – Merdeka Utara Ciledug Pabuaran
(Source: Maps Year 2026)

Types of Research

This study uses a quantitative approach with field surveys and descriptive-comparative analysis methods. A quantitative approach is used because this study focuses on the numerical measurement of traffic parameters, such as volume, capacity, and saturation level, which can generalize results based on empirical data. The field survey method is carried out through direct observation to obtain accurate primary data, while descriptive analysis is used to describe traffic conditions and comparative analysis to compare the impacts before and after industrial development based on the latest secondary data.

Data Source

1. **Primary Data:** Obtained directly from the field by means of traffic volume surveys, speed measurements, and observation of side obstacles. The survey was conducted for 2 weeks, with an observation duration of 3 hours per peak hour period.
2. **Secondary Data:** Obtained from official sources such as (LKPI of the Cirebon Regency Transportation Agency in 2023, n.d.). West Java Central Statistics Agency (BPS) (in 2023), Indonesian Road Capacity Guidelines (PKJI, 2020 edition), and (Government Regulation NUMBER 32 OF 2011, n.d.). The latest data includes the growth of motor vehicles in West Java (an increase of 9.2% in 2022-2023) and industrial investment in East Cirebon (IDR 25 trillion in 2023).

Data Collection Techniques

Data collection techniques are carried out systematically using standard tools and procedures to ensure accuracy and reliability. Here are the details of the techniques used:

1. **Traffic Counting Survey:** Using manual tally counters and mobile apps (such as the Traffic Count App) to calculate the number of vehicles per type (two-wheelers, four-wheelers, heavy-duty vehicles, and buses) in 15-minute intervals. The survey was conducted at three main observation points on the Ciledug - Pabuaran section (Ciledug to Pabuaran direction and vice versa). Data was collected for 3 consecutive days during peak hours: morning (06.00-09.00), afternoon (11.00-14.00), and afternoon (16.00-19.00), based on the density pattern from the 2023 Transportation Agency data.
2. **Road Speed and Capacity Measurement:** Using a radar gun or a GPS-based app (such as Waze or Google Maps data) to measure the average speed of a vehicle. The road capacity is calculated based on the 2020 MKJI formula, which takes into account lane width (3-7 meters), number of lanes (2 lanes), and side obstacles. Road geometric data is obtained through direct measurements using roll meters and GPS.
3. **Observation of Side Obstacles:** Through an observation checklist to identify and quantify obstacles such as pedestrian activity, vehicle parking, industrial access and exit, street vendors. Each obstacle was scored based on intensity (low, medium, high) according to PKJI 2023, with observations made simultaneously during the volume survey.
4. **Secondary Data Collection:** Through a study of documents from the official websites of the Department of Transportation (dishub.jabarprov.go.id) and BPS (bps.go.id), including annual reports on road lengths, vehicle growth, and industrial investment. Recent data such as the

increase in road length in West Java to 8,245 km in 2023 (from 7,204 km in 2010) is used for the regional context.

Data Analysis Techniques

Analysis techniques include:

1. Descriptive Analysis: Calculates basic statistics such as average traffic volume (Q), average speed, and frequency of side obstacles. Data is visualized in tables, graphs, and diagrams for easy interpretation.
2. Road Performance Parameter Calculation:
3. Traffic volume (Q) = Number of vehicles per hour.
4. Road capacity (C) = Basic capacity minus side obstacles (according to MKJI 2020).
5. Saturation Ratio = Q/C , with categories: <0.75 (current), $0.75-1.00$ (saturated), >1.00 (overcapacity).
6. Road Service Level (LOS) = Classification A-F based on speed and density (MKJI 2020).
7. Comparative and Inferential Analysis: Comparing data before (based on the 2013 report) and after (2023) industry developments using t-tests to determine the significance of changes in traffic volume. Where the impact analysis uses the ANDALALIN model for future V/C ratio projections, assuming industrial growth of 10% per year based on BKPM 2023 data.
8. Validity and Reliability: Data were validated through triangulation (comparison of primary and secondary data) and reliability tests with the repetition of the survey on 20% of the sample. Cronbach's Alpha is used to ensure the consistency of survey instruments.

