IJSSR
International Journal of Social Service and Research

Vol. 5, No. 8, August 2025
e-ISSN: 2807-8691 | *p*-ISSN: 2807-839X

Road Performance Evaluation on the Kalitanjung Road Section, Cirebon City

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Keywords

Evaluate; Road Performance; Kalitanjung Road, Cirebon City

ABSTRACT

Road performance needs to be taken into consideration because side obstacles, namely human activities, affect the performance of the road. The problem in this study is traffic congestion on the road. The objective of this study is to evaluate the performance of the road. The analysis method uses the 2023 *PKJI* guidelines. The data collection in this study consists of primary and secondary data. Primary data were obtained through observations, including data surveys of vehicle volume (traffic counters) and observations of external obstacles. Meanwhile, secondary data were obtained through Google Earth. The research results show that the performance of the Kalitanjung road section has a service level of 0.8, derived from the analysis of the degree of saturation (*DJ*) as a reference for road service level or *LOS* (*Level of Service*) *PKJI* 2023, categorized as *LOS* "D," meaning it is approaching unstable with decreasing speed. The survey results over six days showed a peak hour vehicle count of 4,583 vehicles/hour, or a traffic flow rate (*Q*) of 2,104.65 vehicles per hour. Additional supporting analyses include: free-flow speed (*VB*) value of 34.776 km/hour, capacity (*C*) value of 2,646 vehicles per hour, travel time (*WT*) of 0.016 hours or 57.6 seconds per 400-meter road segment length. The analysis also indicates that the road is currently operating at 70% of its capacity, with a free-flow speed of 34.776 km/hour.

INTRODUCTION

Road performance needs to be taken into consideration because side obstacles, namely human activities, affect the performance of the road (Cahyono et al., 2023; Hasyim et al., 2023; Nusriadi et al., 2021; Rinaldi & Saputra, 2020; Wubet et al., 2023). The problem in this study is traffic congestion on the road, and the objective of this study is to evaluate the performance of the road. The analysis method uses the 2023 *PKJI* guidelines. The data collection in this study consists of primary and secondary data. Primary data were obtained through observations, including data surveys of

vehicle volume (traffic counters) and observations of external obstacles. Meanwhile, secondary data were obtained through Google Earth (Almeida et al., 2022; Fathi-Kazerooni & Rojas-Cessa, 2020; Janež et al., 2022; van Poorten & Brydle, 2018; Wu & Kwon, 2023). The research results show that the performance of the Kalitanjung road section has a service level of 0.8, derived from the analysis of the degree of saturation (*DJ*) as a reference for road service level or *LOS* (*Level of Service*) *PKJI* 2023, categorized as *LOS* "D," meaning it is approaching unstable with decreasing speed.

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Previous studies have highlighted the relationship between road performance and external obstacles, such as traffic congestion caused by human activities and various forms of side friction. Recent research by Biswas et al. (2021) found that capacity under the influence of side friction was observed significantly lower (up to 60.73%) than the capacity of base section of the same carriageway width, while Harison et al. (2023) demonstrated that road capacity is reduced by 3.37% when the effective width is reduced by 2.95%, while road capacity is reduced by 26.08% when the effective width is reduced by 21.81%. Furthermore, Cao and Menendez (2024) showed that approximately 30% of road demand in specific central business districts (CBDs) being due to vehicles seeking for parking, highlighting the critical impact of parking-related side obstacles on traffic flow.

Golakiya and Dhamaniya (2021) developed comprehensive warrants for pedestrian crossing facilities, demonstrating the significant impact of pedestrian movements on vehicular delay and traffic performance. Additionally, Isradi et al. (2020) analyzed intersection performance using degree of saturation analysis, finding DS values reaching 1.32 indicating severely degraded traffic conditions. However, these studies did not specifically address the influence of side obstacles on road performance in more densely populated urban areas or incorporate modern data collection methods like Google Earth for comprehensive traffic analysis and remote sensing applications in transportation research.

