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ANALYSIS OF ROAD GEOMETRY CALCULATION BASED ON ROAD GEOMETRIC DESIGN GUIDELINES: CASE STUDY OF PARAGLIDING TOURISM ROAD, MAJALENGKA

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ABSTRACT

Geometric planning is part of road planning that focuses on physical form so that the main functions of the planned road can be fulfilled. The main function of the road is to provide optimal service in traffic flow and access from one place to another. Geometric planning also has an important role for the economy of a region, with road geometric planning making it easier for people to reach areas that are difficult to reach but has the potential to improve the regional or national economy. A country that desperately needs to upgrade its infrastructure to improve the living standards and well-being of its people. To achieve this goal, the country needs various supporting factors, including infrastructure. The latitude of the research location is between -6,846,332,965 to -6.850200754, while the longitude is between 108203130505 up to 108.199008503, with a horizontal alignment of 112 m and a vertical alignment gradient of 3.43 %.

1. Introduction

Geometric planning is part of road planning that focuses on physical form so that the main functions of the planned road can be fulfilled. The main function of the road is to provide optimal service in traffic flow and access from one place to another (Arifin & Rifai, 2022). Geometric planning also has an important role for the economy of a region, with road geometric planning making it easier for people to reach areas that are difficult to reach but has the potential to improve the regional or national economy. A country that urgently needs economic development to improve people's standard of living and welfare. To achieve this goal, the government requires various supporting factors, one of which is infrastructure (Rizki, Rifai, & Djamal, 2022).

Infrastructure development is very important to improve the economy of a country, by increasing state infrastructure it can absorb a competent workforce, improve the economy of society and the country, and encourage various other positive activities. To achieve rapid economic growth, the government must ensure reliable and adequate infrastructure, especially

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transportation, to support economic growth (Nabila, Rifai, & Muhammad, 2022). Road or transportation infrastructure development must be carried out in a planned manner in potential

and strategic areas, so that the infrastructure can be useful and beneficial and reduce or prevent unwanted adverse impacts, it is necessary to plan or evaluate the road geometry design.

In Majalengka, West Java, the government is currently intensively developing infrastructure, such as road infrastructure, transportation infrastructure and other infrastructure. One of them is building road infrastructure in tourist areas in Majalengka, such as Paragliding, Panyaweuyan, Ciboer Pas tourism and other tourist attractions. However, many of the roads that will be traversed to the tourist attractions are damaged not long after being built or repaired, geometric criteria is indispensable for road planning. This standard is used to evaluate ineffective road planning. The geometric design of highways is concerned with the design of the cross-sectional elements, visibility, alignments, curves, superelevations and other related factors that are physically visible on the roadway. (Muhammad, Rifai, & Bhakti, 2022).

One of the tourist attractions in Majalengka is Paragliding which is in the village of Sidamukti, Majalengka District/Regency, West Java. Majalengka Paragliding Tourism is one of the tourist attractions visited by many tourists from Majalengka or from outside the city, this tourist spot is suitable for visitors who want to see or try to fly in the air using a parachute and also visitors can enjoy the beauty of the beautiful city of Majalengka from above. However, the road/access to these tourist attractions is a bit poor, because many of the roads are damaged and have potholes. Moreover, trucks transporting sand or gravel are added along the same road to the Cilutung river, causing the road to deteriorate quickly and there are fears of an accident. Studies have attempted to relate road geometric design elements such as lane number, visibility distance, superelevation, median width and type, lane and shoulder width, curve radius, slope, and horizontal and vertical alignment with accident rates (Islam, Hua, H., & Arash, 2019).

In order for the road to fulfill its basic function and provide optimum service to traffic flow, a planning or evaluation of the road geometry design is made. In planning this road geometry to make the road to the tourist spot smooth and safe for motorists in accordance with the road geometry design guidelines. The geometric road design that forms the basis of road safety factors mainly refers to the symmetrical placement of physical road elements, cost (efficiency) analysis, reduction of harmful impacts on the environment, traffic volume, road accessibility, etc (Simić, et al., 2020). The road to the Paragliding tourist spot, Majalengka has a steep incline, lots of potholes, and poor street lighting, so the road to the tourist spot is very prone to accidents. Therefore, the purpose of this study is to analyze road planning calculations, on the road to the Majalengka Paragliding tourist spot by using road geometric design guidelines as the main reference for road evaluation. geometric design.