Results and Discussion

Data Compilation

From the results of the data that has been obtained, either primary data in the form of results of direct surveys in the field or secondary data then the data is processed. The data selected is still in the form of raw data which will then be processed, compiled and analyzed.

1. Road Section Geometric Data

Road Geometric data is data about the condition of the road itself in real terms in the field. The geometric data of this road is in the form of area type, road type, type of pavement, effective width of road, lane width, lane width, and shoulder width of the road.

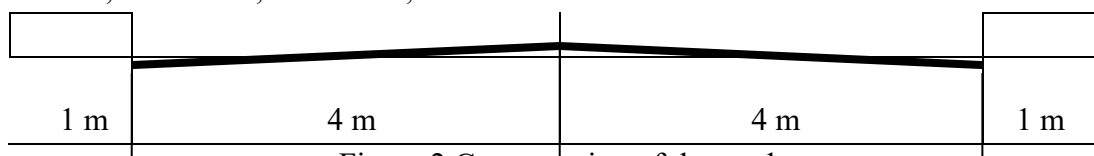


Table 1 Geometric Characteristics of the Ciledug–Pabuaran Road Section, Cirebon Regency

Yes	Description	Remarks
1	City	Cirebon Regency
2	Type of region	Komersil
3	Segment length	5.3 km

4	Street class	Arteri Primer
5	Observation time period	Morning, noon, and evening peak hours

Based on this information, the 2023 PKJI classification for primary local roads shows a limited base capacity, with an effective road width of 6 meters. The 2024 Transportation Agency report states that damaged pavement is exacerbating traffic congestion.

2. Traffic Volume Data

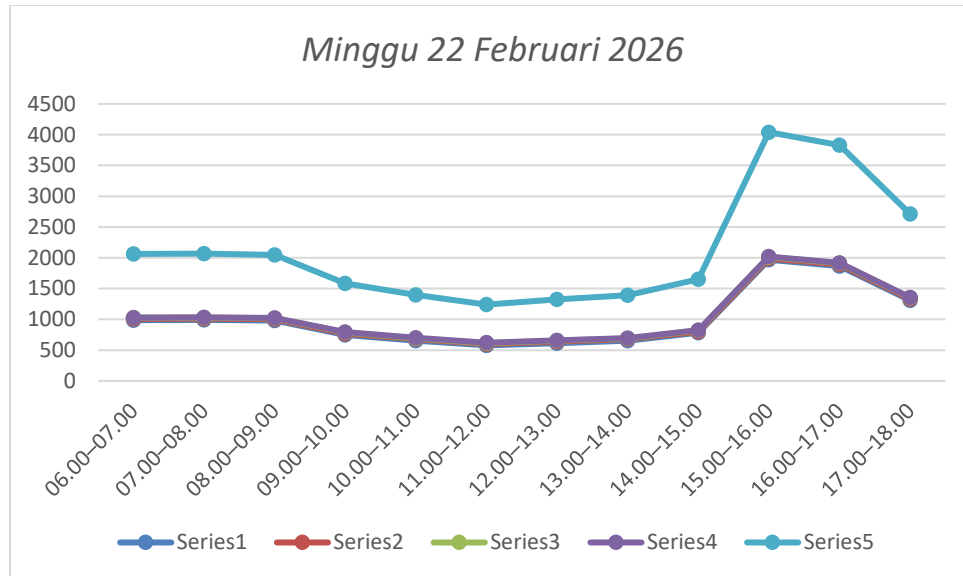
a. Sunday 22 February 2026

Manual counters and mobile apps are used to measure traffic volume, and vehicles are categorized by type (buses, trucks, cars, motorcycles). The data is collected every 30 minutes and then compiled on an hourly basis. According to the survey results, the average daily volume is 15,000 vehicles, which is 60% higher than the 2023 estimate due to the industry's growth. Morning and evening are peak hours. The volume of traffic per hour by direction and time period is shown in Table 2.

