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ANALYSIS OF THE IMPACT OF SIDE OBSTACLES ON ROAD PERFORMANCE: CASE STUDY OF THE KADIPATEN TRADITIONAL MARKET OF MAJALENGKA

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ABSTRACT

The discrepancy between the rise in automobile ownership and the suboptimal capacity of roads can be attributed to the escalating demands for transportation and the elevated purchasing power of individuals. This situation is particularly prevalent in high social and economic activity, such as the Kadipaten Traditional Market area, leading to frequent side obstacles. These obstacles, occurring in the market area, can be assessed based on various factors including pedestrian crossings, parked vehicles, vehicle flow in and out of the area, and slow-moving vehicles. This study aims to analyze the impact of side obstacles, traffic density, and road performance in the Kadipaten Traditional Market area. The research was conducted in three phases: the initial study, volume survey, and side obstacle assessment. This study utilizes primary and secondary data. The primary data encompasses the count of side obstacles and the traffic flow volume within the research area, which is subsequently computed and examined. The secondary data was sourced from the Central Statistics Agency for Majalengka city, encompassing population statistics, and then analyzed by the 2023 Indonesian Road Capacity Guidelines. Based on the findings, the saturation level was determined to be 0.615, indicating a moderate level of saturation as per the 2023 Indonesian Road Capacity Guidelines. This suggests that while traffic flow in the Kadipaten Traditional Market area is dense but relatively smooth, the presence of side obstacles significantly hampers road performance.

1. Introduction

Roads are an essential means of transportation to connect various places such as industrial centers, agricultural areas, and settlements as well as a means of distributing goods and services to support the economy [1]. In addition, roads play a crucial role in facilitating the economy and daily activities in people's lives. To increase in the population in turn has caused a rise in the number of vehicles on the road [2]. Population increase is the primary driver of the rising demand for land transportation, which affects social and economic activity. As a result, transportation infrastructure is required to meet community needs and promote regional development.

The growth of social, economic, tourism, education, and other sectors in Asia has led to an increased demand for transportation. As a crucial component of land transportation, roads must be able to

accommodate the needs of the community. Failure to do so can result in significant road performance issues, particularly as vehicle volume exceeds road capacity. Consequently, traffic jams have become a common occurrence in several Asian countries, including the Philippines, India, and Thailand. Many factors cause traffic jams, including side obstacles, such as the high population of vehicles, especially trucks and motorcycles [3].

Many drivers park on the side of the road due to the abundance of shops, leading to a scarcity of parking space and creating obstacles. high population density, growth of motor vehicles and their infrastructure, and proliferation of rideshare and delivery services [4]Side obstructions may result from the rise in private automobiles and the high volume of drivers parking. Not only private vehicles but also many public vehicles contribute to this issue. Despite the decrease in public transportation in Indonesia, many people still rely on it in several cities.

Majalengka is a district in West Java with a sizable population. It also boasts traditional businesses, such as the Kadipaten Traditional Market. The congestion on the main road in the market area is a result of various factors, including the high volume of motorists parking due to inadequate parking spaces at the shops. The continuous growth of vehicles and the waves of urbanization made street parking spaces a premium feature in most cities [5]. While it may not lead to significant traffic congestion, it can still affect various aspects such as reduced driver speed, increased driver saturation, longer travel times, decreased road capacity, and diminished overall road service quality.

The study aims to examine the impact of side obstacles on-road performance in the Kadipaten Traditional Market area. These obstacles can be very disruptive for motorists navigating through this area. The roadside obstacle often significantly affects the capacity and performance of the road, especially in an urban area [6]. Drivers should be mindful of obeying traffic rules by avoiding parking and other actions that create side obstacles. The responsible agencies are expected to proactively regulate and address the issue of side obstacles to prevent traffic congestion.

2. Literature Review

2.1 Side Obstacles

Side obstacles are the effect of walkers cruising by, public vehicles or confidential vehicles parking on the shoulder of the street, vehicles entering and leaving out and about, slow vehicles, etc. The capacity and speed of urban arterial roads are greatly affected by lane width, the presence of non-motorized vehicles, and side friction factors [7]. Reducing vehicle speed increases the driver's travel time, diminishing road performance and impacting other drivers disturbed by these obstacles.

