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ANALYSIS OF THE SUITABILITY OF HORIZONTAL ALIGNMENT TO DRIVER SAFETY LEVEL NEEDS CASE STUDY OF CIGASONG - MAJA ROAD, MAJALENGKA ROAD

Fikri Abdul Muizz[1], Andri Irfan Rifai[2], Adinda Fajarika[3]
[1]Faculty of Civil Engineering, University of Majalengka, Indonesia
[2]Faculty of Civil Engineering and Planning, Batam International University, Indonesia
[3]Faculty of Engineering, Universitas Mercu Buana, Indonesia
Email korespondensil: fikriabdulmuizz21@gmail.com

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ABSTRACT

Road geometric design is a way of planning roads geometrically or involves calculating angles with processes. In relation to road geometric planning, it is necessary to examine the suitability of the planning criteria with the applicable guidelines, namely the Road Geometric Planning Guidelines. Therefore, this paper evaluates the geometric design in relation to the geometric design suitability of the existing road, namely Cigasong-Maja Road, and adapts it to the Road Geometric Design Guidelines. In this study the research method used was the research object evaluation research method, namely Cigasong-Maja Road.

1. Introduction

Road infrastructure plays an important role in the security, economy and well-being of a country, because the safe, efficient and reliable movement of citizens and goods will facilitate social and economic development. continues to increase worldwide [1]. Poor coordination between horizontal curved geometric elements can lead to unsafe speeds. This study evaluates the effect of horizontal curved geometry on the distribution of vehicle speed on the highway and develops a prediction model for average speed and standard deviation [2].

Roads are land transportation infrastructure covering all parts of the road, including complementary buildings and equipment intended for traffic, which are at ground level, above ground level, below ground and water level, and above water level, except railroads. , lorry roads and cable roads [3]. A highway design is said to be "successful" if its application is able to provide a sense of security and comfort for every road user, so that the purpose of the existence of a highway can be achieved, namely to facilitate people's lives in their activities. In the highway geometric concept, there are several planning components, one of which is the horizontal alignment design.

Cigasong Sub-district is located in Majalengka Regency with also has fisheries potential in the form of supporting natural resources and human resources, namely fisheries business actors in the field of processing and aquaculture such as value nurseries [4].

Roads are the infrastructure of land transportation that is very important and inseparable from human life, so the geometric design of the road must be made with consideration of comfort and safety so that the distribution of goods becomes the smooth and geometric design of the road is emphasized on the physical form of the road, so that it meets the requirements of safe and comfortable for road users who will minimize the level of traffic accidents by road factors. [5]. In road geometric design, sharp bends according to geometric standards, but only for certain functional roads with relatively low speeds.

Generally, sharp bends are classifieds as Spiral - Spiral (SS) bends. In the field, the rate of traffic accidents on sharp bends is simply high. One of the things that which thought to cause this is the mismatch of the bend design with the applicable planning standards. The aggravated by high-speed driving behavior [6].

The slightly uphill condition of the road encourages researchers to evaluate the suitability between the regulations made by the government about the rules in planning and building roads with the actual conditions in the field. Accidents can also occur due to lack of driver attention in crossing bends, this condition results in conflicts in traffic flow, causing traffic jams and other traffic congestion.

By looking at the condition of the road which is the research site, it is a road that connects the route to the southern area. Because by paying attention to the vertical alignment that often occurs accidents that take many victims, because the slope and angle of the bend are not good according to the researcher, therefore the researcher raised the research title "Analysis of Horizontal Alignment Conformity to the Needs of the Driver's Safety Level Case Study of the Cigasong - Maja road, Majalengka".

2. Literature Review

2.1 Road

Highways are infrastructure consisting of buildings and complementary designs to maintain traffic above and below the surface of land and water. Highways have an essential role as a means of transportation in various community activities in urban and rural areas. In addition, highways have an important impact as infrastructure for the movement of people and goods. [7].

A highway is a facility or place for motorized vehicles, both motorized and non-motorized, to travel on the highway. Highways are very important facilities that affect all aspects of life. From various perspectives, highways are the driving force of a country's economy and progress. [8].

In Indonesia, highway construction was carried out on a large scale from 2014 to 2019. Approximately 1,235 km of highway was constructed throughout Indonesia. Currently, development in Indonesia is still focused on big cities and has yet to penetrate into remote areas, so that its implementation requires integrated planning and following regional needs, as well as taking into account the conditions and potential that exist in the area [9].

