LEADER
Civil Engineering and Architecture

Civil Engineering and Architecture Journal Vol 1 No.4 (2023) E-ISSN
DOI 10.37253/leader.v1i4.8633

The Horizontal Alignment Design Jalan Prabumulih-Simpang Belimbing Muara Enim, South Sumatra

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ARTICLE INFO

Keywords:

Geometric Design, Horizontal Alignment, Highway Design Standard

ABSTRACT

Road geometric planning is part of road planning, whose main objective is horizontal alignment and vertical alignment to fulfill the road function, namely to provide maximum comfort for traffic flow according to the planned speed. To satisfy the road infrastructure, we need to have geometric planning of the road, which is part of the road planning that focuses on planning physical form. In this paper, we will discuss the alignment horizontal of the road so that it can be well-planned. The location of the horizontal alignment design is in Jalan Prabumulih-Simpang Belimbing-Muara Enim, South Sumatra, starting from STA 80+000 to STA 82+050. This paper uses road class regulation based on road functions and classifications, which refer to Indonesia's 2021 Road Design Standard. Based on the horizontal alignment geometric design results for Jalan Prabumulih-Simpang Belimbing-Muara Enim at STA 80+000 to STA 82+050, it could conclude that Jalan Prabumulih-Simpang Belimbing-Muara Enim at STA 80+000 to STA 82+050 is a category class IIC collector road with design parameters of design speed (VR) 80 km/hour and max slope (e) 8%. Based on the calculations, the dimensional radius (R) is 358 m, with the intersection angle (α) is 45°. The horizontal curved length (Lc) is 211,03 m. In this paper, the authors used the Spiral - Circle – Spiral (SCS) type, which is safe for drivers according to the condition. This calculation uses the Road Class Regulation based on road functions and classification, which refer to Indonesia's 2021 Road Design Standard.

1. Introduction

Transportation is an essential factor for human life and the development of global construction. Generally, a well-developed transport system between the production, goods distribution centers, and consumers is paramount [1]. Several countries concentrate on construction progress. Because of that, Indonesia is required to participate in developing construction technology so that it can safeguard our future. Since we usually find transportation everywhere, it should be an easy solution. This impact has the effect of constraining modern society toward the improvement and assessment of obstacles which are trendy and primarily based totally on economics, analysis, actuality in social life, touchy to surrounding problems, politically acceptable, and may be demonstrated right [2].

One of the countries with the largest population in the world is Indonesia. Indonesia has an area of 2.020.000 million km^2 between the Indian and Pacific Oceans. Indonesia is the largest country compared to other countries in the Southeast Asian region [3]. Indonesia, a developing country, is currently encouraging development in all fields on a national scale to improve the welfare of its people [4].

Receieved 10 September 2023
Available online 1 Oktober 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.4 (2023) E-ISSN
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Planned roads are anticipated to ensure user comfort and offer driving safety. Jalan Prabumulih-Simpang Belimbing-Muara Enim is in the province of South Sumatra. Prabumulih cities, with a total area of 25.194 ha, are part of the Muara Enim district, as defined in UU No. 28 Tahun 1959 concerning the formation of second-level regions [5]. This means that the government is carrying out road construction. The roads aim to connect the cities. It makes it easier for the city to be connected.

Road geometric planning is a part of road planning, whose main objective on horizontal alignment and vertical alignment to fulfill the road function to provide maximum comfort for traffic flow according to the planned speed. This is because the road is one of the development components that enhances national development. When the vehicle goes through a horizontal curve, centrifugal force is generated from the vehicle's center of gravity based on the bend radius and vehicle speed [6]. The construction of roads is needed in connection with the addition of road capacity. The matters that want to be considered in geometric planning consist of topography and the encompassing surroundings to offer economical, optimal, and efficient road planning. Two kinds of requirements may be referenced: countrywide and international [2].

The rapid failure of building construction in recent years is caused by the utilization of soil capacity that exceeds the soil's carrying capacity, which exceeds its carrying capacity [7]. Before the road project, a survey can be carried out to ascertain the actual situation and conditions. However, many unexpected errors can occur. A road design engineer must be aware of specific geometric design components when creating roads to ensure road user safety, security, and comfort. Additionally, it is essential to recognize geometric design elements so that plans can be executed effectively and the road can be durable [8].