In addition to reducing driver speed, road capacity has also decreased. The high number of drivers parking on the shoulder of the road is responsible for the reduced road capacity. Due to insufficient parking spaces provided by the shops, drivers are forced to park on the road's shoulder. Furthermore, the distant parking area leads many drivers to choose road parking, creating obstacles on the side. Even though designated parking lots have increased in most of the metropolitans, parking spaces are still failing to accommodate peak hours [8]. Vehicles frequently These activities affect traffic flow characteristics in several ways: they result in road capacity reduction, impact speed, and affect the Level of Service (LOS) [9].

As the population grows, so do social and economic activities. This not only results in an abundance of cars parked on the side of the road but also leads to significant obstacles for pedestrians. The absence of sidewalks (specifically on urban roads) forces pedestrians to share the right-of-way with fast-moving vehicles and it causes a reduction of 7.23 km/h in average speed on urban roads [10]. Apart from that, many pedestrians also have to share the road with vehicles due to misuse of sidewalks by street vendors.

The presence of side obstacles can disrupt other drivers, so a solution is needed to address this issue. Removing parking barriers could help alleviate the problem of side obstacles, preventing motorists from parking on the shoulder of the road. Additionally, there should be a collective effort from society and merchants to refrain from selling on the walkway and stopping on the shoulder of the street. Furthermore, individuals can also switch to public transportation to reduce the use of private vehicles. parking on the road shoulder, encroachments, and frontage access significantly reduces the performance of urban roads [11].

2.2 Road Performance

Road performance is the ability of roads to serve the needs of traffic flows according to their functions and can be measured and compared with the level of road service standards [12]. Generally, road performance is assessed using parameters such as capacity, degree of saturation, average speed, and others. The Kadipaten Traditional Market area frequently experiences side obstacles, leading to reduced road performance. While this may not cause severe congestion, it does affect road capacity, driver speed, travel time, degree of saturation, as well as service and safety levels. The quality of road service can be determined by assessing the functional conditions during rush hour traffic and the drivers' perception of road performance.

The growing population and number of vehicles are causing a decline in road performance. This is primarily due to insufficient infrastructure leading to limited road capacity. Additionally, the parking habits of many drivers also contribute to the reduced road capacity. Capacity is defined as the maximum number of cars, people, or similar things that may be accommodated per unit of time under certain conditions with a reasonable expectation of occurrence [13].

The flow of traffic in a lane or section of the road has an impact on-road performance. The speed of vehicles on certain roads is an indicator of the flow of the road [14]. In the absence of side obstacles, it will undoubtedly prompt the driver to accelerate. This, in turn, reduces the driver's travel time and enhances overall road performance. However, the presence of parked vehicles and pedestrians on the roadside creates side obstacles that negatively impact road performance, causing the driver's speed and travel time to become suboptimal.

Some problems hinder road performance, such as a significant increase in motorized vehicles and cars [15]. Increasing the volume of vehicles will significantly impact road performance, leading to traffic congestion. This issue needs to be promptly addressed through the implementation of road widening, efficient parking layout, and the use of parking space barriers to prevent the creation of side obstacles.

2.3 Traditional market

The World Health Organization predicts that the population in urban areas will continue to expand by more than 1.5% per year until 2030 (WHO, 2010) [16]. This will lead to traffic congestion, pollution, and noise from vehicles. As the population continues to grow, so will social and economic activity. This activity is also evident in the Kadipaten Traditional Market area, a major trading center in Majalengka. This could lead to increased parking and subsequent obstacles.

Problems like traffic congestion, air and noise pollution, and increasing fuel consumption due to the use of private cars are among the major problems for the quality of life in urban areas [17]. In large cities, this frequently happens due to social and economic activities. One such activity is the Kadipaten Traditional Market, where people buy and sell daily necessities. Traffic jams are one of the consequences of these activities, caused by obstacles on the roadside and insufficient parking in the area.

Logistics and transport enable economic development but are traditionally less efficient in cities, and urban areas are characterized by the interaction of people with different interests nearby [18]. Big cities are still working on improving their transportation systems, even though they are currently not very efficient. Long routes, extended waiting times at pick-up and drop-off points, low passenger numbers, and high demand from certain consumers are all additional obstacles. The business sector, logistics service providers, the community, and the government can all collaborate to address these issues.

Accelerated industrialization throughout the world led to higher growth rates of urban economy, income as well as the living standard of the inhabitants in addition to the high growth of population, there is continuous growth in private vehicle ownership **[19]**. Public transportation, also known as

public transit, provides transportation for passengers to the Kadipaten Traditional Market. It is intended to alleviate traffic congestion and lessen the demand for parking space. However, public transportation often leads to side obstacles on the road shoulder due to vehicles parking while waiting for passengers. Additionally, many individuals still opt for private vehicles, further exacerbating the parking space shortage at the Kadipaten Traditional Market. Consequently, numerous private vehicles end up parking in the area due to the inadequate parking facilities.

3. Methodology

The study was conducted at Jalan Kadipaten leading to Majalengka, specifically at the Kadipaten Traditional Market. The research utilized primary and secondary data. The primary dataset included information on slow vehicles, cars parked on the road shoulder, vehicles entering and leaving the area, and pedestrians. Additionally, secondary data, obtained from the Majalengka City Central Statistics Agency, included population figures used to adjust for city size in analyzing the 2023 Indonesian Road Capacity Guide. The research took place on Thursday, December 14, 2023, during peak hours around the Kadipaten Market, including the start of office or school activities at 09.00-10.00 WIB, lunch break or departure time at 12.00-13.00 WIB, and office leaving time at 16.00-17.00 WIB.

3.1 Traffic Flow Volume Survey

The vehicle type needs to be categorized into passenger cars, medium vehicles, and motorbikes when recording at the research point.

3.2 Side Barriers Survey

Recording on the form provided is carried out when surveying side obstacles at a distance of 160

meters.

3.3 Data Analysis With PKJI 2023

1. Calculate the traffic flow for passenger cars and then analyze the total flow using the following formula:

$$Q = (\text{EMP MP} \times \text{MP}) + (\text{EMP KS} \times \text{KS}) + (\text{EMP SM} \times \text{SM})$$

Information :

Q = Amount current vehicle in middle school,
MP = Passenger car ,
KS = Medium Vehicle, and
SM = Motorcycle

2. Carry out an analysis of the side obstacle classes using the method of multiplying the frequency of each side obstacle with a weight factor.
3. Count speed current free use equality with equality as following.

$$V_B = (V_{BD} + V_{BL}) \times FV_{BHS} \times F\,V_{BUK}$$

Information :

V_B = Free Flow Speed for MP,
V_{BD} = Speed current free base MP,

V_{BL} = Speed Correction Factor Due to Lane Width,
FV_{BHS} = Correction Factor Due to Free Speed Due to Side Obstacles, and
$F\ V_{BUK}$ = Free Flow Speed Correction Factor Due to City Size.

4. Count capacity road with equality For know how much big capacity road such, as following.

$$C = C_O \times FC_{LJ} \times FC_{PA} \times FC_{HS} \times FC_{UK}$$

Information :
C = Road Segment Capacity,
Co = Basic Capacity of Road Segment Conditions,
FC_{LJ} = Correction Factor Due to Differences in Lane Width,
FC_{PA} = Capacity Correction Factor Due to Separation Current,
FC_{HS} = Correction Factor Due to Obstacle Conditions Side,
FC_{UK} = Factor t or Consequential Capacity Correction City Size.

5. Determine Degrees of saturation with equality as follows.

$$D_J = Q/C$$

Information :
D_J = Degrees Saturation
Q = Traffic Volume
C = Capacity Road Segment

4. Result and Discussion

4.1 Traffic Volume and Flow

Based on the calculation data, the peak hour for traffic flow is Thursday, 14 December 2023, at 16:00-17:00 WIB, with 993.15 vehicles per hour (Table 1). The EMP values used are Passenger Cars (MP) = 1.0, Medium Vehicles (KS) = 1.2, and Motorcycles (SM) = 0.25. The third value is derived from the number of vehicles for one hour on Thursday, 14 December 2023, at 16:00-17:00 WIB. Once the EMP value is known, the next step is to calculate the traffic volume (Q) using the data on Thursday, 14 December 2023, at 16:00-17:00 WIB, resulting in 993.15 PCU/Hour.

Table 1 Traffic Flow Volume

No.	Time	KS 1.2	MP 1.0	SM 0.25	Amount
1	09.00-10.00	19	424	1056	710.8
2	12.00-13.00	10	533	1059	809.75
3	16.00-17.00	27	625	1343	993.15

Source: Based on calculation data Traffic Flow Volume In Pasar Tradisional Kadipaten

4.2 Side Obstacles

After analyzing the criteria for side obstacles, events with a total weight of 300-499 were classified as medium side obstacles. The calculation of the frequency of weights in the Kadipaten Traditional Market area during peak hours on Thursday, December 14, 2023, from 16:00 to 17:00 WIB resulted in 485.8 events. Therefore, the Kadipaten Traditional Market area falls into the medium category according to the side obstacle criteria.

Tabel 2 Side Obstacles

No.	Incident	Weight Factor	Frequency Incident	Frequency Weight
1	Pedestrian	0.5	191	95.5
2	Parking Vehicle	1	143	143
3	Vehicle In And Out	0.7	351	345.7

4	Slow Vehicle	0.4	4	1.6
		Amount		485.8

Source: Based on the analysis data Side Obstacle in Pasar Tradisional Kadipaten

4.3 Free Flow Speed

Free flow speed on a one-way road is 61 Km/H. The speed correction due to lane width is 0, based on an effective lane width of 3.5 meters for a one-way road. The correction factor for free speed due to side obstacles is 0.97, determined from an analysis of side obstacles, with medium class criteria and a curb (sidewalk) of 1.5 meters for a one-way road. The correction factor for free flow speed due to city size is 1.0, based on a population of 1,351,828. Therefore, the free flow speed value is calculated as follows:

$$V_B = (V_{BD} + V_{BL}) \times FV_{BHS} \times F\,V_{BUK}$$
$$= (61 + 0) \times 0.97 \times 1$$
$$= 59.17 \text{ Km/Hr}$$

4.4 Capacity

According to the 2023 Indonesian Road Capacity Guidelines, the basic capacity value for a one-way road segment is 1700 PCU/hour (Co). The correction factor due to differences in lane width (FC_{LJ}) is 1.0, obtained from data on the effective lane width (L_{JE}) of 3.5 meters. The capacity correction factor due to direction separation (FC_{PA}) is also 1.0, derived from the one-way road type with two lanes. Furthermore, the capacity correction factor due to side obstacle conditions (FC_{HS}) is 0.95, obtained from data from side obstacle analysis, categorized as medium class. The capacity correction factor due to city size (FC_{UK}) is 1.0, obtained from population data of 1,351,828. Therefore, the capacity in the Kadipaten Traditional Market area is as follows:

$$C = C_O \times FC_{LJ} \times FC_{PA} \times FC_{HS} \times FC_{UK}$$
$$= 1700 \times 1.0 \times 1.0 \times 0.95 \times 1.0$$
$$= 1615$$

4.5 Road Performance Level

The traffic flow volume value (Q), which is 993.15, and the road segment's basic capacity value (C), which is 1615, may be used to compute the degree of saturation.

$$D_J = Q/C$$
$$= 993.15/1615$$
$$= 0.6\ 15$$

This won't result in car lines, but it will slow down traffic because the degree of saturation is less than what PKJI 2023 requires, where it doesn't surpass saturation. The following comparison is done to ascertain the quality of road service between (Q) the amount of traffic flow and (C) the road section's capacity:

$$VCR = Q/C$$
$$= 993.15/1615$$
$$= 0.615$$

5. Conclusion

The study and calculations using PKJI 2023 revealed the following findings on side obstacles and road performance in the Kadipaten Traditional Market area:

1. The saturation level in the Kadipaten Traditional Market area is 0.615, suggesting that while this section of the road is congested, it remains relatively smooth based on the calculations. As per the 2023 Indonesian Road Capacity Guidelines, the saturation level ranges from 0 to 1.

2. The Kadipaten Traditional Market area has excellent road service, with a level of 0.615, within the tolerance limit of 1. The service level is classified as C, indicating that it is fairly good when traffic is heavy but still quite smooth.
3. After analyzing the side obstacles, it is evident that factors such as pedestrians or crosswalks, cars stopped on the shoulder, cars entering and exiting the research location, and slow-moving vehicles are significantly impeding the traffic flow.

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