LEADER
Civil Engineering and Architecture

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

The Horizontal Alignment Design for Jalan Munjul – Sindang Resmi, Pandeglang - Banten

Erwin Batista[1], Mulia Pamadi[2]
[1]Civil Engineering, Faculty of Engineering, Mercubuana University, Indonesia
[2] Faculty of Civil Engineering and Planning, Universitas Internasional Batam, Indonesia
E-correspondence: erwinsmbln@gmail.com

ARTICLE INFO

Keywords:

Road Geometric Design, Horizontal Alignment,
AutoCAD® 2D,
Connecting Road

ABSTRACT

The improvement of road infrastructure plays an important role in ensuring the prosperity of nations all over the world. Indonesia is also taking part in the development of road infrastructure in each region. In the province of Banten, Pandeglang Regency has some of its finest natural and economic potentials. To encourage economic connectivity to the surrounding districts, the development of this potential must be supported by appropriate infrastructure development. Planning a connecting road for the Munjul Sindangresmi could be a way to shorten the flow of traffic in the Munjul sub-district. The route was planned manually using the AutoCAD(R) 2D application, Google Earth Pro, Global Mapper, and other supporting applications. Planning begins with determining the road alignment plan, which is then projected on the plan location map. Then, apply the topographic map observations from remote imagery mapping. After that, continue with the road geometry design calculation depending on the location of the chosen route. The requirements that must be followed while determining the road geometry—which in this case is a horizontal alignment—refer to the Road Geometry Design Guidelines that were published by the Directorate General of Highways in 2021. The road geometry planning results in this journal have a length of 2.3 Km with a horizontal alignment design consisting of 3 horizontal curves, 2 Spiral - Circle - Spiral (SCS) curves, and 1 Full Circle arc. To assess the value of the economic and safety benefits of this road design, future planning for this road should consider the amount of embankment excavations as well as a project feasibility study.

1. Introduction

Infrastructure development is one of the most important aspects of the advancement of a nation around the world. The availability of adequate and efficient infrastructural set-up not only improves the quality of life of the people but also promotes rapid industrialization [1]. The two main categories of physical infrastructure are economic (such as roads, dams, irrigation, telecommunications, and electricity) and social (such as water supply, sewage systems, hospitals, and educational facilities). Roads are physical infrastructure with a high use value in terms of increasing the productivity of those who use them and increasing the quantity and quality of roads can indirectly enhance a nation's economy and community connectivity. Therefore, Governments around the world prioritize significant financial investments to develop new highway projects and maintain existing highways [2].

The development of Indonesia's infrastructure, particularly the highways, has advanced significantly over the past eight years (2015 – 2022). Indonesia's central government authorizes investments in national roads, e.g., toll roads, while the lower-tier levels of government control local road projects [3]. According to information from the Directorate General of Highways, 5,386 km of new roads were constructed in Indonesia during that time. The construction of this new national road also has a positive

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

impact on increasing gross domestic product (GDP) based on data from the Indonesian Statistics Center with an average increase of 5.33% annually. With the increased number of these roads, there is a risk of an increase in the number of traffic accidents. due to some shortcomings that continue to exist in road safety standards, vehicle maintenance, and in the design and implementation of safe transport infrastructure policies. As a result, it must be improved in terms of road safety standards, vehicle maintenance, and the design and implementation of safe transportation infrastructure policies [4].

Indonesia is undergoing extensive infrastructure development, with Banten being just one of the locations as a support to the capital city of Indonesia. The Banten province also has long served as one of the economic centers of Indonesia, they have been a transit hub for foreign traders since the 15th century AD. To continue to support the potential of the Banten region, a structured and well-connected infrastructure is required. The government provides infrastructure, provides facilitation in the development and management of each region. [5]. The road network is one indicator to measure the sustainability of urban deployment urban areas and for new urban development areas [6].

The construction of a road is frequently required to support the spatial adjustment of a region that is constantly evolving. Spatial adjustment usually occurs with substantial industrial growth which is closely related to natural products in some regions. Pandeglang is one of four regencies that have existed in Banten Province since its inception. The potential of natural resources at Pandeglang regency can be seen from the distribution or support of each sector in the development of Gross Regional Domestic Product (GRDP) which focuses on how a sector could allocate the economy in some sectors [7]. To improve the potential of this area, it must be supported by the establishment of an integrated and connected infrastructure network with the surrounding area. The development of the sub-district in terms of the availability of service infrastructure shows that the more developed sub-districts are located around the center of the Pandeglang Regency and the sub-districts that are on the border with Serang Regency and Serang City [8].

