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ANALYSIS OF THE CAUSES OF TRAFFIC CONGESTION (CASE STUDY OF JATIWANGI—LIGUNG ROAD)

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ABSTRACT

Traffic congestion on Jatiwangi-Ligung Road in Majalengka Regency has become a major problem. The purpose of this study is to find out the causes of congestion and find the best way to solve it. This study found through field observations, traffic data analysis, and literature studies that the main causes of congestion are the increasing number of private vehicles, limited road capacity, and lack of public transportation integration. In addition, conventional markets and non-ideal intersections worsen traffic conditions. Based on these findings, this study recommends several strategies to overcome congestion, including: increasing road capacity, developing an integrated public transportation system, implementing a technology-based traffic management system, and consistent law enforcement. In addition, active community participation in efforts to reduce congestion is also very important. The results of this study are expected to be a basis for local governments in formulating more comprehensive and sustainable transportation policies, so that they can improve the quality of life of the community and reduce the negative impact of congestion on the local economy.

1. Introduction

Traffic congestion is a critical issue in many cities, especially in areas experiencing rapid population and economic growth. Researcher have focused a lot of attention on the problems of road transportation and traffic congestion in recent years, particularly given the speed at which cities and the road system are developing (Olayode, 2020). Increased mobility of people and the development of industrial and commercial areas in Majalengka Regency, especially along Jalan Jatiwangi-Ligung, have exacerbated this situation. Jalan Jatiwangi-Ligung is an important connecting route connecting Majalengka with several surrounding areas, including trade and industrial centers in the Cirebon and Bandung areas. The road conditions that are unable to accommodate the increasing volume of vehicles make this route prone to prolonged congestion. The increasing number of vehicles and population density puts excessive pressure on urban infrastructure. This trend poses challenges for city planners and policy makers. This is because land use must be planned to reduce traffic congestion in limited city center space. (Song, 2019)

Congestion along this route not only harms road users, but also impacts productivity and efficiency of travel time, as well as increasing air pollution and traffic accident rates. According to the National Development Planning Agency (Nasional, 2019)Traffic congestion in urban areas of Indonesia causes economic losses of up to billions of rupiah each year due to lost productive time and increased fuel consumption. In this context, a study of the factors of congestion on a particular road, such as Jalan

Jatiwangi-Ligung, is essential to identify relevant and effective solutions. The economy and health of a nation are both directly and indirectly impacted by traffic congestion. (Moridpour, 2021)

A number of international studies have shown that traffic congestion is influenced by a variety of factors, including road design, vehicle density, traffic management, and driver behavior.The main cause of traffic jams is unplanned roads that do not take into account the driving culture of car owners and drivers. (Memon, 2020)The main cause of traffic congestion is often poor road planning and lack of consideration for local driving culture. Many roads are built without taking into account future increases in vehicle numbers and driver behavior, such as off-street parking, lack of compliance with traffic regulations, and frequent use of private roads by vehicles. As a result, especially in areas undergoing rapid urbanization, road capacity quickly reaches its limits and traffic congestion becomes an unavoidable problem.Community activity centers that are forced to park on the street frequently experience this. (Rahayu, 2022)

However, specific factors that affect congestion on certain roads, such as Jalan Jatiwangi-Ligung, require more in-depth analysis to obtain a clear picture. The focus of this study is to find the main components that cause congestion on these roads, and then provide applicable suggestions to reduce congestion and improve driving comfort and safety in Majalengka Regency.

