LEADER
Civil Engineering and Architecture Journal

Civil Engineering and Architecture Journal Vol.3 No.3 (2025) 3026-622X
DOI 10.37253/leader.v3i3.10909

The Effect of Side Barriers on Road Performance Levels (A Case Study: Pasar Cigasong, Majalengka)

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ARTICLE INFO

***Keywords**:*

Traffic Flow,
Road performance,
Side Barries

ABSTRACT

The impact of side barriers on road service levels is a crucial consideration in urban transportation planning and management. Side barriers refer to various roadside activities that disrupt traffic flow, such as market operations, illegal parking, and pedestrian movement. In busy urban areas like the vicinity of Pasar Cigasong in Majalengka, these activities can significantly hinder the smooth flow of traffic. Traffic congestion often arises from such disruptions, making it essential to understand their effects. This study aims to assess how side barriers affect road service levels at Pasar Cigasong in Majalengka. The research methodology includes gathering data on side barriers, vehicle speeds, and traffic volumes. The results are expected to offer a thorough understanding of traffic conditions around the market and highlight the main factors contributing to traffic issues. The research was conducted in the Pasar Cigasong area, situated in an urban environment close to the city center of Majalengka Regency. The analysis found that the road service levels at the three-terminal intersection and Pasar Cigasong primarily fall within the average to high range. Based on these findings, the author suggests that the local government take proactive measures to address the growing traffic volumes and prevent future congestion.

1. Introduction

Cigasong Market in Majalengka Regency is one of the main economic hubs serving the needs of the local community. As a location with high daily activity, the market attracts many vehicles from both Jatiwangi and Cigasong directions (Marzoug, Lakouari, Pérez Cruz, & Vega Gómez, 2022). These elements directly create side barriers that negatively impact road performance around Cigasong Market. Furthermore, the high volume of both vehicular and pedestrian movement exacerbates congestion, especially during peak hours. Signalized intersections, which use traffic lights to regulate traffic flow, are designed to enhance traffic efficiency (EG, B, & Purwanto, 2018).

Side Barries is a critical element in transportation studies, particularly in urban areas. It encompasses various activities occurring near the road, such as illegal parking, street vendors, and pedestrians crossing without using designated facilities. In the Cigasong Market area, this phenomenon is quite dominant, considering its strategic location connecting several sub-districts. Side Barries can slow traffic flow, increase travel time, and reduce the overall road capacity. Therefore, analyzing the extent to which side Barries impacts road performance in this location is crucial (Haryati & Najid, 2021). With the increasing activity at Cigasong Market, the level of side Barries is expected to continue rising in the coming years. The growing number of vehicles annually, coupled with the expansion of trade activities, will further deteriorate traffic conditions. Uncontrolled side Barries can lead to a decline in road service levels, categorizing them as low (Purnama, Rifai, & Nasrun, 2022).

Consequently, frequent and prolonged congestion will become the primary challenge for road users in this area. This condition requires serious attention to prevent more extensive adverse effects on urban transportation (Pathivada & Perumal, 2019). With a better understanding of the impact of side Barries, it is hoped that local governments can implement more effective policies in managing transportation in the market area. This study is essential as a reference for developing a sustainable transportation system in Majalengka Regency. Properly managed side Barries will provide long-term benefits, such as reducing congestion, improving travel time, and creating a safer road environment (Alsaawy, Alshanqiti, Bhat, & Bahbouh, 2022). Therefore, this research has significant contributions to supporting the development of efficient and user-friendly transportation around Cigasong Market.

The objective of this study is to evaluate how side barriers influence road performance in the vicinity of Cigasong Market. Through the use of primary data collected from traffic surveys and suitable analytical techniques, the research seeks to provide a comprehensive understanding of the impact of side barriers on road conditions. Furthermore, the study's results will lay the groundwork for recommending traffic management enhancements in the market area. A central focus of the study is on minimizing side barriers to increase the efficiency and comfort for road users. This approach is not only relevant to Cigasong Market but also has wider applicability for similar urban locations, offering useful insights for improving traffic management in other areas.