Planning for the Munjul - Sindangresmi connecting road can be one of the recommendations for building infrastructural connectivity in this district. This route must be capable of supporting the mobilization of industrial vehicles for their existence to be sustained for an extended period time. Based on the analysis of driving forces, the minimum radius of circular curves was determined, and the minimum length of easing curves was determined according to centrifugal acceleration, running time, and occupant visual characteristics [9]. This connecting road must also be considered with the topographical condition in the planned location. Most research involving safety road design components focuses on understanding the relationship between geometric, other design components, and safety, using accident records as an index and driver perception in various geometric and environmental conditions using simulations [10].

2. Literature Review

2.1 Road Geometry Planning

Roads are a component of the infrastructure that was constructed to increase a region's potential for use by acting as facilities to support the transportation of people and goods. The road geometry is part of the planning which emphasizes more on the plan of the physical form of the road so that it can fulfill the essential functions of the road, which is to provide optimal service for operating traffic activities because the objective of transport road geometry planning [11]. Road classification is also one of the important factors to consider when designing a road because it determines the design standard to be used. The purpose of geometric road planning is to fulfill the essential function of road to provide services of the movement of traffic flows is an optimum manner [12]. The impact on safety is an

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

important consideration that designers must consider when combining the limiting values of various design elements and under various circumstances.

Road segments that intersect form a transportation network, which is one of the key elements in the sustainable development of an area, so good effectiveness is required in the operation of the network system. Road sections are an important factor in determining the level of driving safety. Results indicate that in road segments there is an increase in the number of harsh events if average traffic flow per lane increases in the respective areas [13]. This indicates the need to compare projected population growth with vehicle growth when determining road sections and to review vehicle traffic statistics. Traffic engineering must also be taken into consideration when deciding on road segments, especially around intersections.

In order to maximize the benefits of road construction by offering effective and efficient services, geometric planning for roads should be physical form-focused. The security of other road users must also be considered in road design. Decisions that affect road user safety and feed into the design and operation of the road network: standards, orders, laws, policies, campaigns, countermeasures [14]. Regulations and policies are crucial for giving road designers a clear direction. If everything, starting with the safety aspects of other road users, road functions, traffic analysis, etc., is carefully considered, planning the geometry of the road ultimately becomes good at all.

2.2 Horizontal Alignment

The road alignment, both vertically and horizontally, is the most important factor in road planning in order for it to be used effectively and efficiently, as well as an important factors in driving safety. Horizontal alignment, also known as road alignment, is the projection of the road's axis on a horizontal plane composed of straight lines connected by a curve. The design of horizontal alignment requires the determination of the minimum curve radius and the length of the curve, as well as the calculation of the horizontal offset from the tangent to the curve to facilitate the placement of the curve in the field [15]. The curved line can be a combination of circular arcs and transitional arcs, or a combination of each arc while keeping the desired design speed in mind. Sharp Curve are only permitted on functional, low-speed roads by the standard horizontal alignment geometry. Furthermore, a low curve radius was considered the riskiest deficiency related to the road alignment (Papadimitriou et al., 2019), but also lane width, shoulder width, and horizontal alignment (degrees of turn per km) were related to an increase in road risk rate (Zia et al., 2019) [16].

The design of a horizontal alignment is influenced by many factors, including the terrain’s functional classification, the design's speed, the traffic volume, the right of way, environmental conditions, and the level of service required [17]. Furthermore, driver safety is the most important value to consider when designing a road alignment. These factors become significant considerations when determining whether a horizontal alignment design is effective and efficient. It is possible to ensure that the community's benefits are maximized if all of these factors are properly connected to one another.

In Indonesia, the rules of the Directorate General of Highways concerning Road Geometry Design Guidelines (PDGJ) are generally used in planning the design of horizontal alignment of roads. As much as possible, the horizontal alignment design is straight with a large bend radius in order to avoid using a repetitive or similar-looking road shape. This will prevent road fatigue and boredom among drivers. Therefore, it is a crucial to research how to optimize the horizontal alignment of the road because this can effectively improve the safety and economy of the designed horizontal alignment [18].

