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THE SIGHT DISTANCE PLANNING FOR ROAD USER SAFETY: A CASE OF JALAN PASUKAN SINDANGKASIH-MAJALENGKA

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Abstract

This study aims to provide practical and applicable solutions to improve road safety on the Pasukan-Sindangkasih Road section in Majalengka Regency, West Java, by analyzing road visibility using empirical data and the Bina Marga method. The primary data consisted of looking for a literature review on the classification of road classes based on their functions, calculation of visibility, while for secondary data collected about the location map of this study. The results show that visibility planning can be improved to improve traffic efficiency and reduce the risk of accidents. The research could also consider the influence of different vehicle types and weather conditions on visibility requirements to refine the standards set by the Geometric Planning Procedures for Intercity Roads. It is also hoped that this research will increase awareness of the importance of visibility planning for overall road safety to avoid accidents.

Keywords: Visibility, road user, safety

INTRODUCTION

Many countries around the world continue to pay attention to road safety. Worldwide, Traffic accidents cause about 1.35 million deaths every year (Chand, 2021). Studies by the World Health Organization (WHO) show that an increase of more than 65% in these figures has occurred over the last 20 years (Sahaf, 2021). Highways are built to make regional development balanced and ensure equitable development. The result is justice by building a road network funded by road users to improve distribution performance and facilitate economic growth, especially in areas that have experienced increased development (Stefanus, 2022). Poor road planning, traffic violations, and lack of awareness of driving safety are the causes of most accidents (Alkaabi, 2023), which shows the need for improved road infrastructure, stricter law enforcement, and increased public education and awareness regarding the importance of road safety. Visibility planning is an essential component of road planning that is often overlooked (Kerr & Phaal, 2021). In many developed countries, this has become a significant focus on improving road user safety and reducing the risk of accidents.

Traffic safety has become a growing concern in both developed and developing countries due to its impact on the global economy and the well-being of society (Chaudhari, 2021). To improve road safety, Southeast Asian countries, including Indonesia, face similar problems at the regional level. Road safety issues are becoming increasingly complex, along with the increase in the number of vehicles, especially on two-lane roads (Kumar & Verma, 2023). One of the essential aspects of a two-lane highway is the passing sight distance (PSD), the minimum distance a driver must see to perform a safe passing maneuver (Haq, 2022). In addition, accidents in this area are often caused by inadequate road infrastructure, lack of traffic supervision, and unsafe driving behavior. Several neighboring countries, such as Malaysia and Thailand, have launched programs to improve road safety by emphasizing visibility planning

and driving safety training. These programs show that paying more attention to visibility planning can significantly reduce the number of traffic accidents that occur.

Along with the increasing population growth in Indonesia, the need for transportation will also increase. It can also increase the risk of accidents (Sony, 2020). In particular, many young people are affected by traffic accidents because most traffic accidents are caused by the age group of 15–29 years (Lee, 2019). Many of these accidents occur on arterial roads and in areas with many vehicles. Planning that does not consider visibility is often the leading cause of accidents. Improving road infrastructure and implementing stricter road safety standards are some of the efforts that must be made by the Indonesian government to overcome traffic accident problems, with the hope of reducing the risk of accidents, improving comfort and safety for road users, and supporting sustainable economic development throughout the country. However, more specific efforts to plan visibility still need to be improved.

Public roads are classified into national, provincial, county, city, and local roads based on their status (Adiputra, 2022). The Pasukan-Sindangkasih Road section in Majalengka, West Java, is included in the category of provincial roads with high traffic volume and faces challenges related to road safety. Majalengka is experiencing the development of new infrastructure that is increasingly advanced. Majalengka's economy is increasing, as shown by several significant developments such as BIJB Airport, Kertajati Toll Gate, and bridges. This road is included in the category of provincial roads with hilly terrain conditions, which adds complexity to road safety planning. Data shows that this area often experiences traffic accidents caused by inadequate visibility. This shows the need for better planning and evaluation to improve the safety of road users in this area. Therefore, current road safety strategies clearly distinguish between the factors that cause road accidents (road users, the environment, or road-related) and focus on a multidisciplinary and comprehensive approach to address these issues (Firmansyah, 2022) (Babić, 2020).