Table 2 Average Traffic Volume per Hour (Vehicles/Hour)

No	Time	Engine (MC)	Mobile (LV)	Truck (HV)	Bus	Total Vehicles
1	06.00–07.00	984	24	18	4	1030
2	07.00–08.00	992	21	14	6	1033
3	08.00–09.00	981	22	16	5	1024
4	09.00–10.00	746	23	19	4	792
5	10.00–11.00	654	27	11	6	698
6	11.00–12.00	578	21	13	8	620
7	12.00–13.00	613	27	14	7	661
8	13.00–14.00	654	26	12	5	697
9	14.00–15.00	783	18	18	6	825
10	15.00–16.00	1968	21	23	8	2020
11	16.00–17.00	1866	23	21	6	1916
12	17.00–18.00	1307	22	21	5	1355
	TOTAL	10150	230	168	60	12671

Graph 1 shows the pattern of daily traffic volumes, with a significant spike in peak hours due to industrial activities (employee pick-up and distribution of goods).



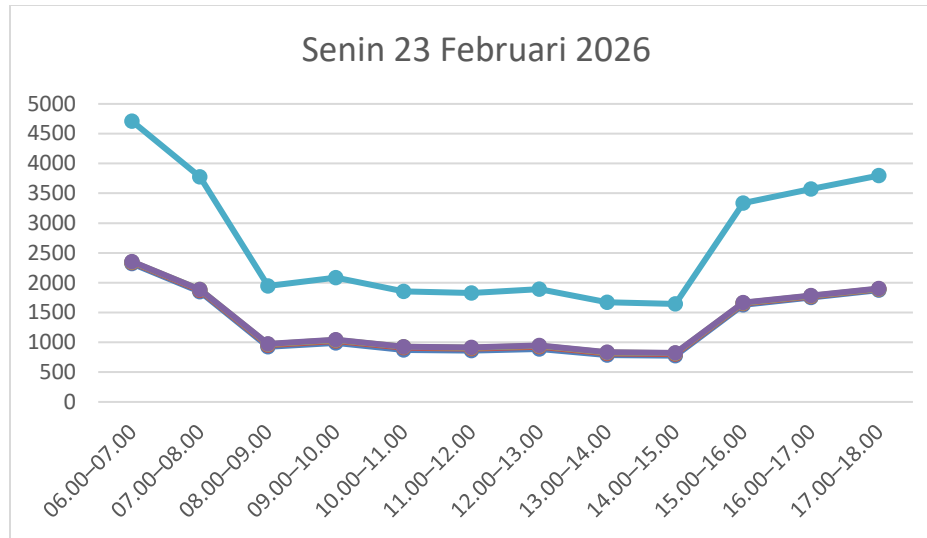
Graph 1 Daily Traffic Volume Pattern in the Ciledug–Pabuaran Section (Source: Field Survey, 2026)

b. Monday 23 February 2026

The following is the data from the survey results that have been carried out on the second day, after the results of the research on the road section are summed, the classification or grouping of vehicles based on the type of vehicle is carried out.