2.3 Manual Road Design

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

Manual road design is still commonly used in Indonesia because the use of 3D applications in construction circumstances is not yet widespread, particularly in remote areas. Manual method that contains design criteria that must be met to obtain a geometric road design that meets its primary purpose, namely safety [19]. To support this manual design, a geological survey is required to maximize the results and minimize design errors during the construction period, though this extends the design process even further.

Indonesia already has a standard for manual road design, known as MKJI 1997, that allows users to estimate the traffic behaviour of a facility under certain traffic conditions, geometry, and surroundings. Manual design generally applies the AutoCAD®2D application in alongside ArcGIS to determine the topographical conditions of the road alignment plan. In this case, the use of AutoCAD 2D makes it easier to visualize of planning geometric elements in the form of working drawings [20]. The results of this design include the longitudinal and cross sections of the road and its auxiliary structures, as well as the anticipated amount of excavation or embankment.

There are guidelines for designing roads in other nations besides just Indonesia. In comparison, the United States uses AASHTO, while Japan uses JRA. The consideration of these guidelines is of course adjusted to the natural and cultural conditions of each region in driving. Therefore, each guide are made to produce products that are accurate in design, meet needs and technical rules, and can be applied in physical execution in the field [21].

3. Method

This study occupies literature to obtain and process data by identifying and processing written reports sourced from the technical implementing unit for the construction of this new road design. The proposed relocation road design will be located in Munjul District, Padeglang Regency, Banten Province.

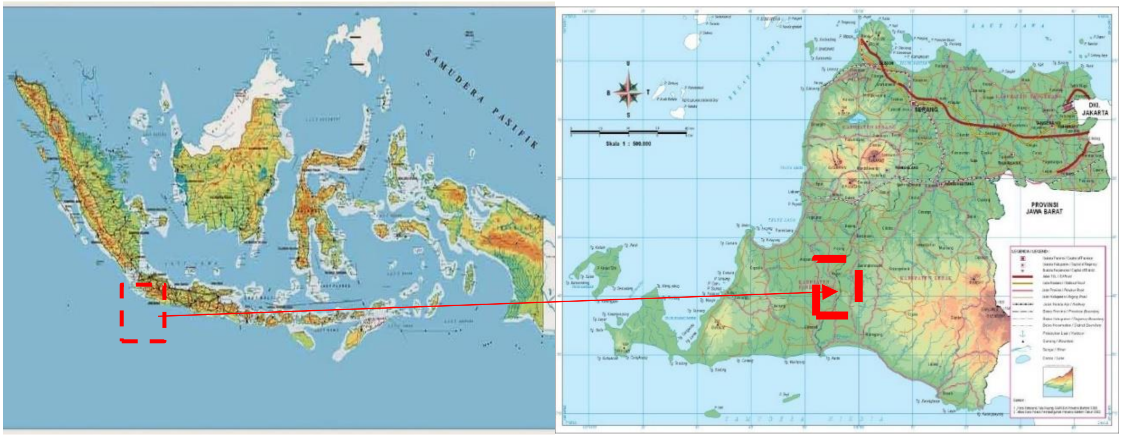

Figure 1 Location of the Study

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

Figure 2 Road Trace Planning Location

The planning process begins with identifying the starting and ending points for the road plan that will be laid out on the Google Earth Pro map. Then, create a complete road pattern using a horizontal curve layout [22] [23] [24] [25] [26]. Next, integrate the topographic map from the global mapper application into the road alignment plan. Finally, all horizontal alignment components are determined and poured into a longitudinal section in AutoCAD 2D.

4. Result and Discussion

According to the Directorate General of Highways' 2021 Road Geometric Guidelines, the Munjul Sindang Resmi Road is included in the local primary road network. The design requirements for this road design are part of the 4/2 UD type with a lane width of 3.5 m and estimation velocity of 100 km/h.

4.1 Horizontal Alignment Calculation

The first step in calculating horizontal alignment is to establish the coordinates of the road alignment plan. Each route is separated at each turn. The coordinate identification findings will be utilized to calculate the difference in azimuth angle values, providing the basis for constructing horizontal curves. The coordinate table and calculations are shown below.

