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Traffic Engineering Analysis of One-Way System at Mambo Market Four-Way Intersection: A Case Majalengka

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ABSTRACT

The economic centre is a very important thing that is located in an area, as a result the area affected as an economic centre experiences congestion which results in time, energy and health being disrupted. As happened in the implementation of the one-way system at the simpang empat Pasar Mambo, which is one of the accesses to the economic centre in Majalengka. Congestion at the Simpang Empat Pasar Mambo is the most common traffic problem, particularly in the middle of the day because of the higher volume of traffic compared to other times. This study set out to assess the effectiveness of traffic engineering on one-way system The intersection Mambo Simpang Empat Pasar, which can cause congestion and accidents caused by shopping activities, and to find more careful traffic engineering solutions. This research uses a qualitative approach.

1. Introduction

High levels of congestion on urban roads affect people's safety and time effectiveness and are a major problem for many countries. There have been many efforts to improve traffic safety on urban roads as part of initiatives to lessen the likelihood of traffic jams and accidents. However, there are still several cases of accidents and congestion that occur on urban roads. Traffic engineering changes the flow of traffic. It improves road safety, capacity, and security. Nonetheless, one-way highways offer benefits and drawbacks, and metropolitan traffic networks are intricate, expansive systems [1]. This study aims to identify factors that influence the implementation success of one-way systems.

Traffic engineering is one of the Indonesian government's efforts to address traffic congestion. The government often makes policies on the implementation of one-way systems partially and has not been integrated with other transport policies. Therefore, the geographical, social, and economic characteristics of each region of Indonesia are different. The characteristics mentioned present a method that may be better suited to the demands faced in development assessment in the future [2]. This research aims to analyse government policies related to the implementation of one-way systems in Indonesia and provide recommendations for improvement.

West Java is experiencing an increasing number of vehicles as one of Indonesia's fastest growing economic provinces. Due to rapid population movement, the quality of life has become better in some cities, especially in big cities. As a result, traffic congestion has been a long-term problem, especially at junction roads. Because controlling autonomous vehicles at crossings presents unique issues, this can be addressed in the control system architecture as a unique component of an algorithm for course planning in cars of the future [3]. Taking into account the characteristics of the area and the high growth rate of vehicles in this area, the purpose of this study is to see how effective the implementation of a one-way system is in addressing traffic congestion at the four-way intersection.

Majalengka is a city in West Java that will be the centre of industry and tourism in the future, infrastructure development has now occurred in various areas in Majalengka, one of which is the West

Java International Airport (BIJB) which was built in the Kertajati Majalengka area. It is possible that foreigners will also visit the region, so preparations are needed to prevent congestion and accidents with traffic engineering, especially in economic centres. One of the economic centres in Majalengka city is Pasar Mambo which implements a one-way system because this area is quite crowded visited by school children and the surrounding community, the peak hours occur in the afternoon and evening. Pasar mambo is also one of the UMKM centres in Majalengka, so it is not only the surrounding community who visit the centre. Although people appear to accept the inevitable existence of traffic delays with reluctance, these delays frequently have disastrous effects on other road users, such as disruptions in vehicle movement, significant fuel waste, and lost time. [4]. This research aims to manage traffic management at one-way intersections, thereby minimising accidents or congestion.

This research will analyse the traffic engineering on the one-way system road of the Simpang Empat Pasar Mambo that has the potential to cause congestion and accidents caused by shopping activities, and seek more prudent traffic engineering solutions. Current or future problems in traffic engineering will be addressed by this research.

2. Literature Review

2.1 unsignalized intersection

The intersection is essential to the operation of this design since it allows traffic to interchange and disperse; any obstruction to the intersection can cause traffic to be disrupted from all directions, resulting in overflow and even citywide gridlock [5]. Because some intersections do not have traffic lights, it is possible for drivers or pedestrians to try to walk at the same time, which can cause accidents. According to estimates from the World Health Organization (WHO), traffic accidents kill around 1.3 million people annually in Indonesia's most economically developed province [6]. Therefore, many intersections now use traffic lights in urban environments to minimise accidents. However, in many cities or regions, Additionally, traffic lights may be detrimental.

Intersections are road facilities where accidents often occur, due to frequent activities. So as to minimise the occurrence of accidents, traffic management is needed. The intricate problem of efficiently managing and controlling traffic at intersections is addressed by Intelligent Transportation Systems (ITS). [7]. Intersection management is one of the most difficult issues to manage. Traffic patterns on roads are intricate networks of actors interacting with one another. It can be difficult to model traffic flow, particularly at crossings [8].

Sustainable transport planning is to build a safe, efficient, and environmentally friendly transport system. In recent years, this development is common especially in the field of transport, especially in vehicle transport. The major street's traffic flow pattern is a crucial issue. Generally speaking, three patterns may be identified: congestion, platoon traffic, and free-flow traffic [9]. These days, a lot of study has been conducted in the sector of transportation since economic expansion necessitates an increase in activities related to transportation [10].

2.2 Performance of Highways

The ability of a road to facilitate traffic flow is known as highway performance. To increase highway safety with the least amount of disturbance to accessibility, a variety of access management strategies can be applied [11]. For this reason, it is necessary to improve the quality of road performance by looking at various aspects such as health, economic development, and changes in travel patterns. Time lost, energy wasted, health issues from vehicle pollution, stress, and a drop in income are the most drawbacks for road users. Activity productivity [12]. Therefore, it is necessary to maintain the performance of the motorway.

The intersections of major roads with city centers, regional administrations, and internet hubs are often congested [13]. One promising solution to urban congestion is the implementation of multimodal transportation networks, which can offer alternatives to car travel and reduce peak-time congestion [14]. The application of technology in traffic management is also considered as an effective way to tackle congestion. While advanced technology can help reduce congestion, the influence of holistic policies should not be overlooked.

Cities can create a more efficient and sustainable environment by increasing the speed of traffic flow, reducing accidents, and optimising infrastructure use. Good traffic performance provides economic, social, and environmental benefits in addition to reducing congestion. However, there is conflicting information on the relationship between traffic and economic growth [15]. More research is needed. A good traffic system also helps people travel faster and cheaper.

2.3 Traffic Flow

Road capacity and geometry can affect traffic flow. To provide traffic flows that have their own geometry is a challenge. Therefore, there is an evident need for empirical study that explicitly examines the link between speed and flow when a sufficient number of geometric and traffic characteristic circumstances affect the capacity of urban highways [16].

Averaging is usually used to calculate traffic flow. This is determined by figuring out the typical number of cars using the road.

3. Method

This study employs a qualitative approach with the aim of describing. The writer's research methodology involves the random collection of data, illustrative analysis, and a factual and detailed interpretation of current issues based on the facts [17]. So qualitative methods are research methods that are carried out directly. The research was conducted near SDN Majalengka Wetan IV, Majalengka Regency, located at Simpang Empat Pasar Mambo. Figure 1 shows the research location. Before conducting research, the survey must know the data needed by the researcher. Primary and secondary data are the data sources needed for the research.

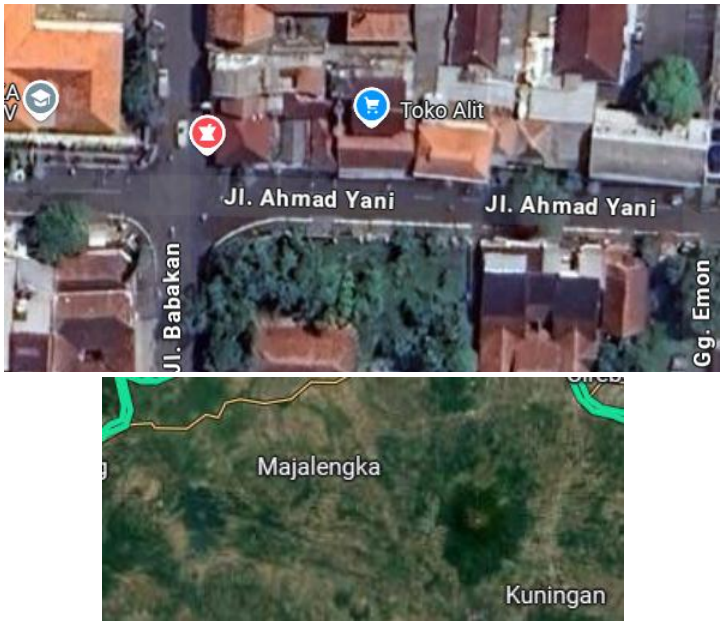

Figure 1. Research location

Primary data will be collected through field surveys. Traffic volume data will be used for this study. To ensure that the data collected is appropriate before it is reprocessed, The equipment used to collect the data must also be understood by the data collecting process.
Traffic surveys were conducted for three days, every morning, afternoon, and evening peak hours, using traffic volume counts. Once the data is collected, the MKJI 1997 method will be used to process the data. The objective of this study is to ascertain whether the one-way system is functioning properly at the Simpang Empat Pasar Mambo.

4. Result and Discussion

Calculation data also requires real and accurate data, hence the need for primary data for this study. The calculation process uses the (IHCM 1997) Indonesian Highway Capacity Manual method.

4.1 Vehicle Volume

To calculate the traffic volume on the Mambo Market Intersection One-Way System Road, observation points were used to count the number of vehicles travelling through the intersection. The survey was conducted in person for three days, Tuesday, Saturday and Sunday for one hour. Collections were made during peak hours, from 11.00am to 12.00pm. The results show manual classification for some vehicles. The 1997 Indonesian Road Capacity Manual (MKJI) divides motorcycles (MC), heavy vehicles (HV), and light vehicles (LV) into three groups. Once classified, The car type data was required, and the passenger car equivalent factor (emp) value was calculated. The passenger car equivalent factor (emp) values found are as follows :

Table 1: Equivalent factor (emp) values for passenger cars

No	Vehicle Type	Emp Factor Value
1	Motorcyle (SPM)	0,25
2	Light Vehicle (KR)	1
3	Heavy Vehicle (KB)	1,2

Sumber : MKJI 1997

The most automobiles on Monday, December 23, 2024, provided the data used. Then, to produce a traffic volume calculation in units of SMP/hour, the number of vehicles is multiplied by the passenger car unit factor (SMP).

Table 2: Volume Kendaraan Lalu Lintas

Time	Traffic flow vehicle/hour			VECHILE VOLUME/HOUR	VECHILE TRAFFIC FLOW SMP/HOUR			VOL. SMP/HOUR
	MC	LV	HV		MC* 0.25	LV* 1	HV* 1.2	
Morning	973	306	8	1279	243,25	306	9,6	558,85
Afternoon	524	227	3	751	131	227	3,6	361,6
Evening	794	286	4	1080	198,5	286	4,8	489,3

4.2 Side Barriers

To analyse the side barriers, the data must come from direct survey results to the study site. The highest frequency results were obtained on 23 December 2024, for 1 hour, with a side obstacle distance of 200 metres. (MKJI) 1997 mentions pedestrians, parked or stopped vehicles, in and out vehicles, and slow cars. The value of side obstacles is calculated based on the results of the weighted occurrence of hours/200 metres of sections that need to be considered.

The data must next be processed after the frequency of occurrence of side impediments has been determined. This is the side obstacle calculation table.

Table 3. Determination of the frequency type of side obstacles

Side Obstacle Event Type	Symbol	Weight Factor
Pedestrian	PED	0,5
Vehicle Parking	PSV	1
Entering and exiting vehicles	EEV	0,7
Slow vehicles	SMV	0,4

Sumber : MKJI 1997

Table : 4 Perhitungan Hambatan Samping

Time	Frequency of occurance/200/ hour				Frequency of Occurance /200/hour				Total	Class Side Obstacle
	PED	PSV	EEV	SMV	PED*0.5	PSV*1.0	EEV*0.7	SMV*0.4		
Morning	221	47	324	6	110,5	47	226,8	2,4	386,8	SEDANG
Afternoon	198	23	232	2	99	23	162,4	0,8	285,2	RENDAH
Evening	252	29	278	5	126	29	194,6	2	351,6	SEDANG

5. Conclusion

After talking about the traffic volume and side obstacles on the Mambo Market Junction Four One-way System Road, we can draw the following conclusions from the discussion on this issue :

1. On Monday, 23 December 2024, the one-way system at the intersection of four mambo markets recorded a traffic volume of 558.85 smp/hour. This occurred in the morning from 11am to 12pm and in the afternoon from 3pm to 4pm. This shows that the traffic gets fairly heavy in the morning.
2. The outcomes of the side-obstacle computation on the Mambo Market Intersection One-way System Road show that the side obstacle class is medium in the morning, low in the afternoon, and medium in the afternoon.

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