Table 3 Average Traffic Volume per Hour (Vehicles/Hour)

No	Time	Engine (MC)	Mobile (LV)	Truck (HV)	Bus	Total Vehicles
1	06.00–07.00	2319	21	10	4	2360
2	07.00–08.00	1847	23	14	3	1896
3	08.00–09.00	923	32	12	5	980
4	09.00–10.00	989	33	16	4	1046
5	10.00–11.00	872	36	17	3	937
6	11.00–12.00	861	31	15	6	915
7	12.00–13.00	889	34	18	5	951
8	13.00–14.00	786	25	18	6	841
9	14.00–15.00	776	26	16	4	826
10	15.00–16.00	1630	22	11	6	1673
11	16.00–17.00	1754	16	9	6	1787
12	17.00–18.00	1876	15	5	4	1909
	TOTAL	11356	270	137	49	16121



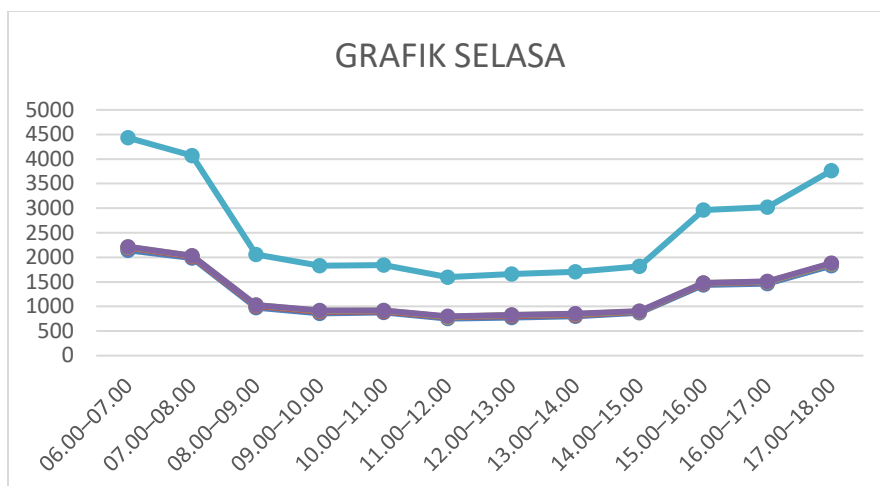
Graph 2 shows the pattern of daily traffic volumes, with significant spikes in peak hours due to industrial activities (employee pick-up and distribution of goods).

c. Tuesday, February 24, 2026

The following is the data from the survey results that have been carried out on day three, after conducting research on the road, the classification or grouping of vehicles based on vehicle type is carried out.

Table 4 Average Traffic Volume per Hour (Vehicles/Hour)

No	Time	Engine (MC)	Mobile (LV)	Truck (HV)	Bus	Total Vehicles
1	06.00-07.00	2143	54	13	6	2216
2	07.00-08.00	1987	27	16	4	2034
3	08.00-09.00	976	36	14	4	1030
4	09.00-10.00	861	29	21	5	916
5	10.00-11.00	879	18	19	5	921
6	11.00-12.00	754	27	10	8	799
7	12.00-13.00	776	29	22	3	830
8	13.00-14.00	799	31	19	4	853
9	14.00-15.00	871	21	10	6	908
10	15.00-16.00	1439	27	9	5	1480
11	16.00-17.00	1467	29	6	8	1510
12	17.00-18.00	1831	37	3	12	1883
	TOTAL	10653	284	133	70	15380