Table 1 Coordinate of Horizontal Curve

Point	Coordinate	
	X	Y
Start	563.976	-717.163
1	1034.069	-443.360
2	1714.773	-434.597
3	2240.886	-318.623
Finish	2753.922	-572.924

a. Coordinate Difference (Δx and Δy)

<u>Δx Coordinate x</u>

$$Start\ - x1 = 563.976 - 1034.069 = 470.093$$

$$\Delta x1 - x2 = 1034.069 - 1714.773 = 680.704$$

$$\Delta x2 - x3 = 1714.773 - 2240.886 = 526.113$$

$$\Delta x3 - Finish = 2240.886 - 2753.922 = 513.036$$

<u>Δy Coordinate y</u>

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

$$Start - y1 = -717.163 - (-443.360) = 273.803$$

$$\Delta y1 - y2 = -443.360 - (-434.597) = 8.763$$

$$\Delta y2 - y3 = -434.597 - (-318.623) = 115.974$$

$$\Delta y4 - B = -318.623 - (-572.924) = 254.301$$

b. Length Before The Curve (D)

$$D = \sqrt{(\Delta x)^2 + (\Delta y)^2}$$

$$D(S-1) = \sqrt{470.093^2 + 273.803^2} = 544.018\, m$$

$$D(1-2) = \sqrt{680.704^2 + 8.763^2} = 680.760\, m$$

$$D(2-3) = \sqrt{526.113^2 + 115.974^2} = 538.744\, m$$

$$D(3-F) = \sqrt{513.036^2 + 254.301^2} = 572.604\, m$$

c. Azimuth Angle Calculation (Z)

$$Z = Arc\ tg\frac{\Delta x}{\Delta y}$$

$$Z(S-1) = Arc\ tg\ \frac{470.093}{273.803} = 59.782°$$

$$Z(1-2) = Arc\ tg\ \frac{680.704}{8.763} = 89.262°$$

$$Z(2-3) = Arc\ tg\ \frac{526.113}{115.974} = 77.569°$$

$$Z(3-F) = Arc\ tg\frac{513.036}{254.301} = 116.367°$$

d. Delta Angle Calculation (Δ)

$$\Delta A - 1 = 59.782° - 89.262° = 29.481°$$

$$\Delta 1 - 2 = 89.262° - 77.569° = 11.694°$$

$$\Delta 2 - 3 = 77.569° - 116.367° = 38.798°$$

The resume results from calculating the coordinates to get azimuth angle, delta angle, and arc type determination.

Table 2. Calculating Horizontal Arch Planning

Point	Coordinates		Different Coordinates		Distance (m)	Azimuth	Δ	type
	X	Y	ΔX	ΔY				
Start	563.976	-717.163						
			470.093	273.803	544.018	59,782		
1	1034.069	-443.360					29,481	SCS
			680.704	8.763	680.760	89,262		

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

Point	Coordinates		Different Coordinates		Distance (m)	Azimuth	Δ	type
	X	Y	ΔX	ΔY				
2	1714.773	-434.597					11,694	FC
			526.113	115.974	538.744	77,569		
3	2240.886	-318.623					38,798	SCS
			513.036	254.301	572.604	116,367		
Finish	2753.922	-572.924						

4.2 Curve Calculation

Curve calculations are based on the results of the previous section's horizontal alignment calculations. The results of this curve calculation will include the curve's type, length, and stationing on all road alignments. The procedure for calculating the curve is shown below.

a. **Turn 1 (Spiral Circle Spiral)**

Δ = 29.481°

V_{plan} = 100 km/hour

1) **Calculation of Minimum Radius (Rmin) and Planned Radius (Rc)**

R_{min} = 350 m; Rc = 480 m

2) **Calculation of the Degree of Curve (D) and Super Elevation (e)**

a) $D = \frac{1432,4}{Rc} = \frac{1432.4}{480} = 2.984°$

b) $Dmax = \frac{1432,4}{Rmin} = \frac{1432.4}{350} = 4.093°$

c) $e = \frac{e\ max\ x\ D}{Dmax}\left(2 - \frac{D}{Dmax}\right)$

$= \frac{0.1\ x 2.984}{4.093}\left(2 - \frac{2.984}{4.093}\right) = 0.092665 = 9.266\%$

3) **Calculation of Transition Curve (Ls)**

a) Based on Relative Slope

$$B = \frac{1}{2}\ x\ pavement\ width = \frac{1}{2} x\ 7 = 3.5\ m$$

$$m = \frac{1}{relative\ slope} = \frac{1}{1:240} = 240$$

Obtained based on the following table:

Table 3 Correlation between velocity plan and relative ramps

Velocity Plan (km/h)	Relative Ramps
60	1:160
80	1:200
100	1:240
120	1:280

$Ls_{min} = B\ x\ m(e + en) = 3.5\ x\ 240(0.092265 + 0.02) = 189.2771\ m$

b) Based on Centrifugal Force

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

$$Ls\ min = 0.022\ x\ \frac{Vplan^3}{Rc\ x\ c} - 2.727\ x\ \frac{Vplan\ x\ e}{c}$$

$$= 0.022\ x\ \frac{100^3}{480\ x\ 0.4} - 2{,}727\ x\ \frac{100\ x\ 0.092265}{0.4} = 51.409\ m$$

c) Based on travel time

$$Ls = \frac{Vplan}{3.6}\ x\ T = \frac{100}{3.6}\ x\ 3 = 83.33\ m$$

According to 3 calculation results presented above, the largest value 189.2771 m ≈ 190 m is chosen.

4) Calculation of θs and Δc

$$\theta s = \frac{28.648\ x\ Ls}{Rc} = \frac{28.648\ x\ 190}{480} = 11.33983°$$

$$\Delta c = \Delta - 2\theta s = 29.48084° - (2x11.33983°) = 6.801177°$$

5) Calculation of Main Curve Length (Lc)

$$Lc = \frac{\Delta c}{360}\ x\ 2\pi\ x\ Rc = \frac{6.801177°}{360}\ x\ 2\pi\ x\ 480 = 56.97741\ m$$

6) Calculation of Total Curve Length (L)

$$L = Lc + 2Ls = 56.97741 + 2(190) = 169.8036\ m$$

a) Define Xc

$$Xc = Ls - \frac{Ls^5}{40\ x\ Rc^2\ x\ Ls^2}$$

$$= 190 - \frac{190^5}{40\ x\ 480\ x\ 190^2} = 189.256\ m$$

b) Determine Yc

$$Yc = \frac{Ls^3}{6\ x\ Rc\ x\ Ls} = \frac{190^3}{6\ x\ 480\ x\ 190} = 12.534\ m$$

c) Determine P

$$P = Yc - Rc(1 - cos\theta s)$$

$$= 12.534 - 480(1 - cos11.33983°) = 3.1643\ m$$

d) Determine k

$$k = Xc - Rc\ sin\theta s = 189.256 - 480(sin11.33983°) = 94.8744\ m$$

e) Determine Ts

$$Ts = (Rc + P)tan\frac{\Delta}{2} + k$$

$$= (480 + 3.1643\ )tan\frac{29.48084415°}{2} + 94.8744 = 221.9945\ m$$

f) Determine Es

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

$$Es = \frac{Rc + P}{\cos \frac{\Delta}{2}} - Rc$$

$$= \frac{480 + 3{,}1643}{\cos \frac{29.48084415°}{2}} - 480 = 19.6070813\ m$$

b. Turn 2 (Full Circle)

Δ = 11.69364387°

V_{plan} = 100 km/hour

R_c = 1,600m

1) Calculation of the minimum radius (Rmin)

Table 4 Correlation between Full Circle Curve Minimum Radius and District Plan Velocity

District Plan Velocity (km/h)	Minimum Radius (M)
120	2000
100	1500
80	1100
60	800
40	300
30	180

The minimum radius for district road with 100 km/h estimate velocity is 1500 m.

2) Calculation Degree of Curve (D) and Super Elevation (e)

a) D $= \frac{1{,}432.4}{Rc} = \frac{1{,}432.4}{1600} = 0.895$

b) D_{max} $= \frac{1{,}432.4}{Rmin} = \frac{1{,}432.4}{1500} = 0.955$

c) e $= \frac{e\ max\ x\ D}{Dmax}\left(2 - \frac{D}{Dmaks}\right)$

$= \frac{0.1\ x\ 0{,}895}{0{,}955}\left(2 - \frac{0{,}895}{0{,}955}\right) = 0.0996 = 9.961\%$

3) Calculation of Transition Curve (Ls)

$a)\ B = \frac{1}{2}\ x\ pavement\ width = \frac{1}{2} x\ 7 = 3.5$

$b)\ m = \frac{1}{relative\ slope} = \frac{1}{1:240} = 240$

Obtained based on the following table:

Speed Plan (km/h)	Relative Ramps
60	1:160
80	1:200
100	1:240
120	1:280

$Ls_{imaginary} = B\ x\ m(e + en)$

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

$$= 7\ x\ 240(0.0996 + 0.02) = 200.994\ m$$

4) **Calculation of the start line of curve (TC), distance of PI to curve (Ec), and Curve Length (Lc)**

a) $\text{TC} = Rc\ x\ \left(tan\frac{\Delta}{2}\right)$

$\text{TC} = 1600\ x\ \left(tan\frac{11.69364387°}{2}\right) = 163.8432\ m$

b) $Ec = \frac{Rc}{cos\frac{\Delta}{2}} - Rc = \frac{1600}{COS\frac{11.69364387°}{2}} - 1600 = 8.367\ m$

c) $\text{Lc} = \frac{\Delta}{360}\ x\ 2\pi Rc = \frac{11.69364387°}{360}\ x\ 2\pi 1{,}600 = 326.680\ m$

c. Recapitulation and Stationing

After calculating the horizontal alignment and the curve, the total length of this road layout is 2.312 meters. This route has two Spiral-Circle-Spiral (SCS) curves and one Full Circle (FC) curve. The first SCS arch is 437 meters long, while the second is 529 meters long. Meanwhile, the FC arch measures 326.68 meters long. All of the results of these calculations are then converted to a stationary form in order to identify the starting and ending points of each curve. The table and figure below show a recapitulation of road alignment stations and the final results of alignment drawings using AutoCAD 2D.

Table 5 Recapitulation of Length and Stations of Road Horizontal Alignment

Point	Length (m)	Cumulative Distance (m)	STA	Information
Start			0+000	Start Point
	322.023	322.023		
TS			0+322.023	Start of Curve 1 (SCS)
	190	512.023		Ls
SC			0+512.023	
	56.977	569.001		Lc
CS			0+569.001	
	190	759.001		Ls
ST			0+759.001	End of Curve 1(SCS)
	294.922	1053.923		
TC			1+053.923	Start of Curve 2 (FC)
	326.68	1380.602		Lc
CT			1+380.602	End of Curve 2 (FC)
	102.88	1483.483		
TS			1+483.483	Start of Curve 3 (SCS)
	190	1673.483		Ls
SC			1+673.483	
	148.574	1822.057		Lc
CS			1+822.057	
	190.00	2012.057		Ls
ST			2+012.057	End of Curve 3 (SCS)
	300.583	2312.640		

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

Point	Length (m)	Cumulative Distance (m)	STA	Information
Finish			2+312.640	End Point