2. Literature Review

2.1 Roads acces to tourism area

In general tourism is a trip made for vacation and recreation and also the preparations made for this activity. Tourism is a concept that is impossible to imagine without advertising. The tourism sector is responsible for promoting natural resources, culture, heritage, etc (Kodirovna, Atoevna, & Oktyamovna, 2020), however, to be able to go to a tourist spot requires good road access and according to road geometric design guidelines

Accessibility of tourism is all types of transportation facilities and infrastructure located in roads to tourist attractions to support the movement of tourists from their areas of origin tourists heading to Tourism Destinations, or movement within the region Tourism Destinations as a form of motivation for tourist visits. Access to tourist sites via roads and other transport infrastructure are a vital part of tourism (Shamsa, Rasheed, Pitafi, Adnan, & Minglun, 2020). A location is difficult to reach due to inadequate roads, therefore road access to tourist sites plays an important role in tourism development. Access to a tourist spot depends on the geographical

conditions of the tourist spot which affects the ease or difficulty of these tourist attractions to reach (Quan & Jueyu, 2021), therefore need help from the government to build access roads that feasible for tourists or local residents so that community mobilization can run quickly and smoothly. The geometric design of the highway linked to an authentic physical design can facilitating sustainable road development (Sukma, Rifai, & Bhakti, 2022).

Road access to Paragliding tourist attractions, Majalengka is quite good, but there are some parts of the road to these tourist attractions are potholes. This is due because the access road to these tourist attractions is also an access road for vehicles construction material transport trucks, although currently there are several road points that are in fix it but it's not a solution so that the access road to the tourist spot becomes smooth and safe. A new solution is needed so that the road to these tourist attractions is not fast damaged, one of which is making a special alternative road for material transport trucks construction because Improving accessibility has been a top priority for builders policies at the national, regional and local levels (Aris & Panayotis, 2019)

2.2 Road Geometric Design

Road geometry is part of road planning that emphasizes physical form planning to provide optimal service to traffic and access between locations (Gunawan, Ratih, Rifai, & Irianto, 2022). The geometric design of the road is related with a physical layout as seen from the road and includes factors such as cross section, visibility, alignment, curves, and superelevation (SP, Siddharth, & Jayesh, 2018).

The basic characteristics of traffic, drivers, and vehicles are the main factors road geometric design planning. Road geometric design criteria are the main parameters whose value is determined at the beginning of design planning and becomes the basis to define the design of other geometric elements, road geometric design criteria must meet the requirements of traffic volume, road technicality, and vehicle type. Geometry elements highways obtained through several analysis and calculations are selected and positioned such a way as to meet the road planning criteria (Manoj, Prashan, & Prashan, 2019).

The purpose of planning the geometric design of the road is to produce a good infrastructure safe, Minimize the use of implementation costs, and service efficiency traffic flow for the public. This goal should consider several aspects such as: visibility, sufficient maneuverability, and a sufficiently valuable surface friction coefficient economical and efficient, and easy to implement, providing a physical infrastructure that uniform about the type of road terrain (Agniya, Rifai, & Mohamad, 2022).

2.3 Road Geometric Design Guidelines

Road geometric design guidelines are references or rules to improve performance roads in construction work and to ensure road quality, geometric design guidelines road contains general, technical provisions, and road geometric design procedures. Provision general contains general policies, safety, economics, drainage, environment, classification roads and sections of roads. While the technical provisions contain design criteria, alignments horizontal dan vertikal, cross-sectional elements, visibility, vehicle stability, driver comfort, traffic characteristics, and economic factors (Nurjannah, Rifai, & Akhir, 2022).

Furthermore road geometric design procedure which contains procedures and rules for road geometric design. These guidelines are intended as the main reference base for geometric

designers or planners roads for urban roads, intercity roads, or freeways by providing minimum and maximum limits on its design parameters. So the designer or Road geometric planners have flexibility and ease in designing something roads with appropriate design requirements, results of field surveys, and the road terrain conditions reviewed will make the design criteria produce a product that is accurate in design, meets requirements and technical rules, and can be applied in physical implementation in the field (Joice, Rifai, & Mohamad, 2022).

The purpose of the road geometric design guidelines is to carry out road construction can provide optimal and consistent service to traffic flow, ensure driver comfort and safety by maintaining acceleration below a level that can cause discomfort (Saeed, 2019). Objective other part of the road geometric design guidelines, namely to explain road geometric design procedures for road planners, road management, and other experienced stakeholders design the road geometry, in order to produce an efficient road geometric design, effective, economical, safe and environmentally sound (Sebastian, Raul, & Patricia, 2019).