This paper will discuss the geometric planning of horizontal alignment with the Indonesia Highway Design Standard in Prabumulih - Simpang Belimbing - Muara Enim, South Sumatra. This road was chosen because South Sumatra is one of the largest provinces in Indonesia. The road leads to Palembang City, often used for coal trucks, public transportation, and private vehicles. In this paper, we will discuss the alignment horizontal of the road so that it can be well-planned. Construction needs high capital investment and effective monitoring and maintenance practices over the expected life [9]. Therefore, planning efficient road traffic will be the best advantage.

2. Literature Review

2.1. Indonesia Highway Design Standard

Indonesia Highway design standard is a method of evaluating road conditions by visually surveying road pavement. The Highway design standard is the most common method used in Indonesia. The Directorate General of Wildlife Development oversees a road construction project. The Directorate General of Wildlife Development is beneathneath the auspices of the Ministry of Public Works and Public Housing [10]. In the Highway design standard Method, the things to consider when surveying are patches, cracks, grooves, and vanished. The results that will be obtained will be very beneficial in preparing rehabilitation programs and budgeting for road handling.

PDGJ explains the approaches for geometric road planning, which include planning criteria, road geometric technical provisions, and road geometric planning procedures. This guideline is a technical reference for geometric road designers to obtain minimal and most layout parameters by calculating the best layout requirements, accurate subject survey results, and terrain conditions [11]. It is designed to permit users to predict the traffic behavior of a facility under certain traffic conditions, geometries, and environmental situations. In addition, everything related to the geometric design of the road is contained on this circular, along with the dedication of corridors, visibility, the cross-segment of the

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road, and drainage [10]. PDGJ is commonly designed in order that users can expect the visitor's conduct of a facility below certain user situations and geometries.

The horizontal alignment design of the road must follow PDGJ. Apart from MKJI, there are even more PDGJ (Indonesian Highway Design Standards) 2021-specific guidelines in geometric road planning [12]. By fulfilling these requirements, geometric planning will produce good results. Due to several factors, construction can be done in stages. With the PDGJ, we can determine what needs to be improved in our preparation. When carried out manually, a geometric design can be very cumbersome, tedious, and pretty helpless to luxurious blunders; the conventional method is primarily based mainly on a 2-dimensional evaluation which would not ensure a nice layout [13].

2.2. Road Geometric Planning

Road geometric planning is a part of road planning that specializes in horizontal alignment and vertical alignment to satisfy the road's fundamental characteristics. A geometric road is a road construction on the ground level, both vertically and horizontally. Road geometry also plays an essential role as a factor causing accidents. To fulfill the required road services, geometric shapes must be designed efficiently [14]. The road design concept must also consider several aspects, such as efficient, effective, safe, environmentally friendly, and economical [15]. The purpose of geometric road planning is to get secure infrastructure. So that the roads constructed offer consolation and safety for us.

Transport is an essential component of civil infrastructure. In addition, roads are a part of the infrastructure that facilitates raising a place to expandability while encouraging the motion of human beings and their deliveries. Therefore, while the local economy is experiencing a significant expansion, providing roads is visible as urgent [11]. To fulfill the road infrastructure, we need to have geometric planning of the road, a part of road planning that specializes in planning physical form. It can satisfy the actual road function, provide full service to traffic flow and maximize the ratio of the extent to implementation charges to offer an experience of protection and luxury for all road users [16] [17] [18].

Road Safety Audit (RSA) is probably the best tool for the development of road security, where specialists endeavor to recognize possibly the prone areas where more possibilities of accidents exist on the highway and propose safety methods. In the last three decades, road traffic injuries and deaths have decreased gradually in high-income countries but not in low- and middle-income countries [19]. Good design criteria depend on horizontal alignment, vertical alignment, and road sections on highways, expressways, and roads that serve traffic inside or outside the city. These subjects need to be taken into consideration by the planer in order that the shape and length of the road are suitable and safe. It is necessary to have correct and precise geometric planning so that the road constructed presents consolation and protection for its users.