2. Literature Review

2.1 Side Berrier

Side Barries refers to any element near or along the roadway that interferes with the smooth flow of traffic. These elements can include parked vehicles, pedestrians crossing the road, street vendors, and even obstructions such as construction or debris (Firmansyah, Rifai, & Taufik, 2022). The presence of side Barries is particularly problematic in urban areas, where roads are often narrow and the volume of traffic is high. As vehicles slow down to navigate these obstacles, travel times increase, and congestion becomes more frequent. This disruption not only affects vehicle speeds but also lowers the overall service level of the road, contributing to more significant traffic-related issues. The constant interaction between vehicles, pedestrians, and roadside activities leads to a decrease in the roadway's capacity to handle traffic (Dong, Liu, & Yin, 2022). This is especially evident during peak hours when the number of pedestrians and parked vehicles increases. As traffic slows down due to side Barries, vehicles spend more time in the same area, exacerbating congestion. Such conditions make it difficult for drivers to maintain a steady flow, impacting both travel times and safety. Additionally, the reduced flow increases the likelihood of accidents, as vehicles are forced to maneuver more carefully in confined spaces. Long-term congestion can also result in higher fuel consumption and greater environmental pollution, further compounding the issue.

Managing side Barries is an essential aspect of urban traffic management, as it directly influences road performance and safety. One of the challenges in controlling side Barries is the lack of designated spaces for pedestrians and parked vehicles (Sun, Lin, Jiao, & Lu, 2020). Without clear separation between road users, side Barries can be amplified, making roads even more congested. The addition of more lanes or redesigning roadways can help alleviate some of these issues. However, addressing side Barries requires a more comprehensive approach that incorporates proper traffic management, enforcement, and urban planning. Understanding the impact of side Barries on road service levels can help inform better urban infrastructure planning and policy decisions. Studies on side Barries can identify key problem areas where traffic flow is disrupted, offering insights into where improvements are needed. For example, installing dedicated parking spaces or pedestrian walkways can help minimize the impact of side Barries (Adiputra, Rifai, & Bhakti, 2022). Reducing unnecessary roadside activities that create obstacles can also contribute to smoother traffic movement. Ultimately, effective management of side Barries is crucial for improving traffic conditions, reducing congestion, and enhancing the overall safety and efficiency of urban road networks.

2.2 Road performance

Road performance refers to the ability of a road to handle traffic efficiently while providing a safe and smooth driving experience. This includes factors such as road capacity, travel time, safety, and overall user satisfaction. A road's performance is influenced by several variables, including its geometric design, pavement quality, traffic volume, and the presence of obstacles like side Barries (Rahayu, Rifai, & Akhir, 2022). Proper maintenance and timely repairs are also essential to maintaining good road performance. In urban areas, where traffic density is high, road performance becomes a critical aspect of transportation management.

One of the key indicators of road performance is traffic flow, which measures the efficiency at which vehicles can move along a road. Congestion is a major factor that impedes traffic flow and reduces the overall performance of the road (Isradi, Mufhidin, Dermawan, Rifai, & Prasetijo, 2022). Traffic bottlenecks, often caused by road design flaws, traffic signals, or side Barries, can slow down vehicle movement and increase travel times. Efficient road performance requires that these issues be addressed to allow for smooth traffic movement, even during peak hours. Properly designed intersections and optimally timed traffic lights can significantly enhance road performance.

Road safety is another crucial element of road performance, ensuring that the road is safe for all users, including drivers, pedestrians, and cyclists. The road should be free from hazards like potholes, cracks, or loose debris that could cause accidents. Good road performance is also characterized by clear signage, proper lighting, and safe pedestrian crossings (Sarbaini, 2022). Road safety is directly tied to the quality of the road surface and its ability to withstand the pressure of traffic without deteriorating. Regular maintenance and monitoring of road conditions are necessary to prevent the risk of accidents (Kharisma, Rifai, Taufik, & Prasetijo, 2024).

In addition to safety and traffic flow, road performance also depends on the durability of the infrastructure over time. Roads that are not properly maintained can deteriorate quickly, leading to poor performance and increased costs for repairs. Regular evaluations and monitoring of road conditions using methods like the Pavement Condition Index (PCI) help to assess the state of the road and predict future performance. Implementing timely maintenance programs, such as resurfacing and repairs, ensures that roads continue to perform at their optimal level. Ultimately, good road performance is vital for supporting economic activities, reducing travel times, and ensuring the safety and comfort of road users (Kashyap, Devarakonda, Nayak K, KV, & Bhat, 2022).