3. Research methodology

This study uses a qualitative research method, this method is used when the research subjects be investigated is unclear, not understood, complex, sensitive, related process, requires detailed understanding, or requires new ideas or creativity (Liza & Kreps, 2020). The data that has been obtained from qualitative research is then analyzed evaluation based on the provisions of the road geometric design guidelines. This research carried out at the Majalengka roundabout as the starting point for heading to the Paragliding tourist spot, Majalengka is 6.1 km long

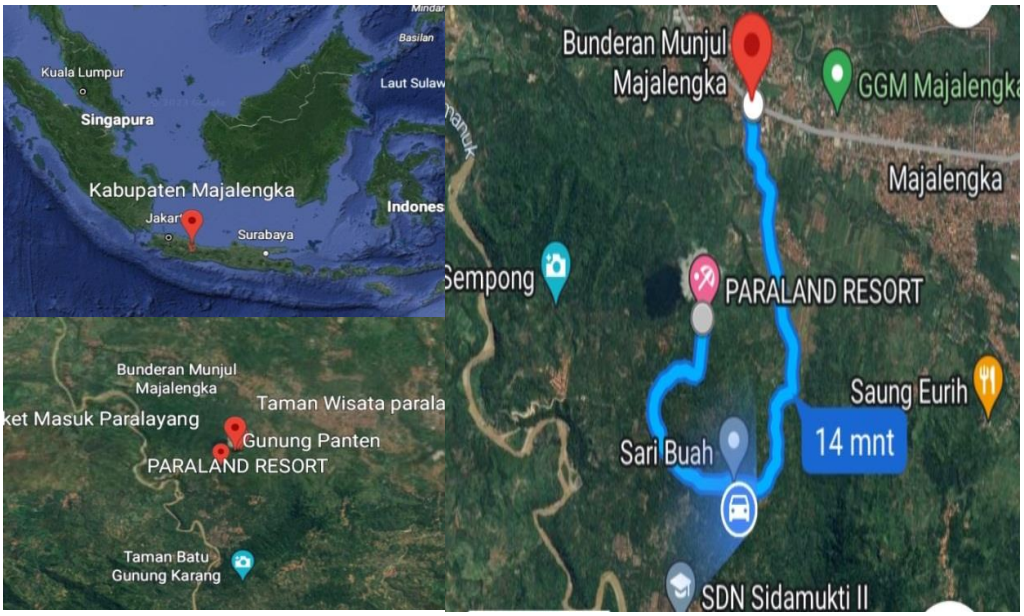

Figure 1. Location Map

The initial step in this research is to collect primary data such as road maps to the research location and road contour maps. Next collect data secondary such as geometric design procedures for roads obtained from the road geometric design guidelines as the main reference for the analysis calculation of the geometric design of the road to the Paragliding tourist spot, Majalengka.

4. Result

4.1 Research Site Elevation

Type	Latitude	Longitude	course distance (km)	distance_interv al (m)
T	-6.846.332.965	108203130505	0.000	#ffff00 1.00 elevation
T	-6.847217036	108.202720429	204.7 0.108 107.77	
T	-6.847999074	108.202638243	186.0 0.195 86.96	
T	-6.848912794	108.202462090	190.8 0.298 102.91	
T	-6.849702445	108.202162137	200.7 0.391 93.41	
T	-6.849463042	108.201320991	286.0 0.488 96.67	
T	-6.849488842	108.200672370	267.7 0.559 71.75	
T	-6.849525637	108.200029663	266.7 0.631 71.16	
T	-6.849895996	108.199614184	228.1 0.692 61.53	
T	-6.850200754	108.199008503	243.1 0.767 74.95	

Table 1. Elevation Data

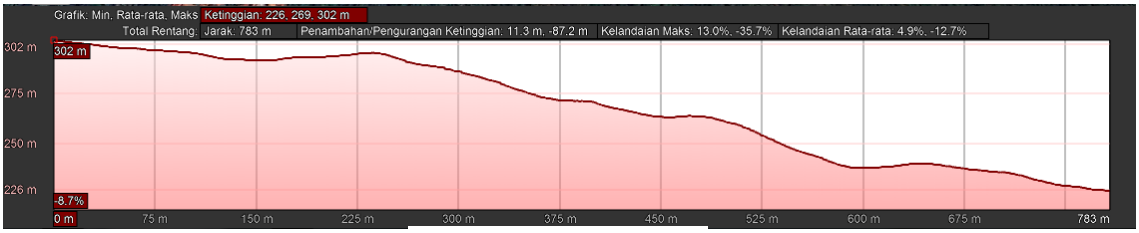

Figure 2. Elevation Data

The table and figure above shows that the latitude of the research location is between -6,846,332,965 to -6.850200754, while the longitude is between 108203130505 up to 108.199008503. while the distance starts from 0.000 (km) to 243.1 0.767 74.95 (km).

4.2 Determining Sight Distance

4.2.1 Stopping Sight Distance(Jh)

VR = 60 Km/Hours

g = Acceleration due to gravity = 9,8 m/s2

f = Coefficient of friction = 0.35 – 0.55

T = Response time 2,5 seconds

$$Jh = \left[\frac{Vr}{3,6}\right]T + \left[\frac{Vr}{3,6}\right]^2 x \frac{1}{2gf}$$

$$Jh = \frac{Vr}{3,6} x\ T + \frac{\left(\frac{Vr}{3,6}\right)^2}{2.g.f\ 0,4}$$

$$Jh = \frac{60}{3,6} x\ 2,5 + \frac{\left(\frac{60}{3,6}\right)^2}{2.9,8.0,4}$$

$= 41,6 + 35,4$

$= 77$ m

4.2.2 Leading View Distance

$Jd = d1 + d2 + d3 + d4$

d1 = 0,270 TI (Vr-m + a.T1/2)

d2 = 0,270 Vr T2

d3 = between 30-100 m d

4 = 2/3 d2

T1 = 2,11 + 0,028 Vr

T2 = 6,58 + 0,046 Vr

a = 2,52 + 0,0038 Vr

m = (Between 10-15 km/h)

Based on the data above, the visibility is:

Known:

T1 = 2,11 + 0,028 x VR

= 2,11 + 0,028 x 60

= 3,79 second

T2 = 6,58 + 0,046 x VR

= 6,58 + 0,046 x 60

= 9,34 second

A = 2,052 + 0,0038 x VR

= 2,052 + 0,0038 x 60

= 2,28 km/h/s

$D1 = 0{,}270\ T1\ \left(60 - 10 + (2{,}52x3{,}79)\right)$

= 0.270 x3,79.2 (60–10+(2.52x3,79)/2)

= 56 m

D2 =0,270 x VR x T2

= 0,270 x 60 x 9,34

= 155,79 m

D3= between 30–100 m , taken = 100 m

D4= $\frac{2}{3}\ x$ 155,79

= 103,86 m

$Jd = d1 + d2 + d3 + d4$

= 56 + 155,79 m + 100 + 103,86 m

= 415,65 m.

The minimum for VR = 60 Km/Hour is 350 m based on TPGJAK, and 415,65 > 350, then Jd = 415,65m.

4.3 Horizontal Alignment and Vertical Alignment

4.3.1 Horizontal Alignment

Data:

Terrain classification = Hill

Road type = Local Class III

Average Daily Traffic (LHR= > 25000

Design speed = 60 km/hour

Pavement width = 4x3.50 m Shoulder width = 2 m

Normal slope across pavement = 2 %

Maximum bend angle (e)= 10 %

Minimum radius calculation (Rmin):

f_{max}= 0,192 – 0,00065VR = 0,192 – 0,00065(60) = 0,153

$$R_{min}=\frac{Vr^2}{127\left(e_{maks+f_{maks}}\right)}$$

$$R_{min}=\frac{60^2}{127(0,1+0,153)}$$

=112 m

4.3.2 Vertical Alignment

Calculation of the vertical curve PV1

Data : Station's PVI1 = 0+350

PVI1 elevation = 106 m2/3 d2 = 2/3 x 155,792/3 d2 = 2/3 x 155,79

Vr = 60 km / h

$g1 = 0$

$g2 = -3,40$

Jh = 77

a. Slope difference
   $A = g1 + g2$
   = 0 – (-3,40)
   = 3,40 %
b. Find a Vertical Curve

   Based on flexibility requirements

   Lv = 0,5 x Vr

   = 0,5 x 60

   = 30 m

   Based on drainage requirements
   Lv = 40 x A = 40 x 3,40 = 137,2 m

   Based on convenience terms

   $Lv = Vr\ x\ t = 60X3 = 180\ KM/H$

   $$\frac{180x1000}{3000}$$
   = 60 m

5 Conclusion

The road leading to the Paragliding tourist spot, Majalengka does have several problems such as potholes, steep inclines and insufficient lighting so that these problems can be bad for tourists. Paragliding Tourism, Majalengka is at the coordinates,latitude between -6.846.332.965 to -6.850200754, while the longitude is between 108203130505 to 108.199008503. whereas jmileage from 0.000 (km) to 243.1 0.767 74.95 (km). Visibility in area that is the stopping sight distance is 77.10 m and the sight distance ahead of it is 417.80 m, with a horizontal alignment of 112 m and a vertical alignment gradient of 3.43 %.

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