2. Literature Review

Various studies on traffic congestion have been conducted in various countries and urban areas, each with unique characteristics related to the factors causing congestion. Congestion can be caused by a combination of increasing number of vehicles, less than optimal traffic management, and inadequate infrastructure availability. These factors are interrelated and have the potential to worsen traffic conditions in an area. (Litman, 2021). people's dependence on private vehicles is one of the main factors that triggers congestion in urban areas. In car-dependent cities, the majority of people rely on their cars. (Okeke, 2020)

Infrastructure factors also play an important role in determining the smooth flow of traffic.Because the safe, effective, and dependable flow of people and commodities will promote social and economic growth, road infrastructure is crucial to a nation's security, economics, and general well-being. (Muizz, 2024)That the physical condition of the road, such as lane width, road surface quality, and supporting facilities such as sidewalks and special lanes, greatly influence traffic flow. One crucial component of urban infrastructure is the road system (Tran, 2021)In the context of the Jatiwangi-Ligung Road, limited road infrastructure is one of the main causes of congestion, especially at points with the road width inadequate to accommodate many vehicles.Let's say a nation has damaged road infrastructure. In that scenario, it will restrict access to more effective modes of transportation, impede the movement of people and products, and possibly impede economic expansion. (Nurhasanah, 2024)In addition, Pang, A., Wang, M., Chen, Y., Pun, MO, & Lepech, M. (2024) highlighted that suboptimal traffic control systems, such as minimal traffic signs and red light settings, also contribute to congestion, especially in areas with dense vehicle volumes. Intelligent TSC systems play a vital role in reducing inefficient signal systems at intersections, It is among the main reasons why cities experience traffic congestion. Conventional TSC techniques like Webster Act (Pang, 2024)

Regarding driver behavior, Ibrahim, NA noted that driver behavior, such as sudden stops or not obeying road markings, can worsen congestion. In many cases, individual behavior in the traffic flow is the determining factor for most of the characteristics of road traffic. (Ibrahim, 2021)This study is relevant

in the context of Jalan Jatiwangi-Ligung, where traffic violations by drivers are often encountered which can cause obstacles on the route. Research by Aleko, DR, & Djahel, S. (2020) also shows that the implementation of smart technology, such as adaptive traffic control systems, can improve the efficiency of vehicle flow by adjusting the duration of traffic lights based on dynamic vehicle volume. According to transportation experts, SGTS will primarily include cutting-edge transportation infrastructure, creative applications, and driverless and autonomous cars. Advanced traffic signal controllers, sophisticated sensors and gadgets for traffic monitoring and the infrastructure consists of numerous additional items. Managing and reducing traffic congestion, a problem that most cities face, is the main purpose of SGTS. (Aleko, 2020)

People's dependence on private vehicles is also a factor that causes congestion, according to Saavedra, M., Muñuzuri, AP, Menendez, M., & Balsa-Barreiro, J. (2024) People's dependence on private vehicles is the main cause of traffic congestion in the city. These factors influence traffic dynamics and can separate traffic congestion from urban size. This is reflected in the alarming increase in traffic congestion in medium-sized cities, with people increasingly relying on cars for convenience and a lack of alternative means of transportation. (Saavedra, 2024). This is due to the limitations of road infrastructure that is unable to keep up with the growth in the number of private vehicles, thus increasing pressure on existing road capacity.

One of the causes of traffic jams is damaged or non-functioning traffic signs. Irregularity in the flow of vehicles occurs when there are no intersections with active traffic lights, especially in locations with many vehicles. Drivers often make mistakes in determining road priorities, which causes vehicle congestion and a higher risk of accidents. During peak hours, traffic chaos becomes worse because drivers tend to rush. To maintain smooth and safe traffic on the road, traffic signs and lights must be maintained regularly. The area's rapid development has increased traffic at the intersection, leading to several traffic problems, including chaos and congestion. The function of the traffic signaling tool has not yet been able to alleviate confusion and congestion, particularly during rush hour. In particular, the roundabout in the center of the intersection makes things more difficult. (Firmansyah, 2022)

Unsignalized intersections are also a factor in traffic congestion. If there are no traffic lights at intersections with many vehicles, drivers must rely on themselves to get through, which often leads to confusion and priority struggles. The most crucial element for road users is traffic signs, which naturally contribute to drivers' safety and security. (Fatimah, 2024)This slows down the flow of traffic and increases the risk of accidents. This condition is made worse during peak hours when the number of vehicles passing far exceeds the capacity of the intersection. To solve this problem, an effective traffic signal system must be installed and the intersection design must be changed to accommodate more vehicles. An intersection with traffic lights installed to help with traffic flow is known as a signalized intersection (Akbar)

Apart from these factors, Del Rosario, P., & Traverso, M. (2023) showed that road capacity management has a crucial role in reducing congestion. A nation's social and economic progress is correlated with its road infrastructure. (Del Rosario, 2023)They stated that road widening and alternative route development can be an effective solution in reducing vehicle density on main roads. This study highlights the importance of infrastructure planning that is in accordance with the needs and growth of the number of vehicles in an area. These studies are the basis for this study in exploring the factors causing congestion on Jalan Jatiwangi-Ligung and providing recommendations for applicable solutions for the area.

3. Method

This study uses a quantitative approach, namely direct observation along Jalan Jatiwangi-Ligung. Traffic volume data was collected through field observations during morning and evening rush hours, as well as surveys of road users regarding their experiences related to congestion on the route. In addition, secondary data from the local Transportation Agency was used to complete the analysis. Statistical analysis was conducted to see the correlation between vehicle volume, peak time, and congestion.
This research was conducted on Tuesday, January 14, 2025 at 06.00 – 07.00 WIB when people were doing activities such as going to work and school, and at 16.00 – 17.00 WIB when people finished their activities. The location of this research is on Jalan Jatiwangi-Ligung, Ligung District, Majalengka Regency.

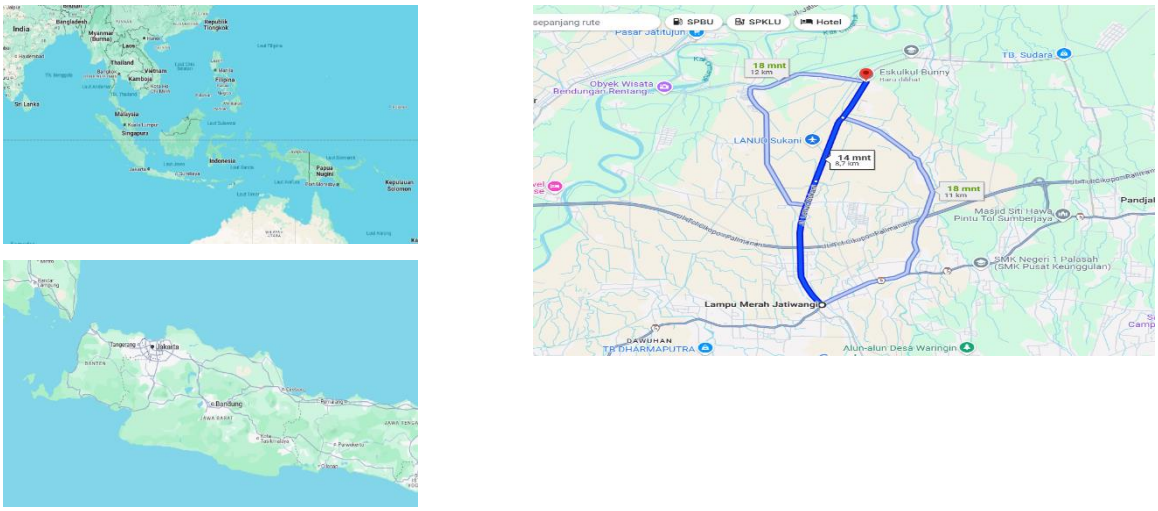

Figure 1 Planned location

4. Results and Discussion

The cause of traffic congestion on Jalan Jatiwangi-Ligung is currently under investigation. The main cause of traffic congestion on this route is the presence of industrial facilities there, resulting in an increase in the number of vehicles, both private cars and freight transport. In addition, poor infrastructure, including damaged roads, worsens the traffic situation. A road section's overall state can be quantitatively measured using the PCI approach, which accounts for a number of flaws such as cracks, potholes, and surface damage. (Natalia, 2023)Another factor is the lack of attention of road users. Road users do not follow traffic regulations or park carelessly, disrupting the smooth flow of traffic. The combination of these factors often results in traffic congestion, especially during rush hour.
The research results show that the following factors cause congestion:

1. Vehicle Volume

It is very important to measure the traffic density of vehicles on a particular road section during a specific period. Average spatial velocity (Us) is calculated in kilometers per hour, while To assess this traffic density volume, (Q) is measured in vehicles per hour (pcu/h), flow rate is measured in vehicles per hour (pcu/h), and density is measured in vehicles per kilometer per hour. The number of vehicles passing through a road section in one hour is called volume (Q), which indicates the traffic intensity on a particular stretch. Volume data is very important to understand the amount of traffic passing through the road. Flow rate indicates how many vehicles are passing through the lane in one hour. which further helps in understanding the traffic intensity on the tested road section.

No	Tuesday Time	Average space speed (Us) (km/h)	volume (Q) (smp/hour)	flow rate (smp/hour)	density (D).
1	06.00-07.00	25.00	1920.5	7682	256.02
2	11.30-12.30	30.50	700.5	2802	91,868
3	16.00-17.00	35.80	1962.8	7850.32	219.28

Traffic density result data

The test results show that vehicles reached the highest density of 219.28 Smp/hour at 06.30 – 07.00 WIB, when traffic tends to be denser and vehicles can move slowly at relatively low speeds. At the same time, the lowest density of vehicles occurred on Tuesday, from 11.30 to 12.30 WIB, at 91.868 Smp/hour. During this period, vehicle density was seen to decrease.

2. Road Damage

The investigation revealed that road damage is the main cause of traffic congestion on Jalan Jatiwangi-Ligung. Unsuitable road conditions such as potholes, cracks, and loose asphalt require road users to slow down or even stop to avoid further damage to their vehicles. This causes congestion and long queues, especially in the middle of the day.

This road damage not only disrupts traffic flow but can also threaten the safety of vehicles that often have to drive to avoid the damage, increasing the risk of accidents. In addition, this situation also slows down the movement of large vehicles such as trucks and buses, which significantly impacts travel time and transportation efficiency in the area.

Therefore, increased repairs and maintenance To address these issues and improve the quality of travel for everyone,

Figure 2 Road Damage Image

3. Undisciplined road user factors

There are residents at some point throughout the day, shopkeepers and owners who sell along the road, as well as individuals who store or park their motorbikes along the road, which can cause traffic congestion. The following photo may explain the irregular parking that often occurs on Jalan Jatiwangi-ligung.

Figure 3 Image of Illegal Parking

This situation is often found along Jalan Jatiwangi-Ligung, especially in the queue section and in front of Pasar Oncog Dango and the shophouses that line this road. This also has an impact by causing traffic jams on Jalan Jatiwangi Ligung.

5. Conclusion

Based on observations and research at several locations (Jatiwangi-Ligung Road), it can be concluded that the factors causing traffic congestion are caused by three main factors, namely:

1. Inadequate road capacity

The road needs to be widened because the volume of passing vehicles has exceeded the maximum capacity of the road. Due to the large number of vehicles, traffic becomes congested, especially during rush hour.

2. Road damage

Road damage is the second factor that contributes significantly to traffic congestion. For example, potholes, uneven asphalt surfaces, and other road quality degradation hamper the smooth flow of traffic. Vehicles must slow down or maneuver to avoid the damage, creating long queues. In this case, regular road repairs and maintenance are needed to ensure smoother traffic flow.

3. Disorderly use of roads

The third factor is the behavior of road users, such as illegal parking on the side of the road, especially in busy areas such as Ongkogu Dango Market. Vehicles parked haphazardly reduce the effective width of the road, forcing other vehicles to slow down or stop, which ultimately worsens congestion. Better enforcement of traffic rules and parking management are needed to address this problem.

Integrated efforts, such as road widening, repairing damage, and controlling illegal parking, are important steps to reduce congestion on the Jatiwangi-Ligung road and increase traffic efficiency in the area.

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