The geometric design also needs to pay attention to the geometric aspects of the road for the safety, comfort, and security of road users (Sahara, 2022). Road visibility is included in the geometry of the road, which is an important aspect. This study investigates visibility planning on the Pasukan-Sindangkasih Road Section to improve the safety of road users. Using empirical data and appropriate calculation techniques, this study is expected to provide practical and applicable recommendations to improve road safety in the Pasukan-Sindangkasih Road Section. It is also hoped that this research will increase awareness of the importance of visibility planning for overall road safety to avoid accidents. Therefore, various efforts have been made in the field of accident analysis, especially in injury prevention and accident prediction modeling (Schlögl, 2019).

This research aims to provide practical and applicable solutions to improve road safety on the Pasukan-Sindangkasih Road section in Majalengka Regency, West Java, by analyzing road visibility using empirical data and the Bina Marga method. The study aims to address safety concerns by proposing improvements to road infrastructure, specifically visibility planning, by establishing geometric planning procedures for intercity roads. The goal is to reduce traffic accidents, enhance the safety and comfort of road users, and support sustainable economic development. This research will provide practical and applicable suggestions to improve road safety on the Pasukan-Sindangkasih Road Section using empirical data and appropriate calculation methods.

RESEARCH METHOD

The Bina Marga method is used in this study. This method comes from the Procedures for Geometric Planning of Intercity Roads, published in 1997 by the Directorate General of Highways. This study collected primary and secondary data. The primary data consisted of looking for a literature review on classifying road classes based on their functions and visibility

calculation. In contrast, secondary data was collected about the location map of this study. This research is in Jalan Pasukan, Sindangkasih, Majalengka Regency, West Java.

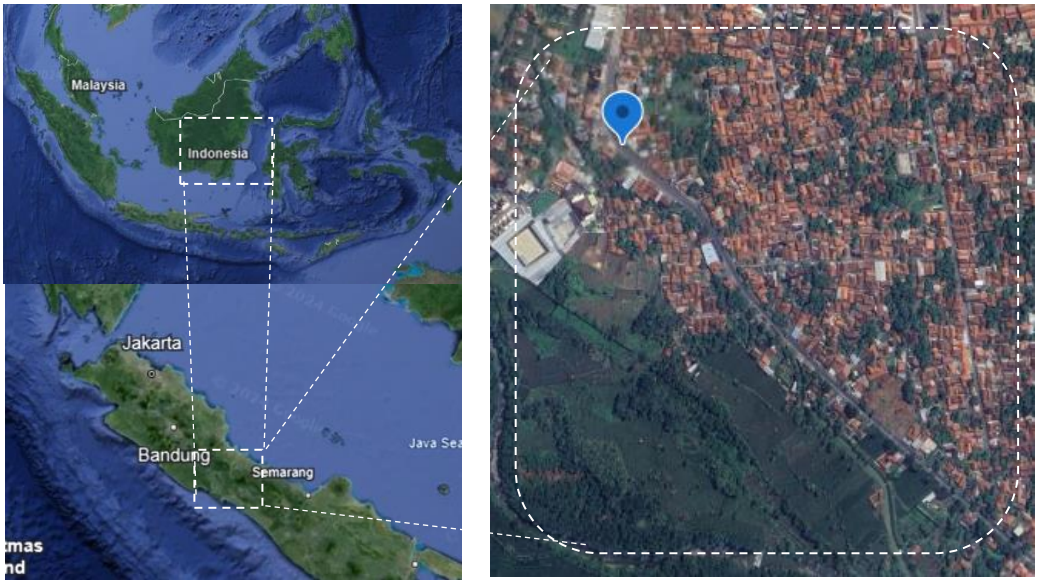

Figure 1. Research Location
Source: Google Earth

RESULT AND DISCUSSION

Road Function Classification

Classifying roads based on their functions is very important in planning and managing transportation infrastructure. Arterial roads connect significant areas with high traffic volumes and are designed for high-speed and long-distance vehicle movement. Arterial roads consist of toll roads, national roads, and provincial roads that connect major cities. Collector roads connect residential, commercial, and public facilities with arterial roads. Roads within towns or districts that connect several residential areas are included in the category of collector roads. Meanwhile, local roads serve a specific location and are usually only used by residents or people visiting the area. Examples of local roads are roads in residential complexes or walkways in park areas.

Table 1. Design Speed

Road Classification	Terrain		
	Plain	Hills	Montain
Arterial Road	70 - 120	60 - 80	40 - 70
Collectors Road	60 - 90	50 - 60	30 - 50
Local Road	40 - 70	30 - 50	20 - 30

In this study, road visibility planning is planned for the Pasukan-Sindangkasih Road section, Majalengka, West Java. This road is included in the category of arterial roads, where it is a provincial road. However, the plains in this road area are slightly uphill, so they are included in the hilly area. Therefore, according to the Geometric Procedure for Intercity Roads from the General Pavement Department of the Directorate General of Highways, the speed of the arterial road plan in hilly areas ranges between 60 and 80 km/h.

Stop Visibility (Jh)

Stop-line visibility is the shortest distance the driver can see, understand, and stop his vehicle before it reaches an obstacle on the road. Reaction distance and braking are the two main components of this understanding. For driving safety, drivers must know the stopping visibility. The risk of collision with obstacles or other vehicles will increase if they do not do so. Therefore, it is crucial for drivers always to maintain a speed that suits the road conditions and stay aware of their surroundings while driving.

Table 2. Minimum Stop Visibility (Jh)

VR, km/hour	120	100	80	60	50	40	30	20
Jh minimum (m)	250	175	120	75	55	40	27	16

The following is the calculation to determine the stop visibility (Jh):

Known:

VR = 80 Km/hour

g = Acceleration of Gravity = 9.8 m/s2

F = Friction Coefficient = 0.35 - 0.55

T = Response Time set 2.5 seconds

$$\text{Jh} = \left[\frac{VR}{3.6}\right] T + \left[\frac{VR}{3,6}\right]^2 x \frac{1}{2 . g . f}$$

$$\text{Jh} = \left[\frac{VR}{3.6}\right] T + \frac{\left(\frac{VR}{3,6}\right)^2}{2 . g . f}$$

$$\text{Jh} = \frac{80}{3.6} T + \frac{\left(\frac{VR}{3,6}\right)^2}{2 . g . f}$$

$$\text{Jh} = \frac{80}{3.6} x\ 2{,}5 + \frac{\left(\frac{80}{3,6}\right)^2}{2 . 9{,}8 . 0{,}45}$$

$$\text{Jh} = 162{,}19\ m$$

According to the table, the minimum Jh for VR = 80 km/h is 120 meters. Since 162.19 is more significant than 120, Jh is taken, which is 162.19 meters.

Visibility (Jd)

Because vehicles move at higher speeds, drivers need more extended visibility to see a safe path before overtaking other vehicles. Knowing the leading visibility is very important for driving safety.

Table 3. Minimum Foresight (Jd)

VR, km/hour	120	100	80	60	50	40	30	20
Jd minimum (m)	800	670	550	350	250	200	150	100

The following is a calculation to determine the preceding line of sight (Jd):

Jd, in meters, is determined as follows.

Jd = d1 + d2 + d3 + d4

d1 = 0,278 TI (VR - m + a . T1/2)

d2 = 0,278. VR. T2

D3 = between 30 -100 m

d4 = 2/3 d2

T1 = 2,12 + 0,026 VR
T2 = 6,56 + 0, 048 VR
a = 2,052 + 0,0036 VR
m = (between 10 - 15 km/h)

Based on the data above, the visibility to prepare is:

Known:

$$T1 = 2{,}12 + 0{,}026 \; x \; VR$$
$$T1 = 2{,}12 + 0{,}026 \; x \; 80$$
$$T1 = 4{,}2 \; seconds$$

$$T2 = 6{,}56 + 0{,}048 \; x \; VR$$
$$T2 = 6{,}56 + 0{,}048 \; x \; 80$$
$$T2 = 10{,}4 \; seconds$$

$$a = 2{,}052 + 0{,}0036 \text{ x VR}$$
$$a = 2{,}052 + 0{,}0036 \text{ x } 80$$
$$a = 2{,}34 \text{ km/hour/second}$$

$$d1 = 0{,}278 \; x \; T1 \; (VR - m + (a \; x \; T1)/2$$
$$d1 = 0{,}278 \; x \; 4{,}2 \; (80 - 10 + (\frac{2{,}34 \; x \; 4{,}2}{2})$$
$$d1 = 0{,}278 \; x \; 4{,}2 \; (80 - 10 + (\frac{2{,}34 \; x \; 4{,}2)}{2}$$
$$d1 = 87{,}47 \; m$$

$$d2 = 0{,}278 \; x \; VR \; x \; T2$$
$$d2 = 0{,}278 \; x \; 80 \; x \; 10{,}4$$
$$d2 = 231{,}29 \; m$$

$$d3 = between \; 30 - 100 \; m, \qquad taken = 100 \; m$$

$$d4 = \frac{2}{3} \; x \; d2$$
$$d4 = \frac{2}{3} \; x \; 231{,}29$$
$$d4 = 154{,}19 \; m$$

$$Jd = d1 + d2 + d3 + d4$$
$$Jd = 87{,}47 + 231{,}29 + 100 + 154{,}19$$
$$Jd = 572{,}95 \; m$$

The minimum Jd for VR = 80 km/h is 550 m based on TPGJAK, and 572.95 > 550 then Jd = 572.95 m.

Design speed is the speed chosen to plan each section of the highway, such as road slope curves, visibility, etc. The choice of design speed dramatically affects the condition of all road sections and the cost of implementing the road. Road geometric planning is part of road planning that focuses on physical form planning to fulfill the primary function of the road, namely providing optimum service to traffic flow and access to houses. So, road geometric planning aims to produce safe infrastructure, efficient traffic flow service, and maximize the

usage level/implementation cost ratio. The road's space, shape, and size are said to be good if they can provide a sense of security and comfort to road users.

As we know, the factors causing traffic accidents can be divided into four factors: human factors, vehicle factors, road factors, and environmental factors. At the same time, traffic accidents can occur with various collisions. Traffic accidents are divided into several types based on the chronology of the incident, namely front-front collisions, front-rear collisions, front-side collisions, side-side collisions, and out-of-control. Traffic accidents can be avoided if the road section is equipped with road equipment, which, among others, are in the form of traffic signs, road markings, traffic signaling devices, street lighting devices, road user control, and safety devices, as well as road monitoring and safety devices, which are on the road and outside the road body.

The safety and comfort of vehicle drivers, to be able to see clearly and be aware of the situation while driving, is very dependent on the distance that can be seen from their position. The length of the road in front of the vehicle that can still be seen is measured from the driver's position and is called the sight distance. This sight distance is helpful for (1) avoiding collisions that can endanger vehicles and humans due to the presence of large objects, stopped vehicles, pedestrians, or animals in the lane, (2) providing the possibility of overtaking other vehicles moving at lower speeds by using the lane next to it, (3) increasing the efficiency of the road, so that the volume of service can be achieved as much as possible, and (4) as a guideline for traffic regulators in placing the necessary traffic signs on each road segment.

Complete the necessary road equipment to improve this case study, including repainting the markings and installing signs. Repainting the markings is intended so that the markings can be seen, direct traffic flow, and limit traffic interest areas. The markings on the road section that require repair are broken line longitudinal markings, solid line longitudinal markings, outer edge line markings and inner edge line markings, solid line transverse markings, and zebra crossings. The installation of signs must be adjusted to the stopping sight distance so that drivers are not late in making decisions about the dangers in front of them. Signs that need to be added to the observed road section are caution warning signs, signs prohibiting driving vehicles at speeds greater than 40 km/h, warning signs for a lot of pedestrian traffic, signs indicating the location of pedestrian crossing facilities, and signs prohibiting turning back for vehicles from the east and the west at the median openings at specific locations.

CONCLUSION

Classifying roads by function is crucial for efficient transportation infrastructure planning and management. Arterial roads, like the Pasukan-Sindangkasih Road Section, are designed for high speeds, especially in hilly areas, with a planned speed of 60-80 km/h. Stop visibility (Jh) is essential for drivers to have enough time to stop before encountering obstacles, and ahead visibility (Jd) is crucial for safety when overtaking other vehicles. Improvements must be made following Geometric Planning Procedures for Intercity Roads standards to improve traffic efficiency and reduce accident risks. Future research should explore the impact of geometric design elements on traffic safety and efficiency, particularly on arterial roads in hilly areas like the Pasukan-Sindangkasih Road Section. Additionally, studies could investigate the correlation between varying levels of stop visibility and ahead visibility on accident rates and how adjustments could lead to safer road designs. Additionally, the research could consider the influence of different vehicle types and weather conditions on visibility requirements to refine the Geometric Planning Procedures for Intercity road standards.

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