Available online at JDR Website: http://journal.unublitar.ac.id/jdr
Journal of Development Research, 9 (2), November 2025, Pages 192-197
DOI: https://doi.org/10.28926/jdr.v9i2.455

Evaluation of The Effectiveness of New Connector Road in Reducing Congestion through VISSIM Simulation

Ratno Damar Rimbawan[1,*], Yohanes Pracoyo Widi Prasetyo[2] , Sunarko[3]

Universitas 17 Agustus 1945 Banyuwangi, Indonesia

E-mail: damarrimbawan@gmail.com[1] , widiprasetyo@untag-banyuwangi.ac.id[2], sunarko@untag-banyuwangi.ac.id[3]

*Corresponding Author

Received: 11 June 2025 | Revised: 25 November 2025 | Accepted: 29 November 2025

Abstract

Rapid motorization in Indonesia has intensified congestion not only in metropolitan areas but also in secondary urban centers such as Genteng District, Banyuwangi, where a single arterial corridor supports commercial and inter-district mobility. However, research addressing congestion mitigation in semi-urban road networks through strategic traffic diversion remains limited. This study evaluates the effectiveness of an alternative road routing strategy in reducing congestion along Jalan Gajah Mada using VISSIM-based microscopic simulation. Two scenarios were compared: the existing condition and a diversion strategy rerouting vehicles through Jalan KH Wahid Hasyim. Key performance indicators—average travel time, speed, queue length, and level of service (LoS)—were analyzed. Results reveal significant performance improvements despite a longer physical route: travel time decreased by 25.8%, speed increased by 143.6%, queue length reduced by 44.9%, and LoS improved from E to D. These findings highlight the potential of strategically planned traffic diversion to enhance mobility in semi-urban settings. The study is limited to peak-hour traffic and a single diversion scenario, suggesting the need for further evaluation with multimodal and multi-scenario analyses.

Keywords: *Alternative Route; Level of Service; Microscopic Simulation; Traffic Congestion; VISSIM*

Introduction

The number of motorized vehicles in Indonesia continues to increase year by year, in line with population growth and the rise of economic activities (Gao & Zhu, 2022). This situation has contributed to growing traffic congestion not only in major metropolitan areas but also in secondary regions such as Genteng District, Banyuwangi Regency. Genteng serves as one of the most prominent economic and trade centers in central Banyuwangi. According to the Banyuwangi Transportation Agency, the annual average traffic growth in the district reached 6.7% between 2019 and 2023, with peak-hour vehicle volume on key arterial roads surpassing their practical capacity.

One of the most significant congestion points in Genteng District is along Jalan Gajah Mada. This corridor connects the commercial center with surrounding residential areas and functions as an inter-district connector, leading to heavy traffic especially during morning and evening rush hours. Preliminary traffic observations in 2024 recorded a peak-hour volume-to-capacity (V/C) ratio of 0.89 on this corridor, indicating an operational level close to breakdown. Addressing this congestion requires appropriate interventions, both in traffic management and in the development of physical infrastructure (Wisetjindawat et al., 2018). mong widely

implemented measures, developing alternative road routes to redistribute traffic from congested arterials to secondary networks has shown promising results (Anupriya et al., 2023).

Microscopic traffic simulation tools such as VISSIM (Verkehr In Städten – SIMulationsmodell) have emerged as reliable instruments for evaluating traffic dynamics under various scenarios (Saidallah et al., 2016; Shaaban & Kim, 2015). VISSIM enables detailed modeling of vehicle behavior based on road geometry, traffic volume, and driver characteristics. Numerous studies have demonstrated its capability to assess the performance of alternative roadway designs by examining key traffic indicators such as average travel time, vehicle queue length, and level of service (LoS) (Saidallah et al., 2016; Shehzad Khattak et al., 2021; Tettamanti & Varga, 2012; Sun et al., 2013). However, previous studies predominantly focus on metropolitan-scale networks; research applying strategic traffic diversion to semi-urban settings characterized by single-arterial dependence remains limited, especially in the Indonesian context.

This study aims to evaluate the effectiveness of an alternative road route as a solution to traffic congestion on Jalan Gajah Mada in Genteng District. Through VISSIM-based microscopic simulation, traffic performance in the existing condition and under a proposed diversion scenario is compared. The findings of this study are expected to offer a data-driven basis for local transport planning and contribute to the scientific understanding of congestion mitigation strategies in semi-urban road networks.

