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Analysis of Traffic Congestion in Densely Populated Residential Areas Based on Infrastructure, Transportation, and Urban Planning (Case Study: Ketintang, Surabaya)

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ABSTRACT

Traffic congestion is a major urban transportation challenge resulting from the imbalance between rapid motor vehicle growth, limited road capacity, and uncontrolled land use development. This study analyzes the factors contributing to traffic congestion along Ketintang Street, Surabaya, a strategic corridor connecting the Ketintang area with Ahmad Yani Street and Gunungsari Street, where traffic conditions deteriorate to severe congestion during peak hours. A descriptive qualitative case study approach was employed using field observations as the primary data source and the Rencana Detail Tata Ruang (RDTR; Detailed Spatial Plan) of Surabaya, Transportation Agency data, and relevant literature as secondary data sources. The findings identified three principal causes of congestion: (1) the transformation of residential land into mixed-use commercial development without corresponding revisions to spatial planning policies; (2) infrastructure deficiencies, including an unpaved at-grade railway crossing and insufficient road capacity; and (3) operational and regulatory issues, such as inadequate traffic signs and pavement markings, illegal on-street parking, informal street vendors, and increased traffic generated by student travel during peak campus hours. The study recommends integrated interventions comprising short-term operational measures, including traffic management and enforcement against illegal parking; medium-term infrastructure improvements, such as paving the at-grade railway crossing and widening the roadway; and long-term spatial planning measures through revisions to the RDTR and the expansion of public transportation services. The findings confirm that traffic congestion along Ketintang Street is a multidimensional problem requiring coordinated management across the transportation, infrastructure, and urban spatial planning sectors.

INTRODUCTION

Traffic congestion is one of the major challenges facing urban areas, resulting from the imbalance between motor vehicle growth, road infrastructure capacity, and rapid land use development. This imbalance leads to traffic volumes that exceed the capacity of the road network, resulting in reduced road performance, declining Levels of Service (LOS), longer travel times, increased fuel consumption, and higher vehicle emissions (Safira, E., 2023). In general, traffic congestion is not merely a transportation engineering issue but also a consequence of urban development dynamics that requires an integrated, cross-sectoral approach to management (Menoni et al., 2024; Onyango et al., 2025).

As the metropolitan and economic center of East Java, Surabaya faces increasingly complex transportation challenges driven by population growth and expanding urban

activities. Motor vehicle ownership in Surabaya is estimated to increase by approximately 5–7% annually, whereas road capacity expands by only 1–2% per year. This imbalance has caused many road segments to experience declining service levels, with some reaching Level of Service (LOS) F, which represents heavily congested conditions characterized by very low travel speeds and long vehicle queues. One of the corridors experiencing these conditions is Jalan Ketintang, which functions as a strategic connector between the Ketintang area, Ahmad Yani Street, and Gunungsari Street while also serving as a primary access route to educational institutions, commercial areas, and residential neighborhoods (Safira, E., 2023).

Traffic congestion along Jalan Ketintang is influenced not only by high traffic volumes but also by limitations in the existing road infrastructure. Relatively narrow roadways, numerous intersections, frequent access points to residential areas and commercial centers, on-street parking, and an at-grade railway crossing all reduce traffic flow efficiency, particularly during peak hours (Al-Zubaidi et al., 2025). These conditions contribute to long vehicle queues, increased travel delays, and reduced Levels of Service, thereby affecting community mobility and the efficiency of the urban transportation system (St. Maryam, 2021; Kusumawaty, 2023). According to the Indonesian Road Capacity Manual, road capacity is strongly influenced by roadside friction, roadway geometric characteristics, and applicable traffic control measures (Ministry of Public Works and Public Housing, 2023).

In addition to infrastructure constraints, the characteristics of the transportation system in the Ketintang area further contribute to congestion. This corridor accommodates private vehicles, public transportation, motorcycles, and freight vehicles operating simultaneously within limited road space. The high dependence on private vehicles suggests that public transportation has not yet become the preferred travel mode for the community. Furthermore, inadequate pedestrian facilities, limited crossing facilities, and suboptimal traffic management during peak periods increase traffic conflicts and exacerbate congestion (Ramadhan, 2023). This finding is consistent with urban transportation theory, which states that increasing travel demand without corresponding improvements in transportation capacity leads to higher traffic saturation levels (Drabicki et al., 2017).