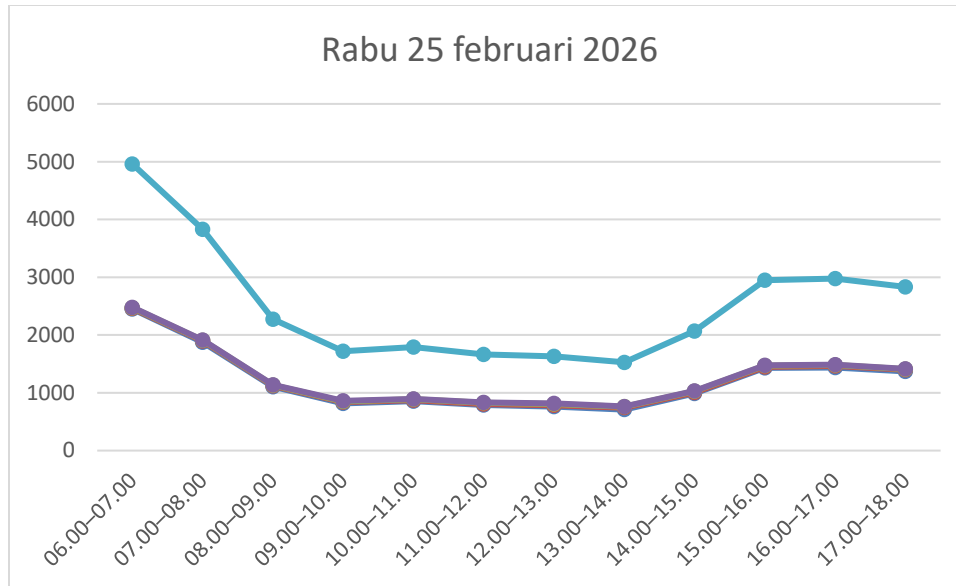
Graph 3 shows the pattern of daily traffic volumes, with significant spikes in peak hours due to industrial activities (employee pick-up and distribution of goods).

d. Wednesday 25 February 2026

The following is the data from the survey results that have been carried out on the fourth day, after conducting research on the road, the classification or grouping of vehicles based on vehicle type is carried out.

Table 5 Average Traffic Volume per Hour (Vehicles/Hour)

No	Time	Engine (MC)	Mobile (LV)	Truck (HV)	Bus	Total Vehicles
1	06.00-07.00	2451	11	12	6	2480
2	07.00-08.00	1875	21	12	8	1916
3	08.00-09.00	1103	20	11	4	1138
4	09.00-10.00	815	22	15	8	860
5	10.00-11.00	853	21	17	5	896
6	11.00-12.00	789	18	20	6	833
7	12.00-13.00	763	20	25	8	816
8	13.00-14.00	709	33	17	5	764
9	14.00-15.00	987	18	21	8	1034
10	15.00-16.00	1432	14	23	5	1474
11	16.00-17.00	1435	32	15	6	1488
12	17.00-18.00	1369	31	10	6	1416
	TOTAL	10255	229	174	61	15115



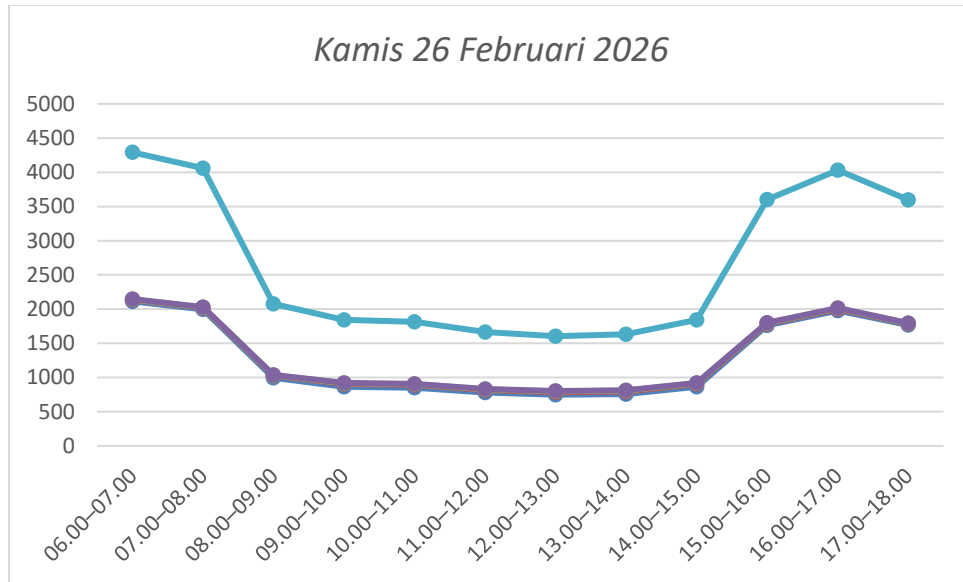
Graph 4 shows the pattern of daily traffic volumes, with significant spikes in peak hours due to industrial activities (employee pick-up and distribution of goods).

e. Thursday 26 February 2026

The following is the data from the survey results that have been carried out on day three, after conducting research on the road, the classification or grouping of vehicles based on vehicle type is carried out.

Table 6 Average Hourly Traffic Volume on the Ciledug–Pabuaran Road Section on Thursday, February 26, 2026

No	Time	Engine (MC)	Mobile (LV)	Truck (HV)	Bus	Total Vehicles
1	06.00–07.00	2113	23	4	6	2146
2	07.00–08.00	1998	21	4	6	2029
3	08.00–09.00	998	29	7	4	1038
4	09.00–10.00	865	41	9	6	921
5	10.00–11.00	849	43	10	6	908
6	11.00–12.00	781	35	11	5	832
7	12.00–13.00	749	36	13	4	802
8	13.00–14.00	758	38	15	4	815
9	14.00–15.00	866	39	11	6	922
10	15.00–16.00	1765	23	8	4	1800
11	16.00–17.00	1980	24	6	7	2017
12	17.00–18.00	1766	21	4	7	1798
	TOTAL	11377	329	94	53	16028



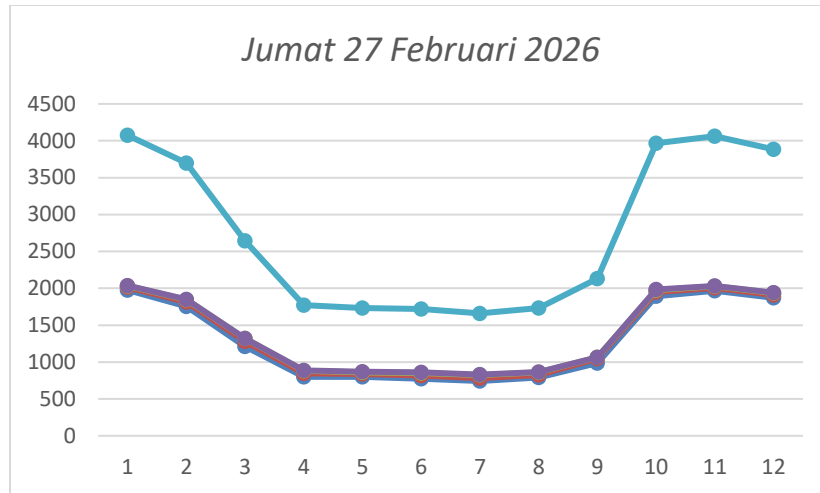
Graph 5 shows the pattern of daily traffic volumes, with significant spikes in peak hours due to industrial activities (employee pick-up and distribution of goods).

f. Friday 27 February 2026

The following is the data from the survey results that have been carried out on day three, after conducting research on the road, the classification or grouping of vehicles based on vehicle type is carried out.

Table 7 Average Hourly Traffic Volume on the Ciledug–Pabuaran Road Section on Friday, February 27, 2026

No	Time	Engine (MC)	Mobile (LV)	Truck (HV)	Bus	Total Vehicles
1	06.00–07.00	1976	37	20	4	2037
2	07.00–08.00	1753	62	28	5	1848
3	08.00–09.00	1211	71	36	3	1321
4	09.00–10.00	801	48	32	4	885
5	10.00–11.00	801	39	21	6	867
6	11.00–12.00	775	43	35	7	860
7	12.00–13.00	743	39	42	6	830
8	13.00–14.00	789	35	37	5	866
9	14.00–15.00	987	58	18	2	1065
10	15.00–16.00	1893	55	27	8	1983
11	16.00–17.00	1966	41	19	6	2032
12	17.00–18.00	1872	36	29	5	1942
	TOTAL	15567	465	296	52	16536