Methods

A. Type and Research Approach

This study adopts a quantitative research methodology with a simulation-based approach. Traffic modeling was conducted using VISSIM software to evaluate the performance of the proposed alternative route in reducing congestion levels. The primary objective of this approach is to obtain both numerical and visual representations of the impact of the alternative road construction on key traffic parameters.

B. Study Area and Research Object

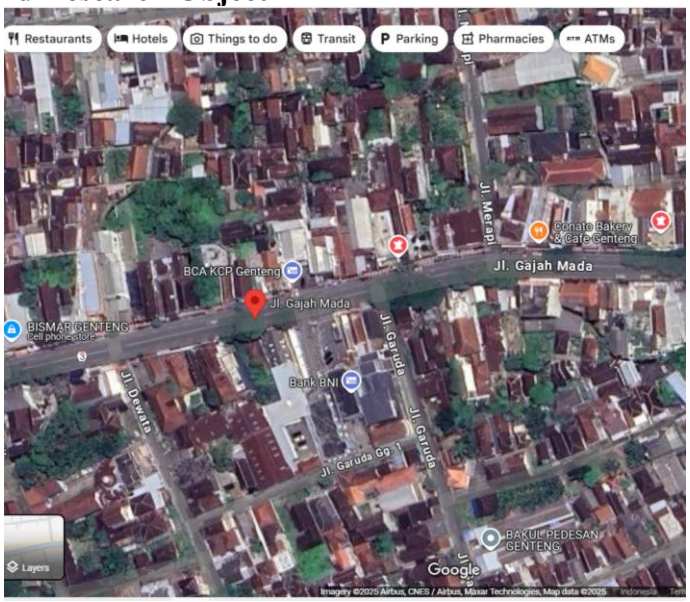

Figure 1. Study area map

Figure 1 shows the study was conducted in Genteng District, Banyuwangi Regency, with a specific focus on Jalan Gajah Mada, identified as the main congestion point. The simulated

alternative route involves diverting traffic from the eastern direction (Jalan Cangaan and Kembiritan) toward Jalan KH Wahid Hasyim**.**

C. Data Collection

The data used in this study consisted of:

- Primary data: Obtained through field observations, covering vehicle volume, peak hour duration, vehicle types, and traffic movement patterns.
- Secondary data: Included road network maps, road geometric data, and traffic documentation from the Banyuwangi Transportation Agency.

Data collection shows on Figure 2 was carried out over a two-week period during morning peak hours (06:30–08:00 WIB) and evening peak hours (16:00–18:00 WIB) to ensure representativeness.

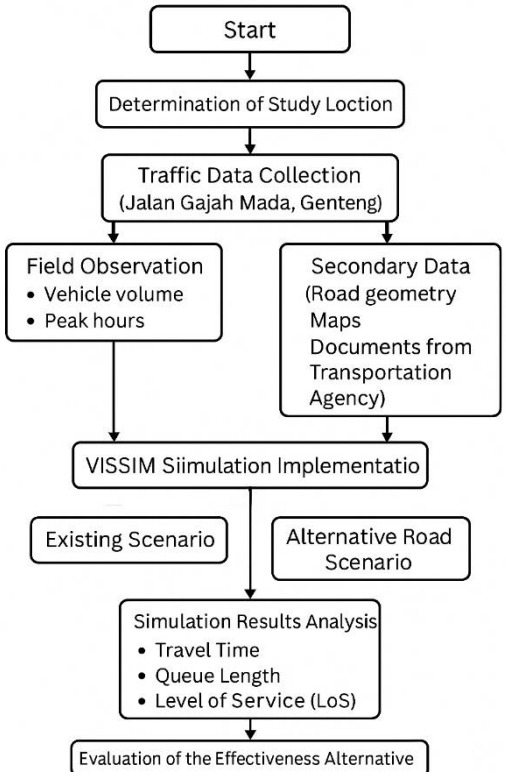

Figure 2. Research workflow diagram

D. Simulation Modeling Using VISSIM

The simulation process was conducted through the following steps:

- Road Geometry Input: Mapping of the road network based on actual field measurements and reference maps.
- Traffic Parameter Calibration: Vehicle speed distribution, driver reaction time (τ), headway time, and lane-change aggressiveness were calibrated based on observed field data. The calibration target was an absolute percentage error (APE) of <10% between observed and simulated traffic volume and queue length.
- Validation: The simulation results were validated using Theil's Inequality Coefficient (U) with an acceptance threshold of $U < 0.3$ to ensure agreement between measured and simulated traffic performance.
- Simulation Scenarios:
    1) Scenario 1 (Existing): Current traffic conditions without the alternative road.