2.3 Traffic Flow

Traffic flow is a critical aspect of transportation systems and plays a key role in maintaining efficient road networks. It is a fundamental concept in transportation engineering, used to analyze and manage road networks effectively (Abdurakhmanov, 2022). Traffic flow can be categorized into three types: free flow, where vehicles move at optimal speeds with minimal interaction; stable flow, where speeds begin to fluctuate due to moderate traffic; and congested flow, where high vehicle density leads to slower speeds and delays. Understanding these categories is essential for designing roads that accommodate varying traffic conditions. The goal of traffic flow management is to ensure smooth movement while minimizing congestion and delays. Traffic volume is a fundamental aspect of traffic flow, referring to the number of vehicles that pass a specific point on a roadway within a given time frame(Zhou, Chen, & Lin, 2022). It serves as a crucial indicator of how heavily a road is used and is usually expressed in terms of vehicles per hour or day. Elevated traffic volumes, especially during peak times, can lead to congestion, necessitating effective traffic management solutions to mitigate bottlenecks. Engineers rely on traffic volume data to plan and design road infrastructure that can accommodate both present and future traffic demands. Accurate measurement of traffic volume is essential for making well-informed decisions regarding road capacity and necessary improvements (Reta, Rifai, Taufik, & Prasetijo, 2024).

Traffic speed is another vital aspect of traffic flow, representing the rate at which vehicles travel along a roadway. Speed is affected by factors such as road geometry, traffic signals, and the presence of side Barries, like parked vehicles or pedestrians. Maintaining consistent speeds is essential for efficient traffic flow, as significant variations can cause disruptions and increase the likelihood of accidents. Traffic engineers analyze speed data to identify areas where improvements, such as speed limits or road widening, may be needed. Effective speed management ensures safety and reduces travel times for road users (Baffoe-Twum, Asa, & Awuku, 2022).

Traffic density, the number of vehicles per unit length of roadway, plays a critical role in determining the quality of traffic flow. High-density traffic often results in slower speeds and increased travel times, especially in urban areas with limited road capacity. Managing traffic density involves strategies like signal timing optimization, lane additions, or the implementation of public transportation systems to reduce vehicle numbers. Traffic simulations and models help engineers predict how changes in density will affect flow and develop solutions to improve it. A balanced traffic density ensures smoother movement, reduces congestion, and enhances the overall efficiency of a road network (Anugraha, Rifai, Taufik, & Isradi, 2024).

3. Method

This study adopts a qualitative research methodology. The use of descriptive research allows the researcher to collect data randomly, describe it, and provide a factual and comprehensive interpretation of existing issues based on the gathered (Ma'aruf, Eprilianto, & Megawati, 2021). The qualitative approach involves several interconnected stages, such as data collection, categorization, validation, and analysis, which help in generating new theories and insights. As a result, qualitative research is considered a practical approach that relies on both primary and secondary data for its execution. This methodology is particularly useful for exploring complex phenomena and gaining a deeper understanding of the subject matter.

The research was conducted in the Pasar Cigasong area, situated in Majalengka Regency, which is an urban area close to the city center. The precise location of the study is illustrated in Figure 1. Prior to conducting the survey, it was necessary to identify the data required for the research. This data includes both primary and secondary sources, which are essential for evaluating traffic conditions and the presence of side barriers in the area. A thorough data collection process ensures a detailed and accurate understanding of the local traffic flow and its contributing factors. By gathering comprehensive data, the study is able to capture the full scope of the traffic dynamics in the region. This approach helps in developing strategies to address the challenges identified in the traffic system.

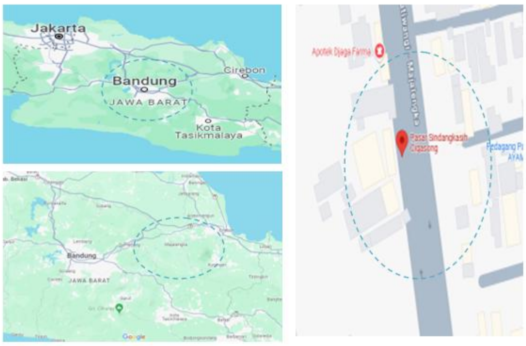

Figure 1. _Research location_

Field surveys were carried out to collect primary data, with traffic volume serving as the main data for this research. Primary data was directly obtained through field surveys. During data collection, careful consideration was given to the tools and methods employed to ensure accuracy before processing the information. The survey was conducted over the course of a single day, focusing on the peak traffic periods in the morning, midday, and evening. During these times, traffic volume was carefully monitored to capture the variations in vehicle flow throughout the day. The analysis of the collected data was performed using the MKJI 1997 method, which provides a reliable framework for evaluating road performance and service levels. To facilitate accurate data collection, a Traffic Counter application was utilized, ensuring precise measurements of traffic volume and vehicle flow. This approach allowed for a comprehensive understanding of traffic conditions and provided the necessary data to assess road performance at different times of the day.