While road traffic is infrastructure for the movement of people's vehicles, and or in the form of roads and their supporting facilities. Safety in traffic is an important part of the account. Traffic to go to a comfortable, safe, or economical traffic engineering destination. Identification of the causes of accidents is carried out to reduce the high number of traffic accidents. Road inspection is a way to deal with traffic accidents which generally occur due to several factors, namely: people, road conditions, vehicle conditions, weather, and obstructed view [10].

2.2 Alignment Horizontal

Horizontal alignment or usually referred to as a bend or turn, is a curve that is a projection of a line on the points of the z and y axes. There are several types of horizontal alignments, namely Spiral-Circle-Spiral (S-C-S), Full Circle (F-C), and Spiral-Spiral (S-S). Spiral-Circle-Spiral (S-C-S) is the intersection of two lines connected by a combination of a fixed radius curve (Circle) R combined with a transitional shape (Spiral). A full circle (F-C) is one of the horizontal curves connecting two lines with the curvature of a single circle. In comparison, a Spiral-Spiral (S-S) is one of the horizontal curves that

connect two lines with two intermediate curves. Roads with these types of curves usually have high design speeds. In addition, poor visibility on horizontal curves results in an increased risk of accidents due to lack of visibility. [11].

Sharp bends have been known to cause driver instability (positioning themselves on the passing line), leading to collisions. Another cause of reduced safety on road sections is due to reduced visibility, which affects the driver's ability to correctly estimate road conditions. Horizontal alignments are prone to accidents if not properly designed and must be continuously inspected and accurately protected. The geometric planning of roads on horizontal sections (bends) is designed to compensate for the centrifugal force received by vehicles traveling at high speeds (VR).. [12].

From the visibility perspective, the minimum radius of From the visibility perspective, the minimum radius of the horizontal curve or arc is also required when the stopping visibility value of the autonomous vehicle changes due to the almost zero reaction time value (about 0.2s). The minimum radius of the horizontal curve depends on several factors such as superelevation, friction factor and stopping visibility, presence of visual obstructions, etc. If the horizontal line-of-sight (HSO) shift, also called the breakdown distance value, is low, it will affect the stopping sight distance value, and the required curve radius will increase. On the other hand, if the HSO is higher, the required bend radius will decrease. In addition, if the sight distance value increases and the obstruction remains fixed, the minimum required bend radius will increase. [13].

3 Method

Data is one of the main strengths in compiling scientific research and modeling. In obtaining and managing data, this research uses the standardization method of the Road Geometric Design Guidelines (PDGJ). To identify and process written materials used in data collection activities After a period of preparation before the research was conducted, data collection was carried out. Finally, the data obtained is under the research plan to acquire the right appropriat and appropriate data. [14].

The research method used is:

1) Library research method, meaning that in this method the author seeks information from literature (such as: MKJI Books, Road Engineering Books), print media (Analisa newspaper, SIB newspaper, etc.), internet media, and other scientific works that are related with research.

2) Field method, meaning that research is carried out by going directly to the field so that the results from the research are stronger, while the data obtained is like primary data (such as: research data in the field, local residents' information about accidents at the site, etc.), data secondary (data obtained such as literature data, searching for information from the internet, papers related to research)

Data obtained for the research location from Cigasong – Maja in Three (3) STAs, namely, such as (STA 49 + 400 Kertabasuki Bend, STA 50 + 500 Nanggerang, STA 58 + 300 Haurduni Bend)
The road planning location is on the Cigasong - Maja road, Majaelngka, West Java, one of the road

sections leading to the Maja Traditional Markets shown in Figure 1 below.

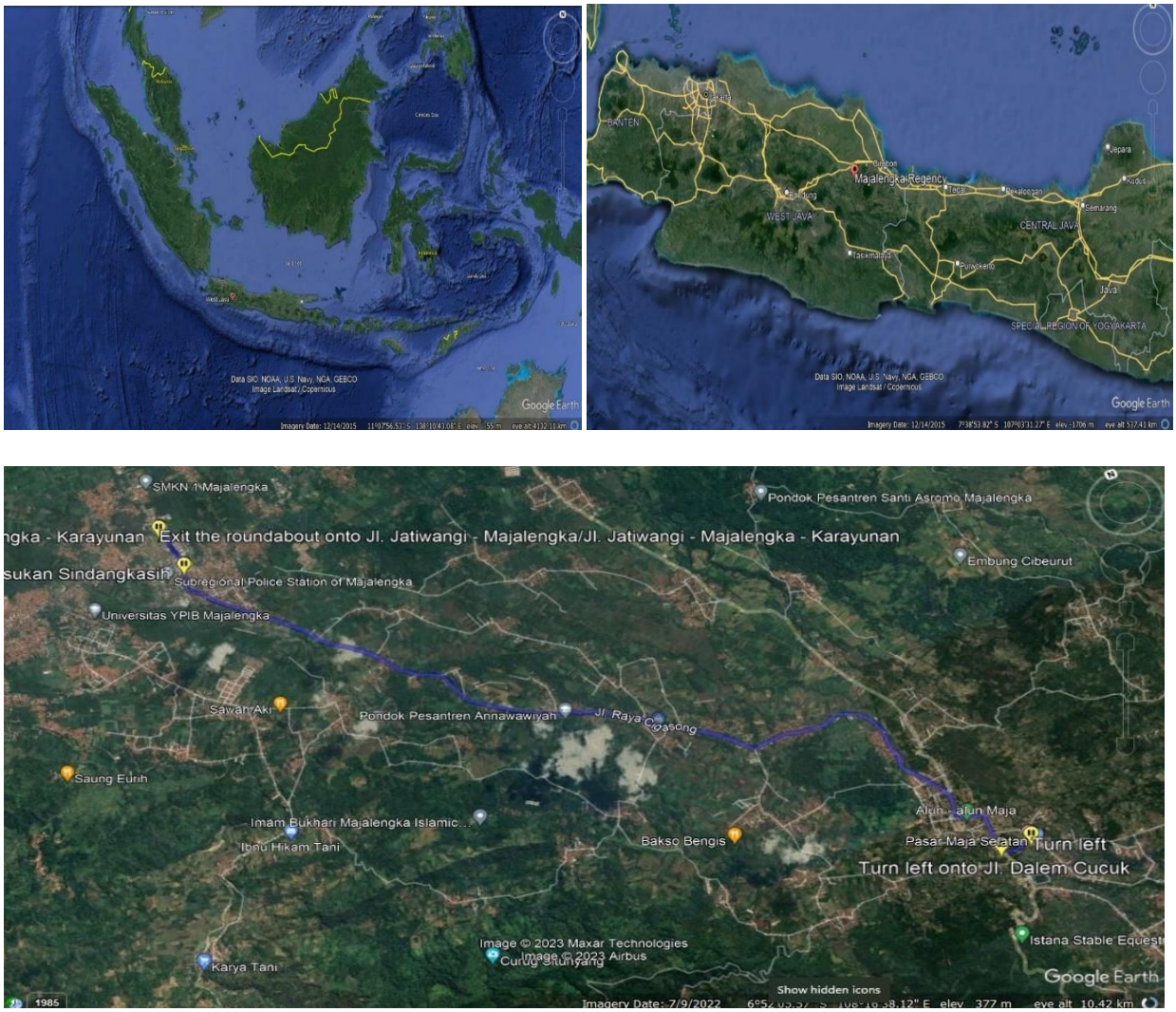

Figure 1. Research Location

In this research, primary data collection will be obtained through contour map data of Cigasong -Maja Majalengka Road through Google Earth and Global Mapper. Secondary data to support primary data will be obtained through the Road Geometric Design Guidelines. The primary data will then be processed through its conformity with the PDGJ. The research results obtained are conclusions regarding whether the road geometric design is in accordance with the design criteria or not in accordance with the design criteria.

3. Result and Discussion

Table 4.1 Research Results Data in the Field
Bend Research Data on Cigasong – Maja Road

No.	Location Name	R (m)	Vr (Km/h)	Information
1.	STA 49 + 400 Kertabasuki Bend	20	30	a. The difference in road height has a large difference, affecting the free area beside the bend.

				b. Too much slope or slope c. Lack of road signs and lighting around corners d. The lack of convex mirrors before entering the corner e. The road surface layer is uneven
2.	STA 50 + 500 Nanggerang Bend	15	20	a. Too much slope or slope b. Lack of signs at corners c. The lack of convex mirrors before entering the corner d. The road surface layer is uneven e. street lighting around the corner
3.	STA 58 + 300 Tikungan Haurduni	40	40	a. Lack of road signs around corners b. The lack of convex mirrors before entering the corner c. The bend is too slippery d. Lack of lighting in corners e. Lack of corner free area

Table 4.2 Bend Type Identification Data

	Bend Type			Identification Results		
No.	Full Circle (FC)	Spiral Circle Spiral (SCS)	Spiral Spiral (SS)	STA 49 + 400 (Kertabasuki Bend)	STA 150 + 400 (Nanggerang Bend)	STA 173 + 425 (Haurduni Bend)
1.	R > 700 m			20 m	15 m	40 m
2.		> Lsmin (40 m)		63,67 m	22,28 m	107.36 m
3.		Δc > 00		-146,40	- 35,10	-68.840
4.		Lc > 20 m		-51,102 m	-9,189 m	-66,080 m
5.			> Lsmin (40 m)	12.56 m	13,089 m	41,276 m
6.			> Lcmin (20 m)	25,12 m	26,178 m	82,552 m
7.			2 Ls < 2 Tt	2 (12,37) < 2 (12,872)	2 (13,089) < 2 (14,339)	2(41,276) < 2(42,495)
Conclusion (Bend Type)				Spiral Spiral (SS)	Spiral Spiral (SS)	Spiral Spiral (SS)

Identification of Results of All Research Data in the Field After the data results from research in the field are obtained, then the data is processed/processed again to identify the resulting data from the field and then it can only be concluded that the data is as seen in Table 4.3.

Table 4.3. Research Data in the Identified Field

No. STA Research	Bend Type Identification	Analysis of Bend Types
1. STA 49 + 400 Kertabasuki Bend	Spiral-Spiral (S-S)	a) Width of the bend = Width of the road (must add to the width of the road) b) There must be a sign before entering the corner. Example: signs for a right turn, a left bend, a sharp turn to the right, a sharp turn to the left. c) The addition of adequate lighting
2. STA 50 + 500 Nanggerang Bend	Spiral-Spiral (S-S)	a) The grade must be corrected (half the width of the bend is too flat and the other half is too high. b) Width of the bend = width of the road (must add to the width of the road) c) Lack of traffic signs, such as: signs for a right turn, a left turn, a sharp turn to the right, a sharp turn to the left d) There must be an additional convex mirror at every turn e) The addition of adequate lighting
3. STA 58 + 300 Haurduni Bend	Spiral-Spiral (S-S)	a) The grade must be corrected (half of the bend width is too flat the other half is too high) b) Lack of traffic signs, such as signs for a right turn, a left turn, a sharp turn to the right, a sharp turn to the left. c) The addition of adequate lighting

5. Conclusion

1. Whereas STA 49 + 400 Kertabasuki Bend, STA 50 + 500 Nanggerang Bend, STA 58 + 300 Haurduni Bend, use the spiral-spiral bend type.
2. Whereas STA 49 + 400 Bend Kertabasuki, STA 50 + 500 Bend Nanggerang have bends with abnormal geometry which often result in accidents especially for heavy vehicles so that improvements are needed to reduce the accident rate even though it requires large funds at the implementation stage but can maximize the level of safety also minimize the rate of accidents due to geometry, especially in corners.

6. Suggestion

For all STA 49 + 400 Kertabasuki Bends, STA 50 + 500 Nanggerang Bends, STA 58 + 300 Haurduni Bends,

a. W = B – L means, if the value of B is greater than the value of L, it will carry out shoulder work to widen the road around the corner. However, if the value of L is greater than the value of B, then there is no need to widen the road at the corner or carry out overall repairs to change the type of bend.

b. There must be a turn sign before entering the bend. For example: signs for turning right to left and vice versa, sharp turns to the left, etc. Adequate lighting needs to be added. Convex mirrors/convex mirrors must be added at every turn.

c. The surface layer of asphalt roads must be added with a wear layer, the function of this wear layer is as a protective layer for the surface layer to prevent water from entering and to provide skid resistance on the road surface. The wear layer is not taken into account in carrying the traffic load or the load of a passing vehicle.

d. The value of R at each STA must be adjusted at the time of planning, the value of Vr (Planning Speed) is adjusted according to the table, the value of Ls is required and the value of $L = 2 \text{ x } Ls + Lc < 2 \text{ Tt}$. So by following these steps, it will be ensured that the bend will not be dangerous (extreme) anymore.

e. Widening from left to right at bend locations

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