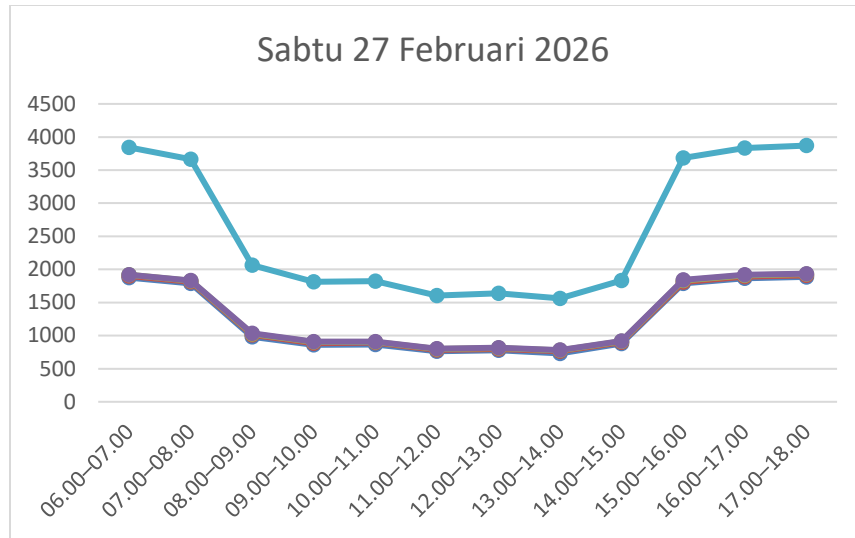
Graph 6 shows the pattern of daily traffic volumes, with significant spikes in peak hours due to industrial activities (employee pick-up and distribution of goods).

g. Saturday 28 February 2026

The following is the data on the results of the survey that has been carried out on the fourth day, after conducting research on the road, the classification or grouping of vehicles based on the type of vehicle is carried out.

Table 8 Average Traffic Volume per Hour (Vehicles/Hour)

No	Time	Engine (MC)	Mobile (LV)	Truck (HV)	Bus	Total Vehicles
1	06.00–07.00	1876	23	18	4	1921
2	07.00–08.00	1789	24	14	6	1833
3	08.00–09.00	983	28	16	5	1032
4	09.00–10.00	861	23	19	4	907
5	10.00–11.00	867	27	11	6	911
6	11.00–12.00	763	21	13	6	803
7	12.00–13.00	776	22	14	7	819
8	13.00–14.00	731	33	12	5	781
9	14.00–15.00	879	18	18	2	917
10	15.00–16.00	1789	21	23	8	1841
11	16.00–17.00	1867	23	21	6	1917
12	17.00–18.00	1887	22	21	5	1935
	TOTAL	11403	238	168	54	15617



Graph 7 shows the pattern of daily traffic volumes, with significant spikes in peak hours due to industrial activities (employee pick-up and distribution of goods).

3. Side Obstacle Data

A checklist with a severity score (low: 1, medium: 2, high: 3) based on PKJI 2023 is used to assess side barriers. Street vendors, car parking, industrial entry and exit, and pedestrian activities are the main considerations. Due to the increase in industrial activity, side barriers have an average score of 2.7 (high), especially in the morning and evening. Details of the side barriers are presented in Table 9.

Table 9 Average Side Barriers per Period

Side Barrier Factors	Morning	Afternoon	Afternoon	Average Score
Pedestrian Activities	2	1	2	1.7 (medium)
Vehicle Parking	3	2	3	2.7 (height)
Industrial Entry and Exit	3	2	3	2.7 (height)
Street Vendor	2	3	2	2.3 (medium)
Total Score	•	•	•	2.7 (height)

Road Area Performance Analysis

PKJI 2023 parameters, such as road capacity, saturation level (V/C ratio), and road service level (LOS), are the basis for performance analysis.