2.3. Horizontal Alignment

Road alignment is a prime challenge for researchers worldwide due to frequent accidents on alignment roads. Therefore, it is necessary to degree the use of suitable protection parameters on the element road design and the influence of design on the safety of road users. When we design the horizontal alignment, we must determine the appropriate curve radius, and the correct curve location, and the curve transition location must be adjusted. So, it would be very convenient to use the road. The radius of the horizontal curve, its location, and the number of horizontal intersection points (HPI) are the three main factors in horizontal alignment [20]. In geometric planning, the curved section aims to offset the centrifugal force received by vehicles walking across the road [21].

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Horizontal alignment is the projection of the road axis at the horizontal plane. Horizontal alignment is likewise referred to as an avenue state of affairs or road alignment. Horizontal alignment makes the driver in the vehicle more secure and snug at the same time as driving [22]. There are numerous horizontal curved designs, which include Full Circle, Spiral-Circle-Spiral, and Spiral-Spiral. It comprises three geometric elements, which include tangents (straight sections), circular curves, and transition spirals among tangents and arcs [23] [24].

Horizontal alignment should be maximally designed for better connectivity between cities. When creating a horizontal alignment, the dedication of the precise radius of the curve, the correct place of the curve, and the location of the curve transition should be considered [25]. The geometric capabilities of the road, which include superelevation, horizontal bend radius, and speed, are also governed by the AASHTO regulations. Then, it also regulates the geometric features of other roads, including elongated slopes, lateral friction factors, and road widths, both full circles and spiral-circle-spiral curves [2]. Horizontal alignment must ensure safety and comfort for road users [26] [27].

. Then, according to the rules, each specified design speed has a minimum radius allowed for planning.

3. Method

One of the most accurate ways to start scientific research and modeling is with data. Before starting everything, there must be preparation for the study. After that, the next step is data collection. The data obtained following the research plan was precise and accurate data. In acquiring and dealing with data, this study uses the literature method to figure out and process written substances utilized in library statistics series activities [11] [28].

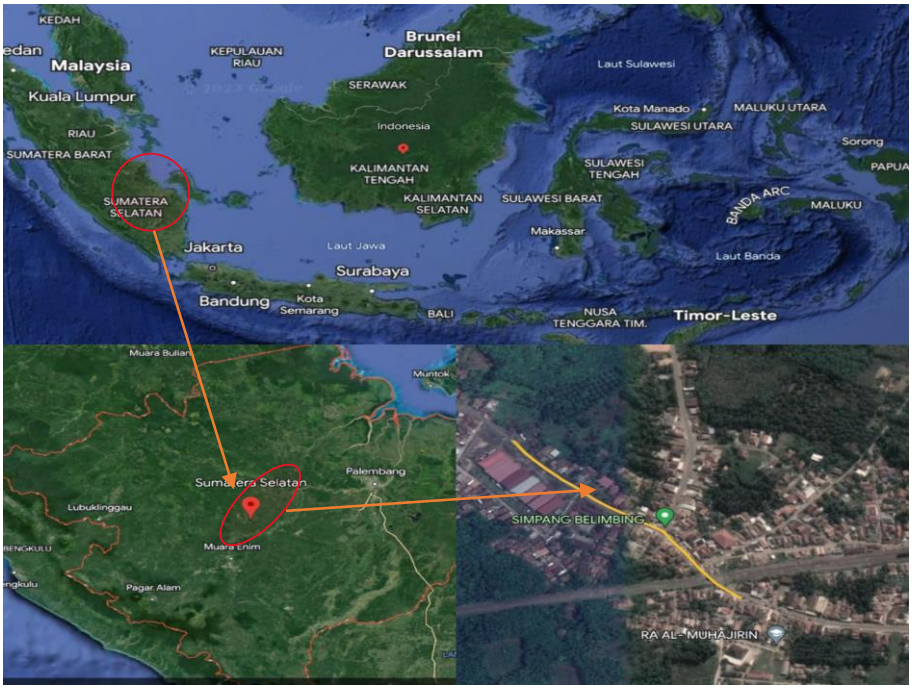

Figure 1. Road Planning Location

The location of the horizontal alignment design is in Jalan Prabumulih-Simpang Belimbing-Muara Enim, South Sumatra. Start from STA 80+000 to STA 82+050. The data are from Google Earth, Google, and PUPR South Sumatra. This paper uses road class regulation based on road functions and classifications, which seek advice from the Indonesia's 2021 Road Design Standard. The effects of the geometric detail calculations can be provided as data tables and superelevation diagrams.

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4. Result and Discussion

The calculation of geometric road planning based on the Indonesian Highway Design Standard:

4.1. Main Design Criteria

At STA 80+000 to STA 82+050, it connects the IKK (Regency Capital) area in Muara Enim Regency to the IKK (Regency Capital) area in Prabumulih Regency. This road is also linked to the national road of Jalan Lintas Sumatera.

Table 1. Main Design Criteria

No	Main Design Criteria Elements	Main design Criteria Value	
1	Road Role	Connecting between IKK and IKK	
2	Road Classification (Road Attribute)	Public Roads	
		SJJ	Primary
		Status	Regency Roads
		Function	Local Primary
		Class	II
		SPPJ	JSD
3	Design Speed Range (km/hour)	40-80 km/hour	
4	Longitudinal Slope (G)	3%	
5	Super elevation (e)	8%	
6	Transition Curve (Ls)	70 m	
7	Rmin Horizontal Curve	230 m	

4.2. Horizontal Alignment Calculation Results

The data obtained from PUPR Sumsel from STA 80+000 to STA 82+050 for horizontal alignment calculations (Spiral-Circle-Spiral) using Highway Design Standard of Indonesia 2021 are followed by: class II C road, design speed 80 km/hour, radius min (Rmin) 230 m, superelevation (e) 8%, standard cross slope (en) 2%, design radius (Rc) 358 m and α 45°.

Table 2. Horizontal Alignment Calculations Results

Formula		Results
θs	$\frac{90\ x\ ls}{Rc\ x\ \pi}$	5.604°
θc	$\alpha - 2\theta s$	33.791°
Lc	$\frac{\theta c}{180}\ x\ \pi$ x Rc	211.03 m, Check Lc>70 (OK)
L	Lc + 2 x Ls	351.030
P	$\frac{Ls2}{6Rc} - Rc\ (1 - cos\ \theta s)$	0.570
K	$Ls - \frac{Ls3}{40Rc2} - Rc\ sin\theta s$	35.041
Ts	(Rc+P) $\tan\frac{1}{2}\alpha + k$	183.566, L<2Ts(OK)
Es	$\frac{(Rc + P)}{\cos\frac{1}{2}\alpha} - Rc$	30.114 m

From **Table 2**, the calculation outcomes received values to decide the horizontal alignment curve on the STA 80+000 to STA 82+050 bend. This calculation is guided with the aid of using the Circular Letter of

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the Ministry of Public Works and Public Housing from the Director General of Indonesia's 2021 Road Design Standard. Calculation values may be calculated in **Figure 2**.

