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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 Troop-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 continue to pay attention to road safety around the world. 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% of these figures has occurred over the last 20 years (Sahaf, 2021). Highways are built to make regional development balanced, ensure equitable development and the result is justice by building a road network funded by road users with the aim of improving distribution performance and facilitating 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 important component of road planning that is often overlooked (Kerr & Phaal, 2021). In many developed countries, this has become a major focus in efforts to improve road user safety and reduce 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 or 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 important aspects of a two-lane highway is the passing sight distance (PSD), which is the minimum distance that 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 various 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 cause the risk of accidents to increase (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 areas with a lot of 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 Indonesia 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 Troop-Sindangkasih Road section in Majalengka, West Java, is included in the category of provincial roads that have a high traffic volume and face challenges related to road safety. Majalengka is experiencing the development of new infrastructure that is increasingly advanced. Majalengka's economy is growing rapidly, which is shown by several major developments such as BIJB Airport, Kertajati Toll Gate, and bridges, among others. This road is included in the category of provincial roads with hilly terrain conditions, which adds complexity in road safety planning. Data shows that this area often experiences traffic accidents caused by a lack of adequate 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 actually cause road accidents (be they road users, the environment, road-related) and focus on a multidisciplinary and comprehensive approach to address these issues. (Firmansyah, 2022) (Babić, 2020)

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 is one of the important aspects. This study investigates visibility planning on the Pasukan-Sindangkasih Road Section to improve the safety of road users. By using empirical data and appropriate calculation techniques, this study is expected to provide practical and applicable recommendations to improve road safety on 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 as far as injury prevention and accident prediction modeling are concerned (Schlögl, 2019).

The purpose of this research is to provide practical and applicable solutions to improve road safety on the Troop-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, in accordance with established geometric planning procedures for intercity roads. The ultimate goal is to reduce traffic accidents, enhance the safety and comfort of road users, and support sustainable economic development. This research is expected to provide practical and applicable suggestions to improve road safety on the Troop-Sindangkasih Road Section by 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 the classification of road classes based on their functions, calculation of visibility, while for secondary data collected about the location map of this study. This research is located on Jl. Pasukan, Sindangkasih which is located in Majalengka Regency, West Java. Here is the location of the study:

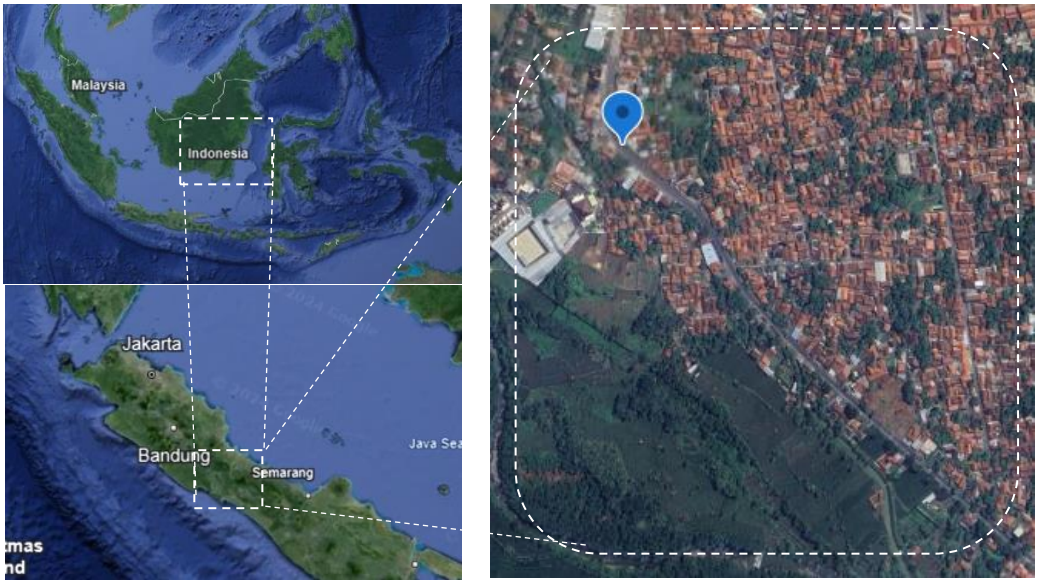

Figure 1. Research Location
Source: Google Earth

RESULT AND DISCUSSION

Road Function Classification

In the planning and management of transportation infrastructure, the classification of roads based on their functions is very important. Arterial roads are roads that connect major areas with high traffic volumes, 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 areas, commercial areas, and public facilities with arterial roads. Roads within cities or districts that connect several residential areas are included in the category of collector roads. Meanwhile, local roads serve a specific area 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. Speed of VR Plan, according to function classification and roadfield classification

Function	Planned Speed, VR'Km/h		
	Plain	Hill	Mountains
Arteri	70 - 120	60 - 80	40 - 70
Collectors	60 - 90	50 - 60	30 - 50
Local	40 - 70	30 - 50	20 - 30

Source: Procedures for Geometric Planning of Intercity Roads

In this study, road visibility planning is planned for the Troop-Sindangkasih Road section, Majalengka, West Java. This road is included in the category of arterial roads where this road 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 at which 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 to always 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

Source: Procedures for Geometric Planning of Intercity Roads

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 greater than 120, Jh is taken, which is 162.19 meters.

Ahead Visibility (Jd)

Because vehicles move at higher speeds, drivers need longer visibility to see a safe path before overtaking other vehicles in front of them. It is very important to know the leading visibility 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

Source: Procedures for Geometric Planning of Intercity Roads

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.

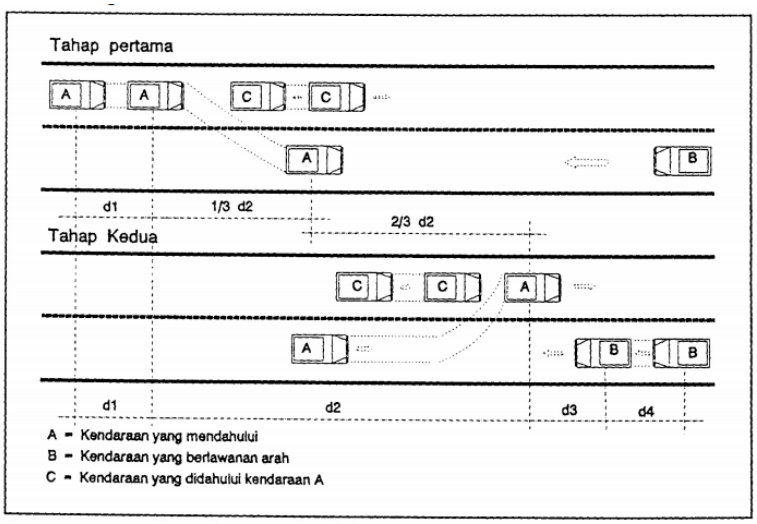

Figure 2. Visibility Ahead
Source: Procedures for Geometric Planning of Intercity Roads

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. To improve traffic efficiency and reduce accident risks, improvements must be made in accordance with Geometric Planning Procedures for Intercity Roads standards. 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, research could consider the influence of different vehicle types and weather conditions on visibility requirements to refine the Geometric Planning Procedures for Intercity Roads standards.

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