4. Result and Discussion

4.1 Traffic Volume

Traffic volume is assessed through surveys conducted during peak periods in the morning, midday, and evening. The survey results reveal that the highest traffic flow occurs during the evening rush hour, particularly between 4:30 PM and 5:30 PM. This period sees the most significant congestion, making it crucial to consider when evaluating traffic patterns. The Average Daily Traffic (ADT) for this road segment is provided in the accompanying table, offering a more comprehensive look at overall traffic trends.

Table 1. Daily Traffic Volume (West Direction)

No	Period	HV(emp=1,3)	LV (emp=1)	Motor cycle (emp = 0,25)	Vehicles	pcu	4x15 minute (pcu/hour)
1	07:00-07:15	55	103	245	403	235,75	975,65
2	07:15-07:30	47	100	276	423	230,1	
3	07:30-07:45	48	114	315	477	255,15	
4	07:45-08:00	63	114	235	412	254,65	

5	13:00-13:15	24	90	165	279	162,45	987,65
6	13:15-13:30	39	134	278	451	254,2	
7	13:30-13:45	41	148	349	538	288,55	
8	13:45-14:00	34	173	261	468	282,45	
9	16:30-16:45	19	169	349	537	280,95	1232,3
10	16:45-17:00	27	167	379	573	296,85	
11	17:00-17:15	39	180	406	625	332,2	
12	17:15-17:30	36	175	402	613	322,3	

The table illustrates that westbound traffic flow is 975.65 pcu/hour in the morning, 987.65 pcu/hour at midday, and 1232.3 pcu/hour in the evening. This data highlights that the evening rush hour, especially between 4:30 PM and 5:30 PM, sees the highest traffic volume, particularly from Cigasong to Jatiwangi. Likewise, the westbound traffic from Jatiwangi to Cigasong shows a flow of 986.65 pcu/hour in the morning, 997.1 pcu/hour at midday, and 1224.2 pcu/hour in the evening. This reinforces the idea that evening traffic in both directions experiences the highest volumes, suggesting that congestion is most intense during these hours. The consistency of these trends underscores the need for targeted traffic management during peak times.

Table 2. Daily Traffic Volume (South Direction)

No	Period	HV(emp=1,3)	LV (emp=1)	Motor cycle (emp = 0,25)	Vehicles	pcu	4x15 minute (pcu/hour)
1	07:00-07:15	58	108	238	404	242,9	986,65
2	07:15-07:30	47	100	267	414	227,85	
3	07:30-07:45	43	115	311	469	248,65	
4	07:45-08:00	65	123	239	427	267,25	
5	13:00-	29	91	178	298	173,2	997,1

	13:15						
6	13:15-13:30	40	137	269	446	256,25	
7	13:30-13:45	44	145	334	523	285,7	
8	13:45-14:00	44	164	243	451	281,95	
9	16:30-16:45	15	178	357	550	286,75	1224,2
10	16:45-17:00	29	152	361	542	279,95	
11	17:00-17:15	43	171	411	625	329,65	
12	17:15-17:30	37	179	403	619	327,85	

According to the table, the westbound traffic flow is recorded at 986.65 pcu/hour in the morning, 997.1 pcu/hour at midday, and 1224.2 pcu/hour in the evening. This indicates that the highest traffic volume is observed during the evening peak, specifically between 4:30 PM and 5:30 PM, in the direction from Jatiwangi to Cigasong. These figures reinforce the observation that evening hours present the most significant challenges in terms of traffic congestion, a key factor in road capacity planning. Recognizing these peak hours is essential for developing effective solutions to manage traffic flow.