2) Scenario 2 (Alternative): Traffic conditions assuming implementation of the proposed alternative route.

Each scenario ran for 60 minutes of simulated peak traffic with a 5-minute warm-up period, selected to reflect the average peak-hour congestion duration and to avoid initialization bias.

E. Data Analysis

Simulation results were analyzed by comparing the following traffic performance indicators:

- Average travel time
- Queue length
- Level of Service (LoS)

A descriptive-quantitative analysis was applied to determine the effectiveness level of the alternative route in mitigating traffic congestion.

Results and Discussions

Microscopic traffic simulation using VISSIM software was conducted to evaluate the effectiveness of an alternative road route in reducing congestion in Genteng District, Banyuwangi. The simulation focused on comparing traffic performance between two scenarios:

- The existing condition, where all eastbound traffic flows through Jalan Gajah Mada, and
- The alternative scenario, where traffic from Jalan Cangaan and Kembiritan is diverted to Jalan KH Wahid Hasyim.

In the existing scenario, Jalan Gajah Mada—measuring 1,200 meters in length and 6 meters in effective width—was observed to be highly congested. During morning peak hours (06:30–08:00 WIB), vehicle volume reached 1,528 vehicles per hour. Simulation results showed an average travel time of 13.2 minutes, an average speed of 5.5 km/h, and a maximum queue length of 198 meters. The Level of Service (LoS) was classified as E, indicating near-gridlock conditions, especially at two major unsignalized intersections that served as conflict points.

Table 1. Comparison of performance between scenarios

Parameter	Existing Scenario	Alternative Scenario	Change (%)
Average Travel Time (minutes)	13.2	9.8	↓ 25.8%
Average Speed (km/h)	5.5	13.4	↑ 143.6%
Maximum Queue Length (meters)	198	109	↓ 44.9%
Level of Service (LoS)	E	D	Improved

In contrast, the alternative scenario implemented a rerouting strategy spanning 2,200 meters. Although this route is geometrically longer, it offers smoother traffic flow due to minimal side friction, fewer heavy vehicles, and reduced conflict points. Simulation results demonstrated a significant improvement in traffic performance: average travel time decreased to 9.8 minutes, speed increased to 13.4 km/h, and maximum queue length was reduced to 109 meters. The LoS improved to D, indicating heavy but stable and flowing traffic conditions a comparative summary of key performance indicators is provided Table 1.

The visual comparison in Figure 3 illustrates the performance differences between the two scenarios. Despite the alternative route being nearly twice as long, its lower congestion and higher flow efficiency resulted in shorter travel times and a smoother driving experience. These

findings reinforce the notion that physical route length alone is not the sole determinant of route effectiveness; rather, a combination of traffic distribution, roadway geometry, and minimized conflict points is critical. The observed improvement in LoS from E to D further affirms that this rerouting strategy yields tangible benefits for road service quality.