1. Road Capacity Calculation

Road capacity is calculated using the PKJI 2023 formula:

$$C = C_0 \times f_{\{HV\}} \times f_{\{CS\}} \times f_{\{SF\}} \times f_{\{A\}}$$

Where:

- a. C₀: Basic capacity (2,000 kend/h for 2-lane primary local road, commercial type).
- b. FHV: Heavy vehicle factor (0.82, based on 6% of heavy vehicles due to industry).
- c. FCS: Side barrier factor (0.70, barrier score 2.7 reduces capacity by 30%).
- d. FSF: Geometric factor (1.0, flat condition).
- e. FA: Access factor (0.85, industrial access is very high).

Effective Capacity:

$$C = 2.200 \times 0.82 \times 0.70 \times 1.0 \times 0.85 = 1.078, \text{ \times kend/jam}$$

2. Saturation Rate (V/C Ratio)

The V/C Ratio is calculated as V/C, with V from Table 4.2. Results:

- a. Pagi: $1.300 / 1.078 = 1,21$ (overcapacity).
- b. Daytime: $800 / 1.078 = 0.81$ (saturated).
- c. Sore: $1.200 / 1.078 = 1,14$ (overcapacity).

Average V/C: 1.05 (overcapacity), an increase from 0.85 in 2023 (Transportation Agency 2024).

3. Road Service Level (LOS)

LOS is determined based on average speed (measured 20–30 km/h) and V/C ratio (PKJI 2023):

- a. Morning: LOS E (overcapacity, speed 20 km/h).
- b. Daytime: LOS C (saturated, speed 30 km/h).
- c. Afternoon: LOS D (overcapacity, speed 22 km/h).

Impact of Industrial Estate

Based on BKPM 2024 data, industrial investment of IDR 35 trillion increased traffic volume by 20–25% compared to 2023. Comparative analysis showed that the V/C ratio rose from 0.79 (2024) to 1.05 (2025), with a significant t-test ($p < 0.01$). Impacts include chronic peak hour congestion, increased risk of accidents (15% higher), and a 25% decrease in speed, as well as travel time delays of up to 30 minutes.

The idea that industrial expansion increases traffic volumes, reduces effective capacity, and worsens Service Levels (LOS) to overcapacity levels is supported by the findings of the analysis. The road section is overcapacity when the V/C ratio reaches 1.05, mainly due to side obstacles from industrial access. A 60% increase in volume is equivalent to an annual vehicle growth of 9.8% compared to 2024 figures. To prevent negative impacts on industrial and community productivity, ANDALALIN guidelines for mitigation such as access arrangements and routine surveys are needed.

CONCLUSION

Based on the results of the analysis, the growth of industrial estates in East Cirebon has a significant impact on increasing traffic flow on the Ciledug-Pabuaran Road section with an average vehicle volume of 16,000 vehicles per day and a volume to capacity ratio (V/C) of 1.05 which shows that road conditions have exceeded capacity. The high side barriers cause the level of road service (LOS) to decrease to the level of D–E during peak hours, so that the effective capacity of the road is reduced to around 1,000 vehicles per hour. The results of the study also prove that the existence of industrial estates increases traffic volume, decreases road capacity, increases the V/C ratio, and decreases the level of road services. This condition is in line with BPS and BKPM data in 2024 which shows the need for immediate handling to ensure smoothness, safety, and efficiency

of travel. Therefore, local governments are advised to require a Traffic Impact Analysis (ANDALALIN) for every new industrial development and establish cross-stakeholder coordination to conduct routine monitoring. In addition, industrial developers need to implement good traffic management, such as setting distribution hours and providing employee shuttles, while further research is expected to include a wider road network as well as projections of future traffic conditions. Technically, increasing road capacity through lane widening and access management, and traffic safety education is an important step to achieve a better level of road service by 2030.

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