



Evaluation and alternatives for performance improvement of the Ahmad Yani Road section in Banyuwangi Regency based on the 2023 Indonesian Road Capacity Manual (PKJI).

Apryan Bagas^{1*}, Femmy Sofie Schouten^{2*}, F.X Bowo Priyambodo^{3*}

¹ Program Studi Manajemen Transportasi Jalan, Politeknik Transportasi Darat Indonesia - STTD, Bekasi, Indonesia

² Magister PIT Politeknik Transportasi Darat Indonesia - STTD, Bekasi, Indonesia

³ Program Studi Transportasi Darat Politeknik Transportasi Darat Indonesia - STTD, Bekasi, Indonesia

Correspondence: [femmy.schouten@ptdisttd.ac.id]

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ABSTRACT

The Ahmad Yani road segment in Banyuwangi Regency is a regency road functioning as a primary collector; it is a four-lane, two-way undivided (4/2 UD) road serving the Roxy Square commercial area, characterized by high side friction due to on-street parking and pedestrian movement. This study aims to evaluate existing traffic performance and formulate management alternatives using the 2023 Indonesian Road Capacity Manual (PKJI). Primary data were collected through traffic counting, parking, pedestrian, and speed (moving-car observer method) surveys, then analyzed to determine capacity, volume-to-capacity (V/C) ratio, speed, density, and Level of Service (LOS). Analysis of existing conditions revealed a peak-hour volume of 2,754 pcu/hour, a capacity of 3,976.65 pcu/hour, a V/C ratio of 0.69, a speed of 22.91 km/h, a density of 120.20 pcu/km, and a Level of Service of D. Management alternatives—comprising the relocation of on-street parking to off-street facilities, widening sidewalks to 1.85 meters, revitalizing pedestrian crossings, and installing rumble strips—were shown to increase capacity to 5,031.77 pcu/hour, reduce the V/C ratio to 0.55, increase speed to 30.86 km/h, and improve the Level of Service to C. This study demonstrates that integrated management of side friction effectively enhances the performance of urban road segments.



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INTRODUCTION

Road networks serve as vital land transportation infrastructure, supporting public mobility, the distribution of goods and services, and regional economic growth (President of the Republic of Indonesia, 2004). The Ahmad Yani Road segment in Banyuwangi Regency is classified as a regency road serving a primary collector function; it is a four-lane, two-way undivided (4/2 UD) road spanning approximately 500 meters, connecting Banyuwangi city center with residential areas and the Roxy Square shopping center. High levels of commercial, office, and educational activity along this corridor generate significant pedestrian and vehicular movement, resulting in "side friction" caused by on-street parking, pedestrians walking along the road shoulder, and jaywalking. These conditions reduce the effective road width, thereby diminishing road capacity and overall traffic performance—manifested as an increased degree of saturation (DS), reduced vehicle travel speed (VT), and longer travel times (WT).

The traffic performance of a road segment can be characterized by the relationship between volume, capacity, speed, density, and Level of Service (Jenderal et al., 2023). Higher levels of roadside friction on urban road segments lead to a greater reduction in capacity and vehicle travel speeds, as

observed in road performance evaluations within the commercial district of Pekalongan City (Borneo et al., 2023) and in studies of road segment performance in East Denpasar (Kariyana et al., 2024). Managing roadside friction through parking regulations and improved pedestrian facilities has also proven effective in increasing road segment capacity, as reported in studies on capacity improvements for Narogong Road in Bekasi Regency (Purwanti & Indra Tjahjani, 2024) and on alternative road networks utilizing ring roads (Salas & Sarjana, 2024). Furthermore, improving pedestrian facilities based on user perceptions has been shown to contribute to enhanced pedestrian movement performance on urban road segments (Romadona et al., 2022).

Based on the foregoing, this study aims to: (1) analyze traffic performance on the existing Ahmad Yani Road segment and the impact of roadside friction; (2) formulate alternative measures to address roadside friction, specifically through parking reorganization, pedestrian facility improvements, and the installation of additional road furniture; and (3) compare road performance before and after the implementation of these measures. The study's novelty lies in its use of the 2023 Indonesian Road Capacity Manual (PKJI)—the latest methodology—to assess the performance of an urban primary collector road directly serving a digital hub, as well as in a management approach that simultaneously integrates parking, pedestrian, and road safety considerations. The findings are expected to serve as a reference for the Banyuwangi Regency Government—particularly the Transportation Agency—in formulating effective traffic management policies for similar road segments.

RESEARCH METHODS

This study employs a quantitative descriptive approach, focusing on Segment I of the Ahmad Yani Road section in Banyuwangi District, Banyuwangi Regency, East Java Province—specifically the approximately 500-meter stretch extending from the Satelit Intersection in the south to the Simpang Lima Intersection in the north, an area that encompasses the Roxy Square shopping center. The study utilizes both primary and secondary data. Secondary data includes road geometry and road network maps obtained from the Banyuwangi Regency Public Works and Public Housing Agency (DPUPR), as well as population figures from the Banyuwangi Regency Statistics Indonesia (BPS). Primary data was gathered through a road inventory survey, classified traffic counting, a parking patrol survey, a pedestrian survey, and a Moving Car Observed (MCO) survey. This road section is a major thoroughfare characterized by high traffic intensity and frequent congestion during peak hours.

Traffic performance analysis was conducted using the 2023 Indonesian Road Capacity Manual (PKJI) method for Type 4/2 UD urban roads, incorporating indicators such as capacity, volume-to-capacity (V/C) ratio, speed, density, and Level of Service (LOS) in accordance with Ministry of Transportation Regulation Number 96 of 2015. Parking analysis utilized indicators including accumulation, static and dynamic capacity, duration, index, and turnover rate. Pedestrian analysis employed indicators such as pedestrian volumes (both longitudinal and crossing), required sidewalk width based on the Technical Planning Guidelines for Pedestrian Facilities (2023), and PV^2 values to determine appropriate crossing facilities. Additionally, stopping sight distance (SSD) and the relationship between vehicle speed and pedestrian volume were analyzed to provide a technical basis for the proposed installation of rumble strips. Finally, the results of the existing condition analysis were compared with the results of the analysis following the implementation of proposed treatment alternatives to evaluate the effectiveness of the recommendations.

RESULTS AND DISCUSSION

Existing Performance of the Ahmad Yani Road Section

Inventory survey results indicate that the Ahmad Yani Road segment has a total width of 9.0 meters, featuring two lanes per direction each 2.25 meters wide without a physical median, and very limited road shoulders of only 0.4 meters on both sides. Capacity calculations using the equation $C = C_o \times F_{CLJ} \times F_{CPA} \times F_{CHS} \times F_{CUK}$ yielded a basic capacity of 6,000 pcu/hour; this was adjusted by factors for lane width (0.75), directional split (0.97), high-class side friction (0.91), and city size (1.00), resulting in a segment capacity of 3,976.65 pcu/hour. Traffic volume during the morning peak hour (06:30–07:30 WIB) was recorded at 2,754 pcu/hour, resulting in a volume-to-capacity (V/C) ratio of 0.69. The average vehicle speed, derived from a Moving Car Observer survey along the segment, was 22.91 km/h, with a traffic density of 120.20 pcu/km. Based on Ministry of Transportation Regulation Number 96 of 2015, this combination of indicators places the Ahmad Yani Road segment at Level of Service (LOS) D, indicating unstable traffic flow where drivers begin to experience limitations in selecting their speed.

Roadside friction on this road segment is dominated by on-street parking activities and pedestrian movement. On-street parking on both sides reduces the effective road width from 9.0 meters to approximately 4.4–4.6 meters; a parking index of 96 percent and a turnover rate of three vehicles per parking space indicate high demand pressure on the available space. Pedestrian surveys reveal a peak flow of 1.51 pedestrians per minute along the left-side sidewalk; however, the existing sidewalk width is only 1.4 meters, falling short of both the calculated minimum requirement (1.57 meters) and the technical standard for pedestrian facilities (1.85 meters). Regarding crossing activity, the PV^2 value derived from the survey reaches the 10^8 magnitude—meeting the criteria for an active crossing facility—but the proximity of the crossing point to the intersection makes the implementation of a Pelican crossing technically unfeasible; therefore, the revitalization of the zebra crossing, supplemented by rumble strips, is recommended.

Alternative Measures for Handling Side Friction

To address the issue of roadside friction, this study formulates three categories of mitigation alternatives. First, regarding on-street parking, the study compares different parking angles and evaluates shifting on-street parking to off-street facilities. The comparative analysis of parking angles reveals that a 0-degree angle (parallel parking) on one side of the road yields the highest capacity 4,396 passenger car units (pcu) per hour with a V/C ratio of 0.62 whereas 30, 45, and 60-degree angles each result in reduced road capacity. As a more permanent solution, the study proposes relocating all on-street parking to an off-street facility situated approximately 100 meters from the commercial area, requiring a capacity of 25 parking space units (SRP) based on peak parking accumulation.

Second, pedestrian facilities should be improved by widening the sidewalk from 1.4 meters to the minimum standard width of 1.85 meters, in accordance with the *Technical Guidelines for Pedestrian Facility Planning* (2023). In addition, the existing zebra crossing should be revitalized by installing pedestrian crossing signs and guardrails to direct pedestrians to cross only at the designated location. This recommendation is consistent with the findings of Hamidun et al. (2021, as cited in the reviewed document), which indicate that the installation of pedestrian guardrails effectively reduces unsafe mid-block crossing behavior in urban road environments. Third, additional road safety facilities are proposed, including the installation of rumble strips at a distance of 30–50 meters before the zebra crossing, as well as no-parking signs and speed limit signs. This recommendation is based on the stopping sight distance (SSD) analysis, which shows that at the existing operating speed of 22.91 km/h, the required SSD is 21.82 meters. However, when the operating speed increases to 40 km/h, the required

SSD rises to 45.76 meters. Therefore, mechanical speed control measures are necessary to reduce vehicle speeds in pedestrian conflict zones and enhance pedestrian safety.

Comparison of Performance Before and After Implementation of the Proposal

Following the implementation of all proposed mitigation measures, the roadside friction level on the Ahmad Yani road segment improved from "high" to "medium," resulting in an increased road capacity of 5,031.77 pcu/hour and a reduced V/C ratio of 0.55. Vehicle travel speed rose from 22.91 km/h to 30.86 km/h, while traffic density decreased from 120.20 pcu/km to 92.60 pcu/km. Improvements across these indicators raised the road segment's Level of Service by one grade—from D to C—indicating stabilized traffic flow and greater freedom for drivers to choose their travel speeds. A comprehensive comparison of road segment performance before and after the implementation of the proposals is presented in the following table. The table demonstrates consistent improvement across all performance indicators following the implementation of the proposed measures.

Tabel 1. Comparison of Ahmad Yani Road Segment Performance Before and After the Proposal

Performance Indicators	Existing Conditions	After the Proposal
Traffic Volume (pcu/h)	2.754,00	2.754,00
Road Capacity (pcu/h)	3.976,65	5.031,77
Volume-to-Capacity Ratio (V/C Ratio)	0,69	0,55
Travel Speed (km/h)	22,91	30,86
Traffic Density (pcu/km)	120,20	92,60
Level of Service (LOS)	D	C

Sumber: Hasil Analisis, 2026

The factor that contributes most significantly to improving the performance of the road segment is the relocation of on-street parking activities to off-street parking facilities. This measure restores the effective road width that had previously been reduced by vehicles parked along the roadside. Sidewalk widening also supports performance improvement by reducing the number of pedestrians who are forced to walk on the carriageway, thereby decreasing the potential for conflicts with motorized vehicles. These findings are consistent with studies conducted on other urban road segments, which indicate that the combined implementation of parking management and pedestrian facility improvements has a more significant effect on traffic performance than the application of a single treatment measure (Purwanti & Indra Tjahjani, 2024; Romadona et al., 2022).

CONCLUSION

The existing performance of Ahmad Yani Road operates at Level of Service (LOS) D, with a Volume-to-Capacity (V/C) Ratio of 0.69, an average travel speed of 22.91 km/h, and a traffic density of 120.20 pcu/km. This condition is primarily attributed to high roadside friction caused by *on-street parking* and pedestrian movements, which reduce the effective roadway width. The proposed improvement measures including the relocation of *on-street parking* to *off-street parking* facilities, widening the sidewalk to 1.85 m, revitalizing the zebra crossing, and installing rumble strips were found to improve all road performance indicators. Road capacity increased from 3,976.65 to 5,031.77 pcu/h, the V/C Ratio decreased from 0.69 to 0.55, average travel speed increased from 22.91 to 30.86 km/h,

traffic density decreased from 120.20 to 92.60 pcu/km, and the Level of Service (LOS) improved from D to C. These findings demonstrate that an integrated roadside friction management strategy, encompassing parking management, pedestrian facility improvements, and road safety devices, is effective in enhancing the performance of urban primary collector roads.

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