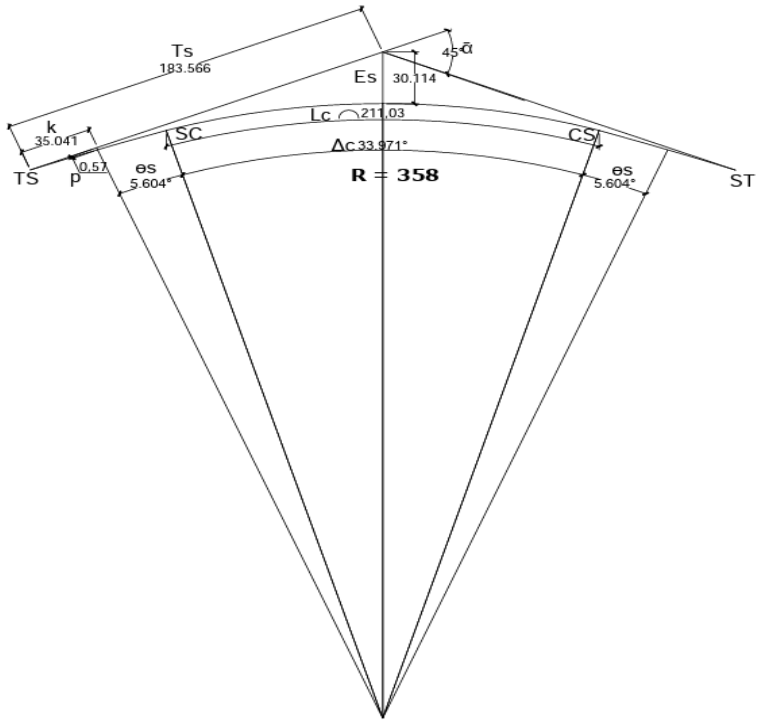

Figure 2. Horizontal Alignment

Based at the calculations, Jalan in Prabumulih-Simpang Belimbing-Muara Enim on the horizontal alignment bends of STA 80+000 to STA 82+050 is Spiral – Circle – Spiral (SCS) type. The horizontal alignment curve that has been visualized in **Figure 2** is made into a superelevation diagram, that is in **Figure 3**.

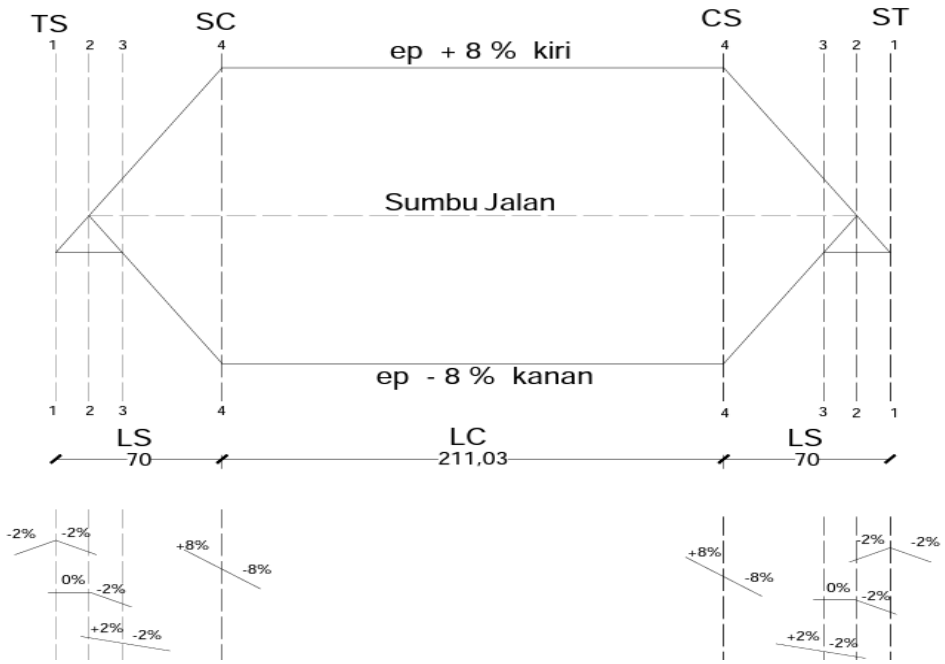

Figure 3. Superelevation Diagram

5. Conclusion

Based on the horizontal alignment geometric design results for Jalan Prabumulih-Simpang Belimbing-Muara Enim at STA 80+000 to STA 82+050, it could conclude that Jalan Prabumulih-Simpang Belimbing-Muara Enim at STA 80+000 to STA 82+050 is a category class IIC collector road with design

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parameters of design speed (VR) 80 km/hour and max slope (e) 8%. Based on the calculations, the dimensional radius (R) is 358 m, with the intersection angle (α) is 45°. The horizontal curved length (Lc) is 211,03 m. In this paper, the authors used the Spiral - Circle – Spiral (SCS) type, which is safe for drivers according to the condition. This calculation uses the Road Class Regulation based on road functions and classification, which refer to Indonesia's 2021 Road Design Standard.

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Available online 1 Oktober 2023
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Available online 1 Oktober 2023
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