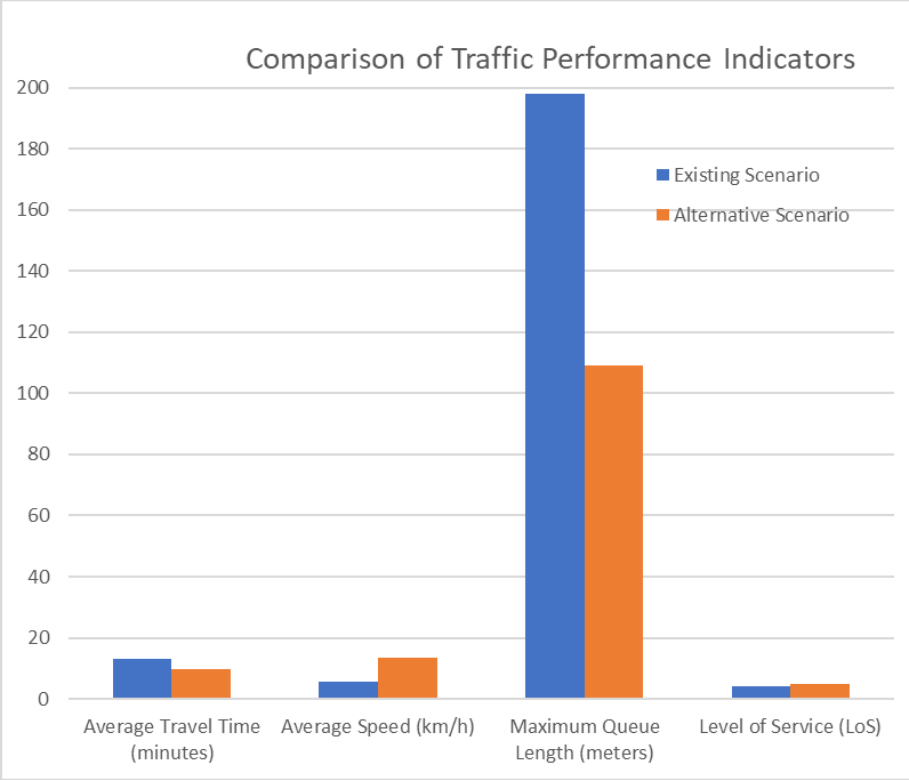

Figure 3. Comparison of traffic performance: existing versus alternative route

Nevertheless, the strategy's long-term effectiveness remains contingent upon the existing condition of the alternative infrastructure. Certain segments along Jalan KH Wahid Hasyim require pavement rehabilitation, widening of bottleneck segments, and improved signage and markings to ensure traffic safety and compliance. Moreover, further community outreach is necessary to encourage adoption of the new route and align travel patterns with the revised traffic scheme.

Limitations of this study include the assumption of driver behavior, which was not fully calibrated using local empirical data, and the simulation's focus on weekday morning peak hours only. Future studies should incorporate evening peaks and weekend scenarios, as well as integrate real-time traffic data to enhance simulation realism and responsiveness.

Based on the simulation results and supporting analysis, it can be concluded that the implementation of the 2,200-meter alternative route from the east direction contributes significantly to relieving traffic pressure on Jalan Gajah Mada and enhancing overall transport system efficiency in the area. This approach may serve as a viable permanent strategy for traffic management in semi-urban regions.

Conclusions

Based on the VISSIM-based simulation and traffic performance analysis, the implementation of a 2,200-meter alternative route via Jalan KH Wahid Hasyim significantly improves network performance. Travel time is reduced to 9.8 minutes, speed increases to 13.4 km/h, queue length decreases to 109 meters, and LoS improves to category D, indicating heavy but stable traffic flow. Although the alternative route is 83% longer in physical distance, it

delivers superior travel time due to more even traffic distribution, fewer conflict points, and low heavy-vehicle intensity. In practical terms, the findings suggest that the proposed alternative route can be adopted as a congestion mitigation strategy by local transportation authorities, particularly when combined with supporting measures such as traffic signage, route socialization, and intersection control optimization. Future research should consider evaluating multi-scenario alternatives, multimodal interactions, and long-term demand growth to provide a more comprehensive assessment of diversion strategies in semi-urban areas.

References

Anupriya, Bansal, P., & Graham, D. J. (2023). Congestion in cities: Can road capacity expansions provide a solution? *Transportation Research Part A: Policy and Practice*, *174*(April), 103726. https://doi.org/10.1016/j.tra.2023.103726

Gao, Y., & Zhu, J. (2022). Characteristics, Impacts and Trends of Urban Transportation. *Encyclopedia*, *2*(2), 1168–1182. https://doi.org/10.3390/encyclopedia2020078

Saidallah, M., El Fergougui, A., & Elalaoui, A. E. (2016). A comparative study of urban road traffic simulators. *MATEC Web of Conferences*, *81*. https://doi.org/10.1051/matecconf/20168105002

Shaaban, K., & Kim, I. (2015). Comparison of SimTraffic and VISSIM microscopic traffic simulation tools in modeling roundabouts. *Procedia Computer Science*, *52*(1), 43–50. https://doi.org/10.1016/j.procs.2015.05.016

Shehzad Khattak, K., Khan-P Eng, Z. H., Ahmad Khan, M., Rehmat Ullah, M., Khattak, K. S., Khan, Z. H., Khan, M. A., Minallah, N., & Khan, A. N. (2021). Vehicular Traffic Simulation Software: A Systematic Comparative Analysis. *Pakistan Journal of Engineering and Technology*, 2021. https://www.researchgate.net/publication/350466666

Tettamanti, T., & Varga, I. (2012). Development of road traffic control by using integrated VISSIM-MATLAB simulation environment. *Periodica Polytechnica Civil Engineering*, *56*(1), 43–49. https://doi.org/10.3311/pp.ci.2012-1.05

Wisetjindawat, W., Derrible, S., & Kermanshah, A. (2018). Modeling the effectiveness of infrastructure and travel demand management measures to improve traffic congestion during typhoons. *Transportation Research Record*, *2672*(1), 43–53. https://doi.org/10.1177/0361198118791909