4.2 Degree of Saturation

To calculate the degree of saturation, several supporting data are required.

$$DS = Q/C$$

Q = Traffic Flow (pcu/hour)
C = Capacity
To calculate Road Capacity, several supporting data are required:

$$C = C_O \times FC_W \times FC_{SP} \times FC_{SF} \times FC_{CS}$$

Where :

C	=	Capacity (pcu/hour)
CO	=	Basic Capacity (pcu/hour)
FCW	=	Road width adjustment factor
FCSP	=	Direction separation adjustment factor (applies only to undivided roads)
FC SF	=	Side Barries and shoulder adjustment factor
FCCS	=	City size adjustment factor

The data requirements are outlined in Chapter 3, where the base capacity (C0) for all road segments at this intersection is set at 2900 pcu/hour, corresponding to the 2/2 UD road type as shown in Table 5. The lane width adjustment factor (FCw) is 1 for all three road segments, as each has a uniform width of 7 meters. Additionally, the directional separator adjustment factor is also 1, as the directional split is evenly divided at 50-50. This consistency in factors helps ensure an accurate analysis of road performance across different segments.

Another important factor to consider is the Adjustment Factor for Side Barriers and Shoulder/Sidewalk. All three road segments at the intersection feature shoulders that are less than 0.5 meters wide. The northern segment has a low side barriers classification, while the eastern and western segments are categorized as having medium side barriers. As a result, the side barriers adjustment factor (Fpsf), as specified in Table 8, is 0.92 for the northern direction and 0.89 for the eastern and western directions. These variations in side barrier classification influence the overall road capacity calculations.

Given the population of Majalengka Regency, which is projected to be 1,328,894 in 2023, the adjustment factor for city size is set to 1. This value reflects the impact of urban density on traffic flow and road capacity. These adjusted factors are then applied to a specified formula to calculate the overall road capacity, providing a comprehensive understanding of traffic conditions in the area.

Table 3. Road Capacity

Direction	Co	FCw	FCsp	FCsf	FCcs	Capacity
North	2900	1	1	0,92	1	2668
South	2900	1	1	0,89	1	2581

Based on Table 13, the road capacity in the northern direction at Pasar Cigasong is recorded at 2668 pcu/hour. This value allows for the calculation of the level of service (LOS) for the road segment, providing insights into how well the road performs under current traffic conditions. Calculating the level of service is crucial for understanding how efficiently the road accommodates traffic and identifying areas where improvements may be needed. The results of this analysis help guide decision-making in terms of road maintenance and capacity enhancements.

Table 4. DOS and LOS

Direction	Period	Q (pcu/hour)	C (pcu/hour)	DOS	LOS
North	07:00-08:00	944.65	2668	0.35	Se
	13:00-14:00	986.65	2668	0.37	Average
	16:30-17:30	1180.85	2668	0.44	High
South	07:00-08:00	986.65	2581	0.38	Average
	13:00-14:00	997.1	2581	0.39	Average
	16:30-17:30	1224.2	2581	0.47	High

The findings show that the level of service (LOS) in the northern direction is classified as average during both the morning and afternoon, improving to high at night. Similarly, the western direction maintains an average LOS throughout the day, which also improves to high at night. The eastern direction follows a similar trend, exhibiting average service levels during the day and high levels at night. This suggests that traffic conditions tend to ease at night, as congestion decreases across all directions. Such insights can be valuable for optimizing road usage and addressing issues during peak hours.

4.3 Side Barries

Field surveys identified side barriers factors across the road segments, with the northern segment (towards Cigasong) measuring 210 meters and the southern segment (towards Jatiwangi) measuring 450 meters. These measurements help in understanding the extent of side barriers in each direction and their impact on traffic flow. The study findings indicate that side obstacles are low in the northern direction and moderate in the southern and western directions. This variation in side barriers affects vehicle movement, with lower obstacles typically allowing for smoother traffic flow. Additionally, these differences must be taken into account when calculating road capacity and assessing traffic conditions.

Table 5. Side Barrier

Direction	PED	PSV	EEV	SMV	PKL	Frequency Weight	CLASS
North	102	121	111	99	19	295,7	Low
South	117	123	113	109	30	324,9	Average

According to the table, the northern direction has a low level of side barriers, while the southern and western directions are classified as having a moderate level of side barriers. These variations in side barriers can significantly affect the flow of traffic, as they influence vehicle maneuverability and safety. The presence and quality of side barriers are crucial for understanding how road design impacts traffic conditions and capacity. These factors are key when analyzing the overall performance of the road network in the study area.

5. Conclusion

Based on these calculations, the overall service level at the three-terminal intersection and Cigasong Market falls within the average to high categories. The findings suggest that the government should prioritize road improvements to address increasing traffic volumes and prevent future congestion. While current side Barries is classified as low to average, this may not hold true in the future. Side Barries levels are expected to rise over the coming years, potentially exacerbating congestion.

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