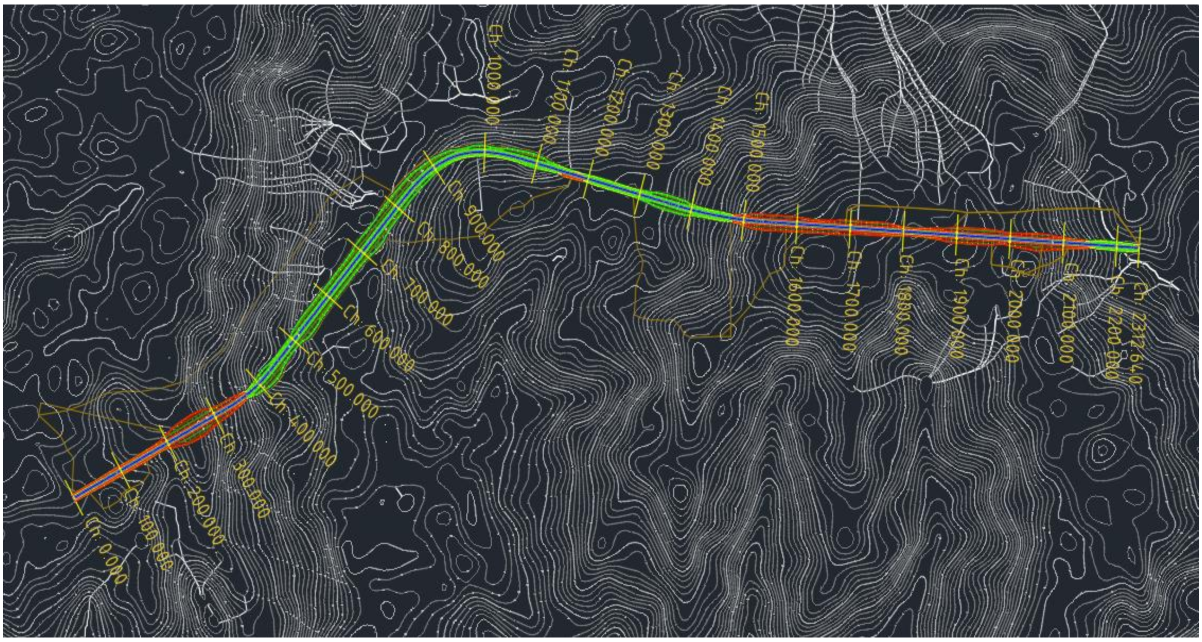

Figure 3 Road Alignment Result by AutoCAD®2D

5. Conclusion

The Mujul-Sukaresmi connecting road was designed using the 4/2 UD design criterion, with a total road width of 7 meters and a design speed of 100 Km/h. This route is 2,312 meters long and consist with 3 curves, there are 2 Spiral – Circle – Spiral (SCS) curves and 1 Full Circle curve. The first SCS curve is 437 meters long, while the second is 529 meters long, with the same radius of 480 meters. The FC arch is 326.68 meters long with a radius of 1,600 meters. This road planning still requires a feasibility study to examine the economic benefit that can be obtained, as well as vertical alignment calculations to determine the effectiveness of the intended amount of excavation and embankment.

Bibliography

[1] C. B. Azolibe and J. J. Okonkwo, "Infrastructure Development and Industrial Sector Productivity in Sub-Saharan Africa," *Journal of Economics Development Vol. 22 No. 1,* pp. 91-109, 2020.

[2] S. Salsabila, A. I. Rifai and M. Taufik, "HE GEOMETRIC DESIGN OF HORIZONTAL CURVES USING THE AUTOCAD CIVIL 3D®METHOD: A CASE STUDY OF TRANS FLORES ROADS," *Indonesian Journal of Multidisciplinary Science Vol. 1,* pp. 251-264, 2022.

[3] I. G. A. Andani, K. Geurs and L. L. P. Puello, "Effects of Toll Road Construction on Local Road Projects in Indonesia," *The Jurnal of Transport and Land Use Vol. 12 No. 1,* pp. 179-199, 2013.

[4] S. H. Maulana, A. Rifai and M. Isradi, "The Horizontal Curved Geometric Redesign on Jalan Kayu Api Kuala Penaso, Riau Using The AutoCAD CIVIL 3D Method," *Indonesian Journal of Multidisciplinary Science,* pp. 318-330, 2023.

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

[5] Kismartini and B. Pujiyono, "COLLABORATIVE MANAGEMENT MODEL TANJUNG LESUNG TOURISM IN PANDEGLANG DISTRICT, BANTEN PROVINCE, INDONESIA," *GeoJornal of Tourism and Geosites, Vol. 30 No.2 ,* pp. 868-874, 2020.

[6] B. Surya, D. N. Annisa, H. H. Sakti and H. Sahban, "Land Use Change, Spatial Interaction, and Sustainable Development in The Metropolitan Urban Areas, South Sulawesi Province, Indonesia," *MDPI Journal, Land 9 No.3,* pp. 95-138, 2020.

[7] D. Desmawan and R. Syaifudin, "Economic and business field development at Economic Regional of Pandeglang," *Management Science Resarch Journal, Vol. 1, Issue-1,* pp. 82-94, 2022.

[8] O. Wulandono, E. Rustiadi and M. Ardiansyah, "Spatial Interaction Based on Sub-District Development Index in Pandeglang Regency," *Economics Development Analysis Journal, 10(1),* pp. 1-11, 2021.

[9] Y. L. Pei, Y. M. He, B. Ran, J. Kang and Y. T. Song, "Horizontal Alignment Security Design Theory and Application of Superhighways," *Sustainability 12 No. 6,* p. 2222, 2020.

[10] R. B. Nugraha, A. I. Rifai and A. Fajarika, "The Geometric Design of Horizontal Alignment: A Case of Bojonggede - Kemang Area Route, West Java," *Indnesian Journal of Multidisciplinary Science 1(1),* pp. 331-343, 2022.

[11] D. Yuniar, L. Djakfar, A. Wicaksono and A. Efendi, "Travel Time Optimization of Coal Hauling Based onf Special Road Topography and Environtment," *Journal of Green Engineering, Vo. 10, Issue-10,* pp. 9789-9800, 2020.

[12] D. S. Adiputra, A. I. Rifai and S. K. Bhakti, "Design of Road Geometric with AutoCAD 2D: A Case Wirosari - Ungaran Semaranag, Indonesia," *Jurnal Ilmiah Multidisiplin Indnoesia Vol. 2 No. 5,* pp. 729-738, 2022.

