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GEOMETRIC EVALUATION OF ROADS ON MAJALENGKA-CIKIJING ROAD: A CASE STUDY OF PASUKAN SINDANGKASIH-JALAN CUCUK DALEM

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ABSTRACT

Highways are one of the land transportation accesses to support human movement in driving and sending goods from one region to another. The geometric of the road is the building of the highway above the ground level both vertically and horizontally with the assumption that the ground surface is not flat. Horizontal alignment is often referred to as road situation or road alignment. The most critical part of the horizontal alignment is in corners, where centrifugal force pushes the vehicle out of the bend area. Superelevation is a slope A transverse slope at a bend that serves to offset the centrifugal force received by the vehicle when traveling through the bend at. The quantitative method can also be interpreted as a research method that looks at reality, symptoms, and phenomena that can be classified, are relatively fixed, concrete, observable, and measurable, and the relationship of symptoms is causal. Road evaluation in this study uses a design speed of 60 km/hour, with a road width of 3.5 m. Road evaluation was carried out using AutCAD® Civil 3D based on the contour data obtained. Based on the calculation results above, the Majalengka-Cikijing road is a hill road type. Then for the horizontal alignment with a speed of 60 km/hour, the results obtained from 11 horizontal alignments all belong to the Spiral-Cirle-Spiral alignment type.

1. Introduction

Highways are one of the land transportation accesses to support human movement in driving and sending goods from one region to another. In the development of the construction world, an efficient network of highway infrastructure is a decisive factor in promoting the socioeconomic development of countries and regions (Salsabila, Rifai, & Isradi, 2022). In developing countries, road construction aims to connect isolated areas and boost economic growth through better mobility of people (Salsabila, Rifai, & Taufik, 2022). Likewise in East Asia, namely China, the development in the economic sector is very rapid the main reason behind Chinese economic growth is a huge investment in developing road and transport infrastructure (Kanwal, Pitafi, Rasheed, Pitafi, & Iqbal, 2022).

Then to Southeast Asia, namely in Indonesia currently has a population of over 230 million people (Rizki, Rifai, & Djamal, 2022) and is also not far behind developing countries in terms of road infrastructure development and increasingly advanced transportation. However, with the increasing importance of roads and many users, institutions demand maximality in road construction, which becomes an advantage for road users (Ulchurriyyah, Rifai, & Taufik, 2022). Because roads are one of the transportation infrastructures used to support the economy, daily human activities can be utilized for traffic operations quickly, smoothly, safely, comfortably, and efficiently (Adiputra, Rifai, & Bhakti, 2022).

However, on highways, especially those that will be the location of the evaluation, there are various incidents, especially accidents. The location for the evaluation will be Majalengka, Majalengka is one of the districts in West Java, which is currently growing in the tourism and trade sector. This has a positive impact on the economy and social welfare. One of the supporting factors for realizing prosperity and improving public services is the improvement of the road network and the orderly opening of new road networks (Hatam, Yunus, & Rijanta, 2018). However, there will be an adverse impact on road users so that undesirable things such as accidents and traffic jams often occur, so if you want to solve these problems you have to do an evaluation offered by the existing road, through procedures based on safety condition verification criteria referring to the road geometry (Cantisani & Del Serrone, 2020).

Highways are separated into National Roads, Provincial Roads, Regency Roads, City Roads, and Village Roads by Republic of Indonesia Law No. 38 of 2004 and Government Regulation No. 34 of 2006 concerning road status (Rizqi, Rifai, & Bhakti, 2022). Jalan Majalengka-Cikijing is one of the provincial roads in Majalengka Regency, this road is one of the roads that has an impact on accidents because there are many sharp bends. So because of that an evaluation was carried out on the road by reviewing it in terms of Horizontal Alignment and Vertical Alignment (Nugroho, Rifai, & Akhir, 2022).

Based on the discussion above, it is necessary to carry out a geometric evaluation of the road on the Majalengka-Cikijing road section according to the road geometric design guidelines no. 20/SE/Db?2021.

2. Literature Review

2.1 Road Geometry

The geometric of the road is the building of the highway above the ground level both vertically and horizontally with the assumption that the ground surface is not flat. Geometrik jalan juga are part of road planning that emphasizes physical form planning to provide optimal service to traffic and access between locations (Gunawan, Rifai, & Irianto, 2022). Road geometric planning aims to produce safe infrastructure, efficient traffic flow services, and maximize the ratio of the level of use of implementation costs.

The road geometry is designed by considering safety and mobility issues that have conflicting interests so that it can fulfill the basic functions of the road which provide optimal comfort in traffic flow (Paikun, SP, Destaman, & Winardi, 2021). Therefore these two considerations must be balanced, the mobility that is considered does not only concern the mobility of motorized vehicles but also the mobility of four-wheeled vehicles and pedestrians.

Planning geometric component of the road, which includes horizontal and vertical alignment (Suraji & Mulyono, 2022) both of which have a road coordination relationship. Horizontal alignment and vertical alignment must be coordinated in such a way as to produce a good road shape that makes it easier for drivers to drive their vehicles safely and comfortably.

2.2 Horizontal Alignment

Horizontal alignment is a collection of points that form a straight line (tangent) or a curve (arch) as a projection of the axis of the road in the horizontal plane (Arifin & Rifai, 2022) . Horizontal alignment is often referred to as road situation or road alignment. The most critical part of the horizontal alignment is in corners, where centrifugal force pushes the vehicle out of the bend area.

In a straight section, consideration of the safety factor for road users, in terms of driver fatigue, the maximum length of a straight section of road must be passed in a follow time of more than 2.5 minutes (according to VR). For curves, transitions are made to avoid sudden changes in alignment from a straight shape to a circular shape, namely before and after a circular arc-shaped bend.

The horizontal alignment is divided into three elements that have a relationship between the steering wheel of the vehicle and the longitudinal axis of the body, such as 0° (straight line), constant (circular curve), or changeable (transition curve). For zero curvature (0°), the line of the running track has an unlimited radius (Farid, Rifai, & Taufik, 2022).

2.3 Superelevasi

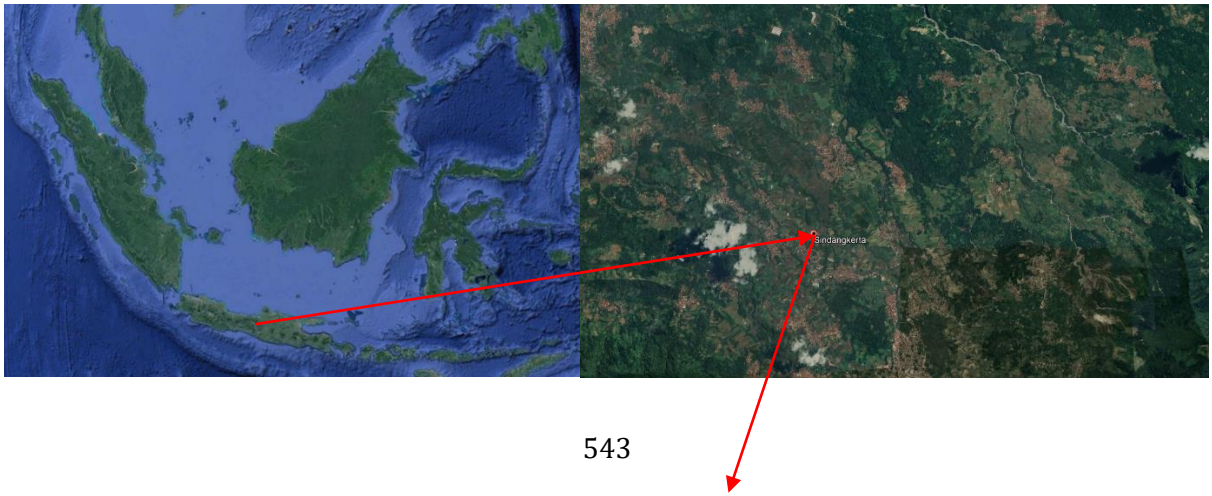
Superelevation is a slope A transverse slope at a bend that serves to offset the centrifugal force received by the vehicle when traveling through the bend at. To ensure a gradual increase or decrease of centrifugal forces to enable the vehicles to negotiate a curve smoothly (Molla, 2020).

Then For the current study superelevation was not included in the road curvature model as the geo-data analyzed did not contain altitude information (Kaneswaran, 2019). For example, adequate superelevation is essential to allow the vehicle to safely navigate horizontal bends. If not properly designed, inadequate superelevation can potentially lead to serious roadway departure crashes.

Superelevation will be achieved gradually from normal cross-fall on straight sections of road to full grade on curved sections. Similarly, an improper cross slope can cause a vehicle to drift and skid laterally while braking (Gupta, et al., 2020). In addition, information about cross-sectional gradients helps in tasks such as reconstruction and accident investigation.

3. Method

The method used in this research is to use quantitative methods. In quantitative data analysis, a sample is a subset of the total data gathered by surveys or lengthy observations (Rahman, Tabash, Salamzadeh, Abduli, & Rahaman, 2022). The quantitative method can also be interpreted as a research method that looks at reality, symptoms, and phenomena that can be classified, are relatively fixed, concrete, observable, and measurable, and the relationship of symptoms is causal. The technique in this quantitative method is applied by observing, measuring and other trend activities on the Majalengka-Cikijing road starting from Sindangkerta Village to South Maja. Then to obtain the data in Commonly used qualitative methods are interviews, focus groups, and observation (Barrett & Twycross, 2018). Thus, in conducting research using this quantitative method, we as researchers must survey directly the location to be examined. The location of this research was carried out on the Majalengka-Cikijing highway which starts from Sindankerta to South Maja in Majalengka Regency which has a length of 3.85 km. The research location is in the picture.



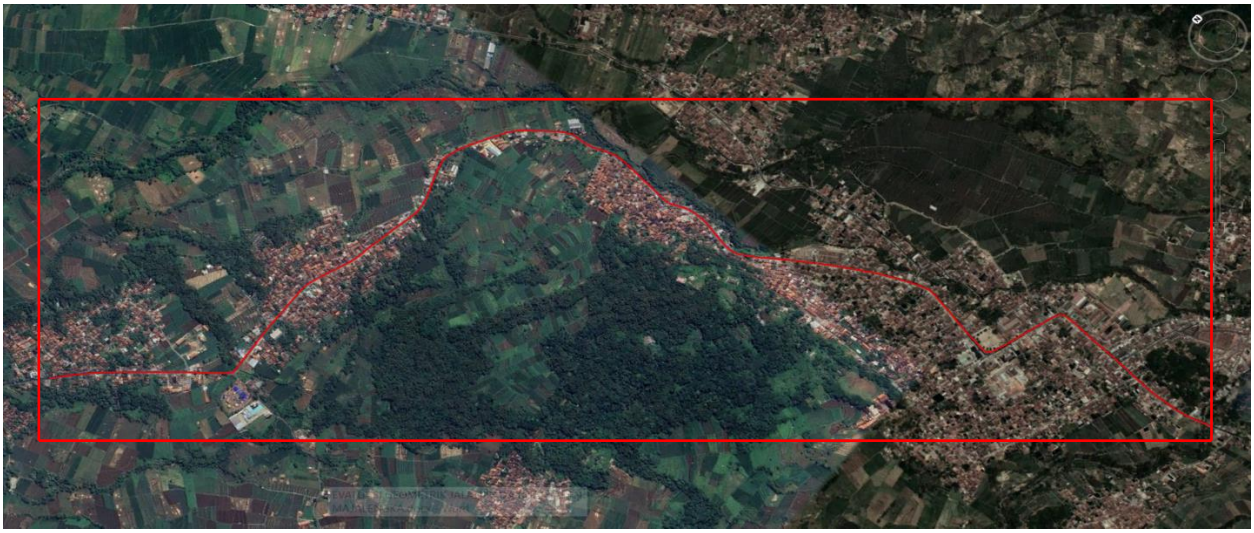


Figure 1. Research Location

The method of data collection is important in research because it is a management strategy or method used by researchers to collect data needed in their research (Aini, Zaharuddin, & Yuliana). This data collection will be carried out on Sundays in the morning until it is finished with the technical data collection used in this study, namely primary data and secondary data.

Primary data is data obtained from observation and direct observation in the field and direct observation in the field which is carried out with several observations. This direct observation produces the necessary data such as general data, road geometric data, environmental conditions, and others. While the secondary data is the supporting data used in the preparation of the final results. This secondary data is obtained not through direct observation in the field, but data obtained from related parties such as agencies, offices, and so on.

4. Result and Discussion

Road geometric evaluation on the Majalengka – Cikijing road section based on the road geometric design guidelines (PDGJ) are as follows:

4.1 Criteria design

Based on the research results on the Majalengka – Cikijing road, the following data is obtained:

Tabel 1. Road Planning Data

Known Data		
Road Function	Class II Primary Local Road	
Road Criteria		
Medan Classification	Bukit	
Path Configuration	2/2-TT	
Plan Speed	60	km/h
Ruja width	16	m
Rumija width	16	m
Ruwasja Width	7	m
Lane Width	3,5	m
Inside Shoulder Width	0	m
Outer Shoulder Width	1	m

Median Width	0	m
Normal Superelevation	2	%
Shoulder Superelevation	6	%
Maximum Superelevation	8	%
Maximum Slope	6	%

4.2 Trace

Road evaluation in this study uses a design speed of 60 km/hour, with a road width of 3.5 m. Road evaluation was carried out using AutCAD® Civil 3D based on the contour data obtained. Road traffic is obtained as shown in the figure, divided into eleven points of interest starting from STA 0+000 and ending at STA 3+850.

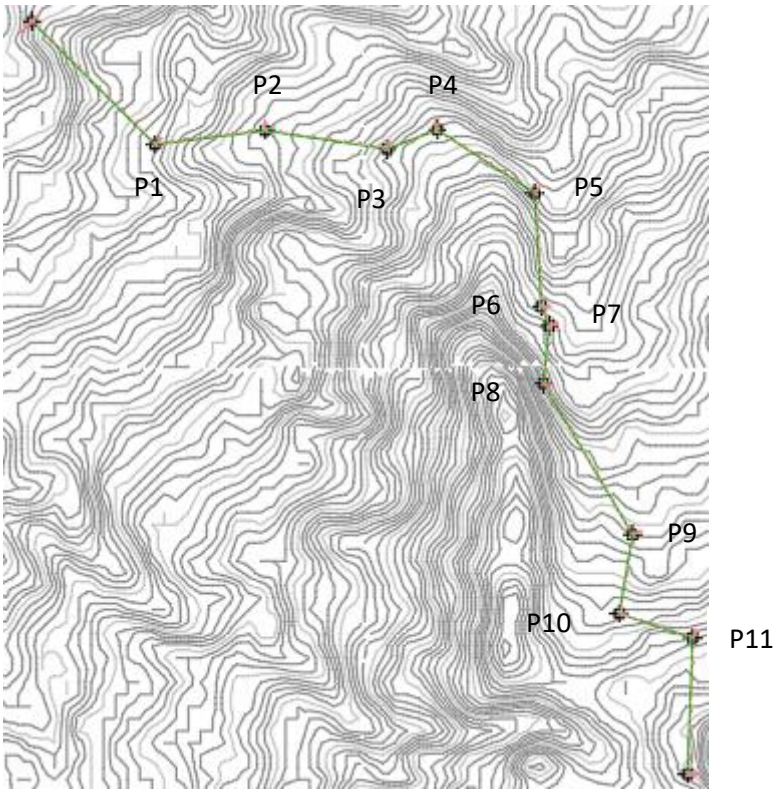


Figure 2. Planning of Trase

Then based on the calculation at the bend angle on the Majalengka - Cikijing road are as follows:

Tabel 2. Bend Angle Calculation Results

Node	Coordinate		Distance			Azimuth	Angle
	X	Y	ΔX (m)	ΔY (m)	d (m)	α	Δ
A	200185,00	9239558,00					
			387,00	-387	547,3006	135	
PI1	200572,00	9239171,00					**52,227**
			347,00	44	349,7785	82,7734	
PI2	200919,00	9239215,00					**15,838**

			383,00	-58	387,3668	98,6112	
PI3	201302,00	9239157,00					**29,286**
			159,00	60	169,9441	69,3256	
PI4	201461,00	9239217,00					**53,711**
			306,00	-199	365,0164	123,037	
PI5	201767,00	9239018,00					**53,597**
			21,00	-357	357,6171	176,634	
PI6	201788,00	9238661,00					**18,919**
			25,00	-61	65,9242	157,714	
PI7	201813,00	9238600,00					**151,755**
			-19,00	-182	182,9891	5,95984	
PI8	201794,00	9238418,00					**143,485**
			281,00	-476	552,754	149,445	
PI9	202075,00	9237942,00					**139,871**
			-42,00	-249	252,5173	9,57423	
PI10	202033,00	9237693,00					**98,861**
			231,00	-77	243,4954	108,435	
PI11	202264,00	9237616,00					**106,299**
			-16,00	-429	429,2983	2,13592	
B	202248,00	9237187,00					**2,136**

4.3 Alignment Horizontal

From the calculations that have been calculated, the calculation results are obtained from eleven points of interest for the geometric evaluation of the road on the results of the horizontal alignment analysis for the existing road, where there are 11 curves that are less than Rmin = 141.732 m, then from the results of the horizontal alignment evaluation, where there are 11 curves with the Spiral-Cirle-Spiral type obtained from the calculation results.

4.4 Superelevation

Superelevation is the cross-slope of the road at a bend which compensates for the centrifugal force acting on the vehicle while cornering, expressed in units of %. Based on the calculation, the superevasion diagram is shown in the figure below.

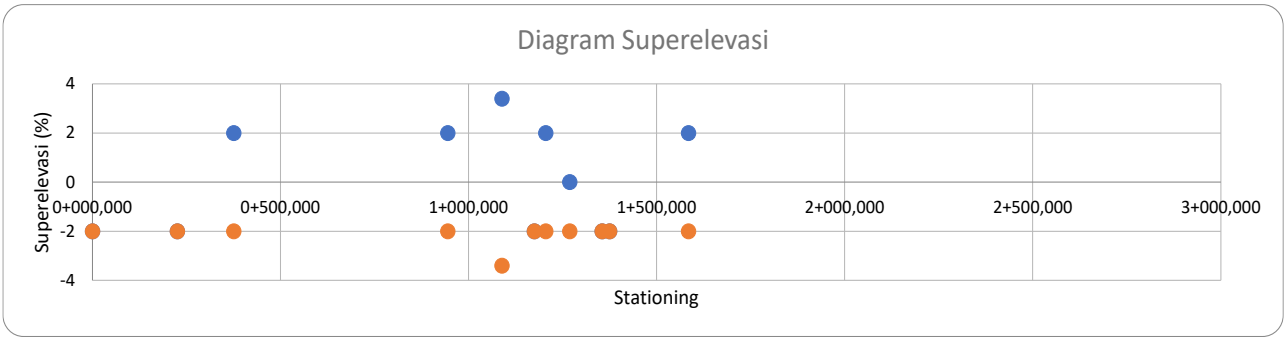


Figure 3. Planning of Trase

5. Conclusion

Based on the calculation results above, the Majalengka-Cikijing road is a hill road type. Then for the horizontal alignment with a speed of 60 km/hour, the results obtained from 11 horizontal alignments all belong to the Spiral-Cirle-Spiral alignment type. In the evaluation it was also found that the length of the straight section, the length of the bend and the length of the transition curve and the elevation for all alignments met the road geometric design guidelines (PDGJ), so no improvements were required in the horizontal alignment design.

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