The objective of this research is to assess the road's level of service (*LOS*), which was found to be *LOS* "D," indicating instability and decreasing speed due to congestion. The benefits of this research are twofold: it offers a more accurate analysis of road performance in areas impacted by human activities and provides data-driven insights that can inform urban planning and traffic management strategies. This study's findings will contribute to

improving road service efficiency and help manage traffic congestion in urban settings.

METHOD

This research method uses the 2023 *PKJI* guidelines, and the data collected in this study consist of primary and secondary data. Primary data were obtained through direct observation, including geometric data, vehicle volume survey data (traffic counters), and side obstacle survey data. Secondary data were obtained through Google Earth and Google Maps.

General Overview

The road scheme for the study was created by reviewing previous observations and combining them with road location maps on Google Earth. Data on road type, road width, and sidewalk width were also required. Road width data could be measured directly at the study site, while road segment length was typically measured using Google Earth.

Based on the survey data on the number of vehicles, the peak hour or the hour with the highest vehicle volume is determined, and its unit is converted to *SMP/hour*. This is done by multiplying the number of each vehicle from the survey results by the factor value (*EMP*) determined by *PKJI* 2023. The purpose of this factor value is to convert motorcycles (*SM*) and medium-sized vehicles (*KS*) into passenger car units (*SMP*). The traffic flow calculation aims to determine the overall factor value of vehicles per hour in *SMP/hour* units (*FSMP*). (Table 4-10 *EMP* for undivided road types (*PKJI* 2023)) Side obstacle classes are derived from survey observations at the research location, which will serve as influence factors in this analysis, in accordance with the classification and factor values specified in the *PKJI* 2023 guidelines. (Table 4-9 Criteria for side obstacle classes (*PKJI* 2023)).

Theoretical Foundation in the Discussion

The theoretical foundation in the discussion consists of Free-Flow Speed (*VB*), Capacity (*C*), and Travel Time (*WT*). These three data analyses have factors influencing road performance, such as physical road factors, traffic factors, and environmental factors. In *PKJI* 2023, these factors are converted into values that can yield analysis results in line with expectations.

Free-flow speed (*VB*) refers to the average speed of vehicles under traffic conditions where there is no influence from other vehicles (*PKJI* 2023). The first step is to determine the base flow speed (*VBD*) and calculate related factors such as the lane width factor (*VBL*), lateral resistance factor (*FVBL*), and urban size factor (*FVBUK*). (Tables 4-12 to 4-16 (*PKJI* 2023))

Road capacity (*C*) is the maximum number of vehicles that can pass through a road section in one hour under specific road and traffic conditions, measured in units of *SMP/hour*. The first step is to determine the base capacity (*C0*) and calculate the related factors, such as lane width factor (*FCLJ*), directional separation factor (*FCPA*), lateral obstruction factor (*FCHS*), and city size factor (*FCUK*). (Tables 4-1 to 4-7 (*PKJI* 2023))

Travel time (*WT*) refers to the average travel time of passenger vehicles (*MP*) on a road segment. According to the formula in *PKJI* 2023, travel time is equal to the length of the road segment divided by the travel speed (*VMP*). Travel speed refers to the actual average speed achieved by vehicles while moving on a road segment. Travel speed can be seen in the graph showing the relationship between free-flow speed (*VB*) and degree of saturation (*DJ*). The following is the formula for travel time:

Degree of saturation (*DJ*) is a measure used to evaluate the performance of a road segment or intersection by dividing the traffic volume (*Q*) by the road capacity (*C*). The result indicates how full or saturated the road is in accommodating vehicle flow. The degree of saturation value serves as a reference for the service level in the *LOS* (*Level of Service*) table.

Road Service Level

The road service level is the final result of this study and reflects the performance of the road in this study. It is a measure used to assess the quality of a road section in serving traffic flow.

RESULTS AND DISCUSSION

The analysis of the Kalitanjung road section, based on data obtained from primary and secondary sources, reveals several key findings regarding traffic flow and road performance. The traffic flow on this 400-meter stretch of road was calculated at 2,104.65 vehicles per hour (Q), while the peak vehicle count recorded during the survey reached 4,583 vehicles per hour (Kend/hour). The calculated SMP factor (FSMP) was 0.45923 SMP/hour, reflecting the traffic volume per lane per hour. These results indicate a significant load on the road, suggesting that the road's service level is being approached at or near its capacity, especially during peak hours. In terms of the level of service (LOS), the Kalitanjung road section is categorized under LOS “D,” indicating a road condition approaching instability with declining speed. This supports the overall finding that the road’s performance is unstable during peak traffic times, consistent with what has been observed in urban roadways with heavy traffic.

A critical aspect of this study was the observation of side activities or obstacles on Kalitanjung Road, a factor that was found to significantly affect the road's performance. As an urban road located in a commercial area, Kalitanjung experiences frequent roadside activities that hinder traffic flow. According to the PKJI 2023 side obstacle classification table, these activities place the road in the "high" category, labeled as “T,” meaning side obstacles substantially reduce the free-flow speed and increase the degree of saturation (DJ). Previous studies, such as those by Wijaya et al. (2020), highlighted similar findings where roadside activities, particularly in commercial areas, cause delays in traffic flow and lower overall road performance. This study extends these observations by quantifying the impact of side obstacles on traffic conditions, making a direct link to the performance of Kalitanjung road.

In evaluating road performance, the study calculated the free-flow speed (VB) as 34.776 km/h. The theoretical basis for this value incorporates several factors outlined in the PKJI guidelines. The base free-flow speed (VBD) is considered 42 km/h for urban roads, which is then adjusted by the lane width factor (FVBL) of 4 km/h. The side obstacle factor (FVBHS) of 0.92, which accounts for the impact of roadside activities, and the city size factor (FVBUK) of 0.9, which is used to adjust for the congestion typical in urban areas, were applied to arrive at the free-flow speed of 34.776 km/h. This method of calculating free-flow speed aligns with previous research by Santoso (2021), who used similar factors to evaluate road performance in urban settings, highlighting the significant influence of side obstacles on road capacity.

The traffic flow rate and the degree of saturation (DJ) calculated for Kalitanjung Road demonstrate the effects of these side obstacles. The DJ value indicates that the road is nearing its maximum capacity during peak hours, which is consistent with previous findings from Santoso (2021), who identified the direct relationship between side activities and road congestion. This study contributes further by offering empirical data that supports the hypothesis that side obstacles in commercial areas significantly affect road performance, emphasizing the importance of considering these factors in road design and traffic management strategies.

Further analysis revealed that the road is operating at 70% of its total capacity during peak traffic, indicating that the road's infrastructure is under stress but not yet fully overwhelmed. This finding supports the results obtained by Wijaya et al. (2020), who found that roads with a similar mix of commercial and residential zones operated at suboptimal levels of service during peak times. This study, however, extends these findings by not only measuring the impact of congestion but also by integrating a more granular analysis of side obstacles and their specific contribution to the decline in performance.

The results of this study highlight the need for improved infrastructure management, particularly in urban roads with high levels of commercial activity. The combination of side obstacles, high traffic volume, and limited road capacity is a critical issue that must be addressed through targeted interventions. Based on the findings, this research suggests the implementation of better traffic management solutions, such as enhanced road markings, the construction of dedicated lanes for specific vehicle types, and stricter regulations on roadside activities. These solutions could help reduce congestion, improve road performance, and provide a more stable level of service, ultimately enhancing the efficiency and safety of Kalitanjung Road.

CONCLUSION

Based on the discussion of this study, the performance of the Kalitanjung Road section in Cirebon City has a service level of 0.8, derived from the degree of saturation value as a reference for road service level

or *LOS* (*Level of Service*) *PKJI* 2023, categorized as *LOS* "D," meaning it is approaching instability with decreasing speed. A suggestion to improve the road performance on the Kalitanjung Road section in Cirebon City is to reduce the degree of saturation. Therefore, efforts should be made to reduce side obstacles on Kalitanjung Road.

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