Land use and spatial planning also contribute significantly to congestion along the Jalan Ketintang corridor. The area has developed into a mixed-use district comprising educational institutions, commercial and service areas, shopping centers, healthcare facilities, office buildings, and dense residential neighborhoods. The concentration of these activities generates high trip production and attraction throughout the day, resulting in sustained increases in traffic volume, particularly during peak commuting and school hours. Gradual land use transformation has intensified regional activities without corresponding improvements in road network capacity, thereby increasing traffic congestion.

Previous studies have demonstrated that congestion in the Ketintang area results from the interaction of multiple interconnected factors. Wicaksono (2020) reported that the corridor operates at Levels of Service ranging from LOS D to LOS E during peak hours because of the imbalance between traffic demand and road capacity. Ramadhan (2023) found that the high use of private vehicles is associated with limited accessibility to public transportation, whereas Hidayat (2022) demonstrated that improvements in pedestrian infrastructure can encourage travelers to shift from private vehicles to walking for short-distance trips. These findings indicate that congestion management cannot rely solely on roadway widening but also

requires improvements in public transportation, non-motorized transportation infrastructure, and land use control.

The novelty of this research lies in its integrated analytical framework, which bridges the traditional disciplinary boundaries among transportation engineering, urban planning, and spatial policy analysis. Unlike previous studies that have examined infrastructure capacity, transportation behavior, and land use independently, this study analyzes their interactions and combined effects on traffic congestion. The case study approach enables a detailed examination of how uncontrolled land use transformation, infrastructure deficiencies, and operational shortcomings collectively contribute to chronic congestion. This integrated perspective provides a more comprehensive understanding of urban congestion than analyses focusing on a single factor.

Based on these conditions, this study aims to analyze the factors contributing to traffic congestion in the densely populated residential area along Jalan Ketintang, Surabaya, by integrating infrastructure, transportation, and spatial planning perspectives. This approach is expected to provide a more comprehensive understanding of the underlying causes of congestion and to generate recommendations for more effective, integrated, and sustainable traffic management. The findings are expected to support the Surabaya City Government in formulating transportation management and spatial planning policies that improve road network performance and promote sustainable urban development.

METHOD

This study employed a qualitative descriptive case study approach to examine traffic congestion in the Ketintang area of Surabaya from the perspectives of infrastructure, transportation systems, and spatial planning. Primary data were collected through field observations, while secondary data were obtained from relevant literature, scientific journals, the Rencana Detail Tata Ruang (RDTR; Detailed Spatial Plan) of Surabaya, and traffic-related data from the Surabaya Transportation Agency.

The data were analyzed by integrating infrastructure, transportation, and spatial planning perspectives. The analysis focused on road capacity, accessibility, roadside friction, Level of Service (LOS), and the consistency of land use with the applicable spatial plan. The findings were used to identify the principal factors contributing to traffic congestion and to formulate recommendations for more effective, integrated, and sustainable congestion management.

RESULTS AND DISCUSSION

Area Overview

Ward Ketintang is one of the the sub - district below Gayungan District, which is located in South Surabaya. Although its territory relatively small, area This be one of the most crowded point in the city Because density land use function. Research This focused on a radius of ±100 meters from intersection rail train fire Ketintang on Jalan Ketintang, Surabaya.

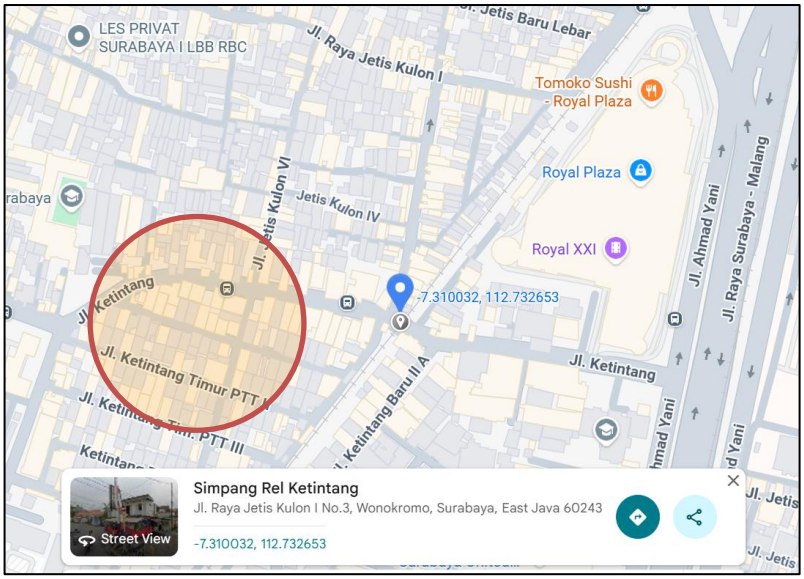

Figure 1. Focus research, Jalan Ketintang Surabaya

Figure 2. Point Important Area

Figure 3. Surrounding landmarks area

Analysis Infrastructure

A. Road Infrastructure

Network roads in the area This dominated by roads main roads, namely Jalan Ketintang, Jalan Ahmad Yani, and Jalan Ketintang Madya, which function as as connector between area as well as support mobility community. This area also has access direct to Jalan Ahmad Yani as corridor the primary artery of Surabaya City, so that own level high connectivity to center city and surrounding area.

Although condition infrastructure roads in general is at in category okay, still there is a number of problems that affect smoothness Then traffic jam often occurs during rush hour consequence high volume of vehicles passing through corridor main. In addition, some section road environment own limited width and located in the area settlement dense, so that capacity road No comparable with intensity movement vehicles and activities public.

B. Infrastructure Drainage

In a way general, system drainage in the area This has available throughout road main and functional as means surface water flow. The existence of network drainage the show that area has own infrastructure base For support control rainwater runoff. However thus, in condition Rain heavy Still often happen puddles in some point. Problem This exacerbated by the presence of channel clogged drainage consequence accumulation garbage, so that capacity the water flow becomes reduced. Condition the indicates the need improvement system drainage based better environment (eco-drainage) sustainable, through better rainwater management effective as well as maintenance channel drainage in a way periodically.

C. Infrastructure Utilities

Infrastructure utilities in the area This has available with Enough Good For support need public.

- Electricity: Services electricity supplied by PLN with level relative stability good, so capable fulfil need House ladder and activity economy.
- Clean water: the need for clean water public filled through Surabaya Regional Drinking Water Company (PDAM) network which serves part big area settlements.
- Telecommunications: Technology information and communication, region This has supported by an internet- based network fiber optics provided by some provider services, such as IndiHome, Biznet, and other operators. Infrastructure telecommunications are also included adequate, marked with quality relative signal strong as consequence from character areas located in urban areas with level density high population. Conditions the give support to activity society, good in field education, work, and service digital- based.

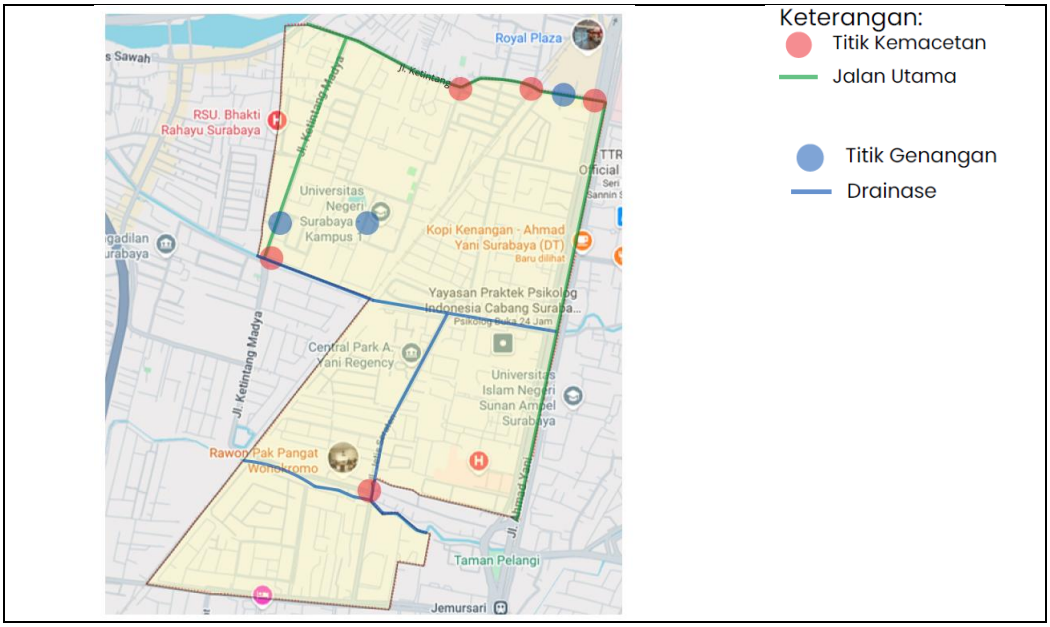

Figure 4. Analysis Infrastructure

Analysis Transportation

A. Network Transportation

Ketintang Area own network adequate transportation Good with level high accessibility to various areas in the city of Surabaya. This area connected direct with center city, nearby with area supporting industry and trade activity economy, as well as own access going to road toll through Waru Toll Gate. Condition the make Ketintang as strategic area and has good connectivity in support mobility resident and distribution goods and services.

B. Public Transportation

Ketintang Area own availability transportation quite common diverse For support mobility community. Available modes of transportation covering transport city (lyn), city bus, and services Suroboyo Bus which connects area with various areas in the city of Surabaya. In addition, transportation based applications, such as Gojek and Grab, have be one of choice main public Because offer convenience access, flexibility, and time travel further efficient. Existence various fashion transportation the give alternative more journeys diverse, increasing accessibility area, as well as support connectivity inter-regional in the environment urban.

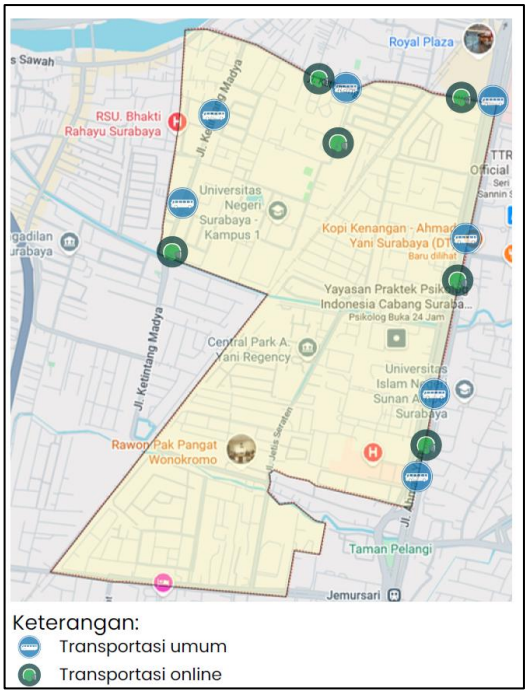

Figure 5. Location of public transportation stops in the Ketintang area

Spatial Planning and Land Use Analysis

The Ketintang Road Corridor is an area with a diverse spatial and land use pattern *(mixed-use)* , where various urban functions are concentrated in one road. Along this corridor there are educational facilities such as Surabaya State University (UNESA) and Telkom University, health facilities in the form of hospitals, trade and service centers such as Royal Plaza, commercial shophouses, cafes, hotels, office buildings (Telkom, PLN, Jawa Pos), public service offices such as Samsat, political party secretariats, and residential areas.

In addition to serving local activities, Jalan Ketintang also serves as a regional movement corridor connecting Surabaya with the Sidoarjo and Wiyung areas, resulting in high mobility intensity. However, the high density of commercial functions, public services, and residential areas is not balanced by adequate road infrastructure capacity. With a relatively limited road width of less than nine meters in some segments, this corridor must accommodate a very large volume of vehicles, coupled with the presence of illegal parking that further reduces the road's effective capacity. This condition indicates an imbalance between land use intensity and the carrying capacity of the road network, thus triggering traffic congestion and reducing the quality of mobility and comfort in the area.

Based on the previously described analysis of infrastructure, transportation, and spatial planning, three main clusters of causes of traffic congestion on Jalan Ketintang were identified: land use issues, infrastructure issues, and operational-regulatory issues. These three clusters are interrelated and reinforce each other, forming a pattern of chronic congestion in the area.

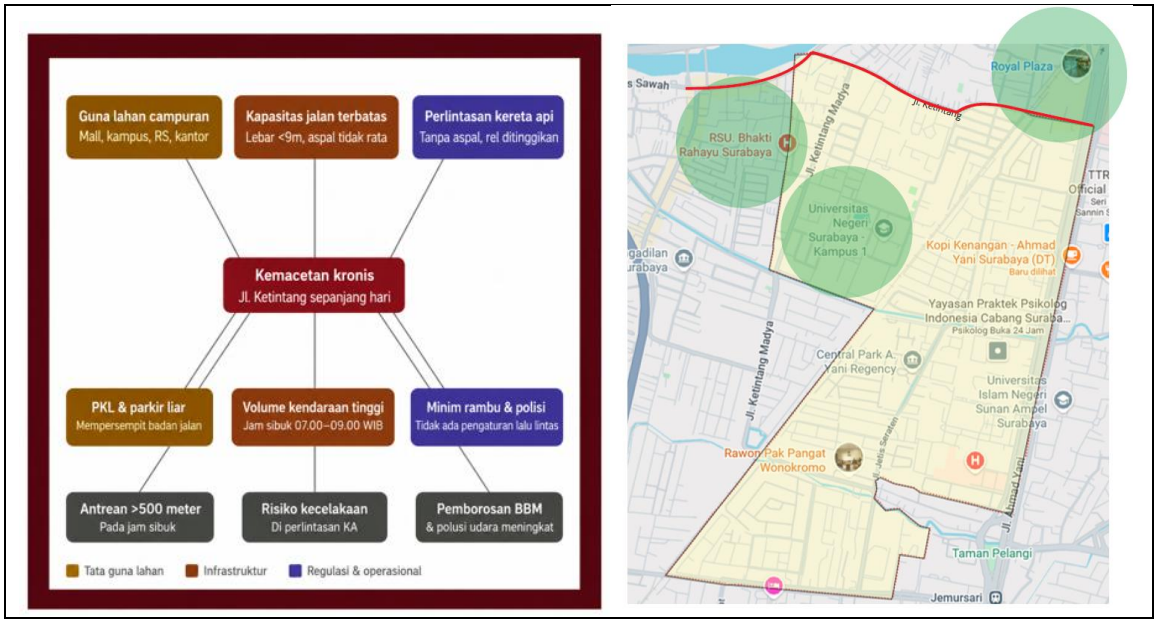

Figure 6. Map of traffic congestion problems

Land Use Problems (Spatial Planning)

The Ketintang area underwent an organic transformation from a residential zone to a mixed-use commercial zone, without adequate spatial planning revisions. In Surabaya, changes in the designation of residential areas are generally influenced by two main factors: the availability of road access and the implemented spatial planning policies—both in terms of the amount of fees and the quality of the spatial planning itself. In the context of Ketintang, the presence of Surabaya State University (UNESA) has become a major magnet for the growth of surrounding commercial functions, such as shophouses, cafes, and boarding houses, which have developed without controlled spatial planning. As a result, land use density has increased much faster than the capacity of the supporting road network can adjust.

Infrastructure Problems

One of the most prominent causes of traffic jams is the unpaved condition of the railway crossing. Gravel scattered across the track often requires motorcyclists to dismount and push their vehicles when a tire becomes stuck, leading to queues of vehicles up to 500 meters long during rush hour. When trains pass, the resulting congestion can even extend onto Jalan Ahmad Yani. Besides impeding traffic flow, the presence of this level crossing in the middle of a densely populated area also poses serious safety risks for road users.

Operational and Regulatory Issues

From an operational perspective, the lack of signs and road markings at several intersections makes it difficult for drivers to predict the direction of other road users. This situation is exacerbated by the presence of street vendors and student gathering points around the entrances to the area, which further restricts vehicle movement. The most consistent congestion pattern is observed between 7:00 and 9:00 a.m. Western Indonesian Time (WIB), coinciding with campus entrance times, when vehicle queues extend to the front gates, prompting some drivers to cut across lanes to speed up their journey.

In terms of regulations, the existing policy framework is actually in place but has not been implemented optimally. The Detailed City Spatial Plan (RDTRK) — as an elaboration

of the Regional Spatial Plan (RTRW) — has designated designated blocks on a 1:5000 scale plan map, and the Ketintang area is included in the Wonokromo/Ahmad Yani Surabaya Development Unit (UP). Formal control of spatial use is implemented through zoning regulations, permits, incentives and disincentives, and sanctions. However, in practice, violations of spatial planning are still frequently found, and control over zoning regulations as a reference for issuing IMBs and RDTRs remains relatively weak.

Recommendation

Based on the three clusters of findings, recommendations for handling congestion on Jalan Ketintang are proposed in stages through short-term, medium-term, and long-term strategies so that implementation is more effective and sustainable.

In the short-term (operational) phase, efforts that need to be made are focused on optimizing traffic management without requiring large infrastructure investments. Recommended steps include the permanent placement of traffic officers at railway level crossings during peak hours to reduce vehicle queues, regulating street vendors (PKL) and illegal parking that utilize the road surface and thus hinder the effective capacity of the road section, and installing more adequate signs and road markings, especially around the gates of Surabaya State University (UNESA), to improve order and safety for road users.

In the medium term (infrastructure), management is directed at increasing the capacity and quality of transportation infrastructure (Narayanaswami, 2017; Wang et al., 2023). Recommendations submitted include repairing and repaving railway crossings that have previously been constructed but still cause problems, widening roads or implementing a one-way system on certain segments in accordance with the results of technical studies, and strengthening collaboration between the State University of Surabaya (UNESA) and the Surabaya City Transportation Agency in regulating vehicle entry and exit patterns on campus during peak hours so that traffic conflicts can be minimized.

Furthermore, in the long term (spatial planning), the proposed policies are oriented towards controlling regional development and improving the urban transportation system in a sustainable manner. Recommended steps include revising the Detailed City Spatial Plan (RDTRK) for the Ketintang area with the implementation of stricter zoning regulations on the addition of new commercial functions, developing more integrated public transportation services, including the Suroboyo Bus network, to reduce public dependence on private vehicles, and conducting technical studies on the possibility of constructing underpasses or flyovers at railway level crossings as a long-term solution to eliminate conflicts between road traffic and train travel.

Overall , these findings confirm that congestion in Ketintang is not caused by a single factor, but rather the result of an interaction between uncontrolled land-use growth, limited infrastructure capacity, and weak operational management and spatial planning regulations . that, the handling need approach three integrated layers — operational, infrastructure, and spatial planning — so that the resulting solution nature structural, not just move point congestion to other locations.

CONCLUSION

Based on the research findings and discussion regarding the factors contributing to traffic congestion in densely populated residential areas from the perspectives of

infrastructure, transportation, and spatial planning, it can be concluded that congestion in the Ketintang area was influenced by several key factors. The first factor was the continuous increase in the number of vehicles, which resulted in high traffic volumes, particularly during peak hours. The second factor was limited road infrastructure capacity, characterized by relatively narrow road widths that were insufficient to accommodate existing traffic demand. The third factor was the high intensity of activities at intersections and access points, which created vehicle movement conflicts and reduced traffic flow efficiency. In addition, the concentration of commercial and service activities along the Jalan Ketintang corridor contributed to increased traffic density, while the presence of educational facilities, including universities and schools, generated significant travel demand during certain periods. Another important contributing factor was the railway level crossing operated by Kereta Api Indonesia (KAI), which periodically interrupted vehicle movement and generated queues and congestion. Furthermore, the proximity of the area to shopping centers and other public facilities further intensified vehicle movements to and from the area.

Based on these findings, it can be concluded that congestion in the Ketintang area was not caused by a single factor but resulted from the interaction between increasing land use intensity, high transportation demand, and limited road infrastructure capacity. Therefore, congestion management should be implemented through an integrated approach involving infrastructure improvements, traffic management optimization, public transportation development, and spatial planning strategies that are aligned with the capacity and function of the road network.

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