[13] V. Petraki, A. Ziakopoulos and G. Yannis, "Combined Impact of Road and Traffic Characteristic on Driver Behavior Using Smartphone Sensor Data," *Accident Analysis & Prevention Vol. 144,* p. 105657, 2020.

[14] E. Hauer, "On the relationship between road safety research and the practice of road design and operation," *Accident Analysis & Prevention,* pp. 114-131, 2019.

[15] A. Megarestya, A. I. Rifai and M. Isradi, "THE HORIZONTAL CURVED GEOMETRIC DESIGN WITH AUTOCAD CIVIL 3D®ON JALAN MUARA WAHAU, EAST KALIMANTAN," *Indonesian Journal of Multidisciplinary Science, Vol. 1, Issue No. 1,* pp. 237-250, 2022.

[16] P. M. Bobermin, M. M. Silva and S. Ferreira, "Driving simulators to evaluate road geometric design effects on driver behaviour: A systematic review," *Accident Analysis & Prevention Vol. 150,* p. 105923, 2021.

[17] I. Pangesti, A. I. Rifai and J. Prasetijo, "THE HORIZONTAL CURVED GEOMETRIC PLANNING USING THE AUTOCAD CIVIL 3D®METHOD ON TANAH MERAH ROAD, BANJARBARU CITY, SOUTH KALIMANTAN," *Indonesian Journal of Multidisciplinary Science Vol.1, Issue No. 1,* pp. 265-279, 2022.

[18] R. Y. Gunawan, A. I. Rifai and M. A. Irianto, "AutoCAD®2DforGeometricDesignofTerbanggiBesar–PematangPanggangHighway(Sta.28+650–Sta.53+650," *CITIZEN: Jurnal Ilmiah Multidisiplin Indonesia, Vol. 2, No.5,* pp. 757-765, 2022.

[19] I. R. Andito, A. I. Rifai and A. Fajarika, "THE DESIGN OF ALIGNMENT HORIZONTAL USING INDONESIA HIGHWAY DESIGN STANDARD: A CASE OF JALAN BABAT –TAPEN, EAST JAVA," *Indonesian Journal of Multidiscpilnary Science, Vol. 1, No. 1,* pp. 199-210, 2022.

[20] S. N. Nurjannah, A. I. Rifai and A. Fajarika, "Geometric Design for Relocation of National Road Sei Duri-Mempawah Section, West Kalimantan using AutoCAD®2D," *CITIZEN: Jurnal Ilmiah Multidisiplin Indonesia, Vol. 2, No. 5,* pp. 692-702, 2022.

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8300

[21] M. R. Farid, A. I. Rifai and M. Taufik, "THE ALIGNMENT HORIZONTAL DESIGN OF ALTERNATIVE ROAD: A CASE OF JALAN SUBANG –CIKAMURANG, WEST JAVA," *Indonesian Journal of Multidiscplinary Science, Vol 1, No. 1,* pp. 344-356, 2023.

[22] S. Suganda, A. I. Rifai and J. Prasetijo, "The Route Choice Analysis of Parung-Sentul Traveler: A Case of Impact New Toll Road Operation," *Indonesian Journal of Multidisciplinary Science,* vol. 1, no. 1, pp. 427-436, 2022.

[23] R. Pramono, A. I. Rifai and S. Handayani, "The Student Perception of public transportation mode choice: A case study of Universitas Mercubuana," *Citizen: Jurnal Ilmiah Multidisiplin Indonesia,* vol. 1, no. 1, pp. 934-943, 2022.

[24] A. W. Rahmadhani, A. I. Rifai and S. Handayani, "The Perception of Travel Behavior on Public Transport Mode Choice: A Case of Depok-Jakarta Route," *Citizen: Jurnal Ilmiah Multidisiplin Indonesia,* vol. 2, no. 5, pp. 896-905, 2022.

[25] A. Setiawan, A. I. Rifai and J. Prasetijo, "The Phenomena of Local Public Transportation Service: A Case Oplet in Pontianak, Indonesia," *Citizen: Jurnal Ilmiah Multidisiplin Indonesia,* vol. 2, no. 5, pp. 916-923, 2022.

[26] I. Prasetyo and A. I. Rifai, "Railway Planning Double-Double Track (Case Study of Bekasi Station km 26+ 652-Jatinegara Station km 12+ 050)," *International Journal of Transportation and Infrastructure,* vol. 4, no. 1, pp. 12-21, 2020.

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB