

GEOMETRIC PLANNING AND THICK PAVEMENT ON ALTERNATIVE ROAD KM 171 TANAH BUMBU REGENCY

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ABSTRACT

Road Geometric Planning is planning the overall road trase along with its alignment. AASHTO and Highways are the two geometric road planning standards to be used. Satui STA Ring Road 0+000-2+245 was chosen in this planning because it is a new alternative road from KM 171 Road which has been damaged due to mining activities. The speed of the road plan is 60 km / h with flat road terrain conditions. The purpose of this study is to assess whether the existing horizontal infrastructure plan meets the standards of Highways. This research will also provide alternative designs of horizontal and vertical alignments with the help of Autocad Civil 3D 2022 software and plan the design of thick pavements.

For geometric planning the road uses AASHTO 2011 standards, but for the study criteria used is Highways 2021. Meanwhile, for thick pavement planning using MDP 2017 regulations. In this study, data collection was carried out in the form of Literature Studies, Primary Data and Secondary Data.

Based on the results of the analysis, there were 12 bends in the horizontal alignment reviewed and 9 bends that did not meet the requirements for horizontal alignment planning. The alternative design provided produces a trase of 2+253 km with a horizontal alignment of 10 bends with *Full Circle* (FC) and *Spiral-Circle-Spiral* (S-C-S) bend types, as well as 44 vertical alignments consisting of 26 concave and 18 convex arches. Analysis of the results of the calculation of road pavement thickness with MDP 2017 guidelines, namely AC-WC = 40 mm, AC-BC = 60 mm, AC-Base = 160 mm, and LPA = 300 mm.

Keywords: Road Geometrics, AutoCAD Civil 3D 2022, Build Marga, Road Violence

1. INTRODUCTION

Indonesia is a country with a significant mining sector and faces serious problems related to road damage due to mining activities. Mining activities such as drilling, quarrying, and transporting raw materials significantly affect the structure and quality of roads. Roads located near mining sites often suffer serious damage in a short period of time, causing high maintenance costs for local governments and disturbing the mobility of local residents. Road damage due to mining activities is not only a technical problem, but also has significant social and economic impacts.

The selection of the location for taking the Final Project in the Satui District, Tanah Bumbu Regency on the KM 171 national road which is the location of a landslide due to mining activities near the location, this resulted in the entire road body collapsing so that the national road broke off and disrupted transportation activities. To restore community access, a temporary alternative road was built that could be passed by four-wheeled vehicles or empty trucks from the direction of Banjarmasin.

This research was conducted to obtain geometric results using the 2021 Highways standard with the help of AutoCAD Civil 3D 2022 software for the design of alinyemen and thick design of road pavements using the 2017 Road Pavement Design Manual method.

2. THEORETICAL STUDY

Geometric Design Guidelines 2021

The parameters for road geometric planning refer to Road Geometric Design Guideline No.13/P/BM/2021. Several planning criteria are determined in advance, such as the planned location, the road trase to be planned, the road function classification, the terrain class classification, the plan vehicle, the road parameters, and the speed of the plan.

AutoCAD Civil 3D

Geometric calculations of roads using AutoCAD Civil 3D software, especially horizontal and vertical calculations of infrastructure, are very interesting compared to the results of manual calculations using the Highways reference standard. This includes the results of geometric line planning calculations using AutoCAD Civil 3D and manual calculations, identifying tools and processing steps in AutoCAD Civil 3D software and providing some adjustments to software calculations. The advantage of AutoCAD Civil 3D is that it is used as an effective geometric road planning solution and saves time, cost and resources (Elsa Eka Putri, 2021)

Road Pavement Design Manual 2017

The planning method used in the 2017 Pavement Design Manual is an empirical mechanical method currently widely used in many developing countries. With this method, pavement structure analysis is carried out using mechanical principles, the results of these principles are used to predict structural performance based on empirical experience (Bina Marga, 2017).

3. METHOD

This geometric and thick pavement planning is located on Alternative Road KM 171 Tanah Bumbu Regency, South Kalimantan Province with a planned road length of 2,245 km which is an alternative road as a replacement road or complement to road routes damaged by mining activities.

Geometric and thick pavement planning uses secondary data from related agencies/organizations and primary data obtained directly in the field through direct surveys at the location of the KM 171 alternative road section in Tanah Bumbu Regency. The flow chart used in this study is seen in Figure 3.1-3.2.

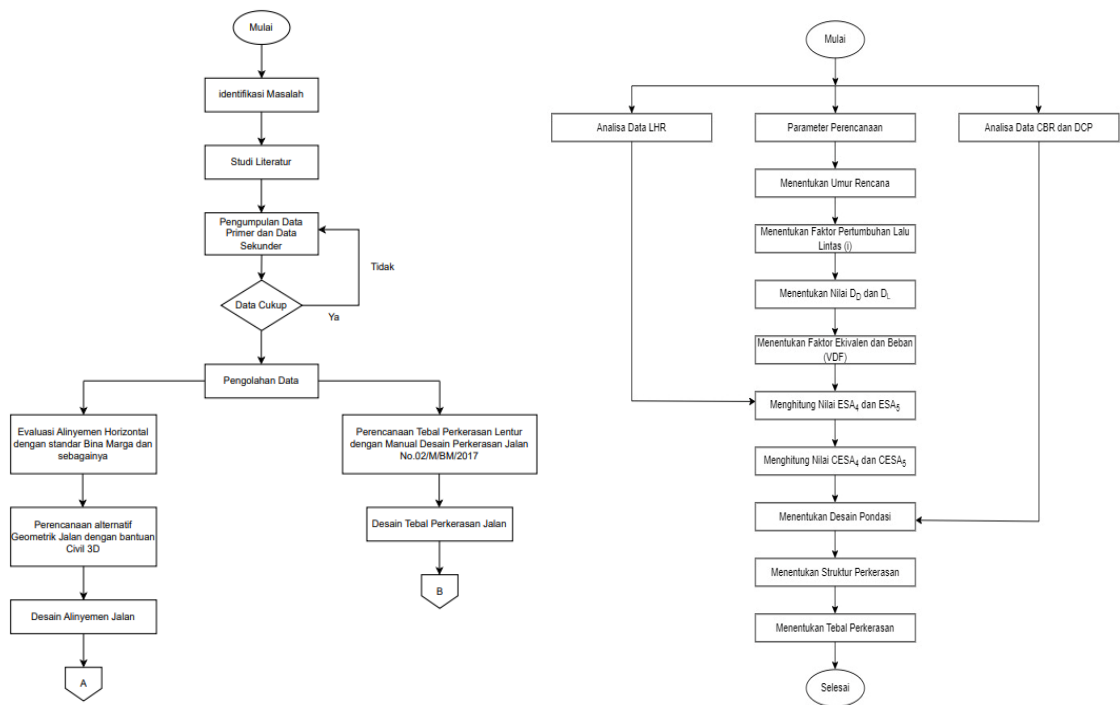


Figure 3.1 Pavement Thick Planning Flow Chart

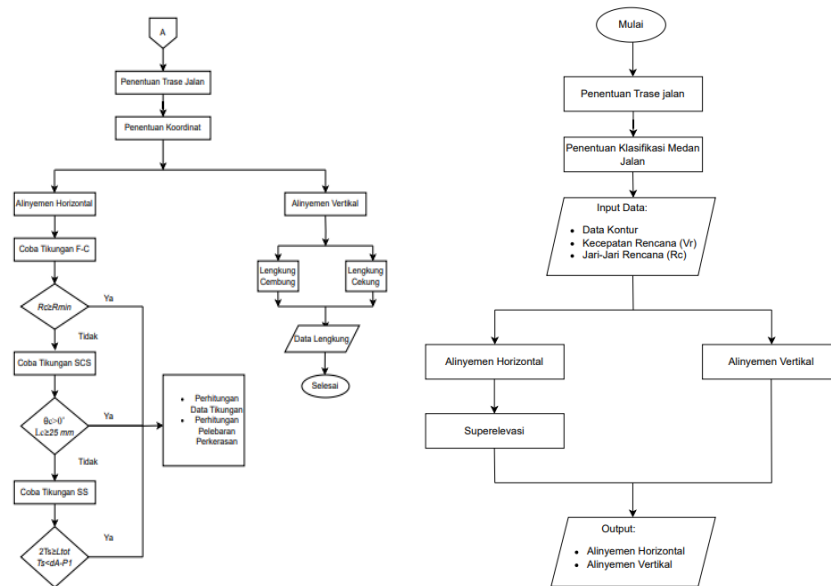


Figure 3.2 Road Geometric Planning Flow Chart

4. RESULTS AND DISCUSSION

1) Horizontal Alignment Evaluation Results

Based on data from planning consultants, there are 12 bends on the Satui Ring Road, Tanah Bumbu STA Regency 0+000-2+245 Km. Horizontal alignment evaluation based on the 2021 Highways standard found 9 inappropriate bends. The evaluation results are shown in Table 4.1.

Table 4.1 Horizontal Alignment Results of Consultant Results and Results After Evaluation

Perbandingan Alinyemen Horizontal						
STA	No	Alinyemen Horizontal Konsultan			Alinyemen Horizontal Konsultan Setelah Dievaluasi	
		Jenis Tikungan	Vr (Km/Jam)	R(m)	Jenis Tikungan	Vr (Km/Jam) R(m)
0+127.771	1	SCS	60	125	SCS	60 125
0+276.101	2	FC	60	125	FC	30 200
0+439.888	3	FC	60	150	FC	30 150
0+547.946	4	FC	60	300	SCS	60 300
0+650.097	5	FC	60	275	SCS	60 275
0+834.762	6	SCS	60	125	SCS	60 125
0+930.183	7	FC	60	125	SCS	40 125
1+069.406	8	FC	60	125	FC	30 200
1+336.597	9	FC	60	125	SCS	40 125
1+637.685	10	FC	60	125	SCS	60 125
1+885.659	11	FC	60	200	FC	30 125
2+073.512	12	SCS	60	125	SCS	60 125

Source: Calculation Results

2) Alinyemen Alternative Results

In this planning, AutoCAD Civil 3D 2022 software is used. The results obtained are Horizontal Road Trase and Vertical Instrument. The results of measuring the planned distance in the field as far as 2+240 km, then a depiction of the plan's road trase was carried out, there was a change in the planned distance to 2+252.61 km because there were several bends that were eliminated.



Figure 4.1 Display of Horizontal Alignment Results with the Help of AutoCAD Civil 3D

Based on the picture above, there are 10 bends with FC and SCS types. The data from making bend curves is as follows.

Table 4.2 Alternative Horizontal Alignment Data Recaps

STA	X	Y	Jenis Tik.	Vr (Km/Jam)	R (m)	e (%)	Ls (m)	Lc (m)	Tc (m)	Ec	Ts (m)	Es	Δ
0+000	325,315.1	9,583,984.3											17°46'29"
0+161.32	325,274.8	9,584,140.3	SCS	40	150	8	33	162.9	-	-	131.9	39.5	75°38'23"
0+337.47	325,403.0	9,584,274.8	FC	40	270	8	-	224.9	121.9	28.1	-	-	52°21'35"
0+479.91	325,517.0	9,584,360.2	FC	40	250	8	-	196.2	103.6	19.2	-	-	42°30'38"
0+625.01	325,623.4	9,584,460.7	FC	40	270	8	-	268.2	150.2	41.7	-	-	62°12'46"
0+854.51	325,846.4	9,584,522.6	FC	40	250	8	-	378.4	230.6	85.1	-	-	81°10'28"
1+064.19	326,055.3	9,584,497.3	FC	40	150	8	-	341.7	206.1	73.9	-	-	79°30'22"
1+300.08	326,285.2	9,584,439.3	SCS	40	125	8	33	136.6	-	-	112.4	28.2	65°45'08"
1+600.49	326,562.7	9,584,553.3	SCS	40	250	8	33	263.2	-	-	200.1	71.6	85°50'11"
1+760.17	326,722.3	9,584,567.0	FC	40	250	8	-	311.4	181.6	59.0	-	-	72°47'57"
2+031.42	326,982.1	9,584,478.3	SCS	40	150	8	33	84.4	-	-	78.9	12.7	45°44'16"
2+252.83	327,050.5	9,584,264.7											15°43'31"

Source: Calculation Results

To get a safe and comfortable geometric design, it is necessary to redesign the road geometrically according to Highways standards and with the help of AutoCAD Civil 3D. The results of the alternative design can be seen in Figure 4.1 obtained as many as 10

corners consisting of 4 SCS corners and 6 FC corners with a planned corner speed of 40 km / hour.

The process of depicting the longitudinal cross section is carried out according to the existing contours. The convenience obtained is to make a trase or road alignment on the contour map, then an elongated profile will automatically form with the condition that the contour map must be able to identify its planimetric position and elevation.

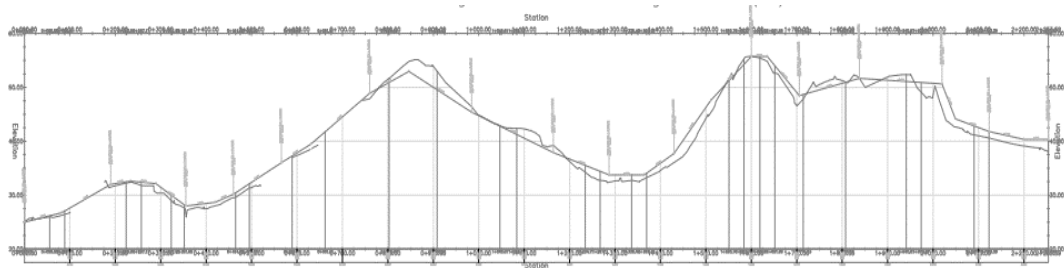


Figure 4.2 Vertical Alinyemen Design

In Figure 4.2 there are 26 concave arches and 18 convex arches obtained from the results of planning design using Civil 3D for the parameters used taken from the 2017 Bina Marga reference.

3) Pavement Thickness Results

The planned life in this plan is 20 years, calculated based on the thickness planning age by taking into account the pavement components presented in the 2017 MDP method. Determination of the value of the lane distribution coefficient can be using Table 4.3. The value of the lane distribution factor (DL) is obtained at 80% for the number of 2-way lanes. Before determining CESA₅, the first thing to do is to determine the value of the annual traffic growth rate (i) so that the traffic growth multiplier (R) is obtained.

a. Traffic Growth Rate Calculation (i)

Traffic growth factors are based on historical growth data or formulas that correlate with other valid growth factors. Annual traffic growth rate (i) 5.14% for Kalimantan region.

Table 4.3 Growth Factors

	Jawa	Sumatera	Kalimantan	Rata-rata Indonesia
Arteri dan perkotaan	4.8	4.83	5.14	4.75
Kolektor rural	3.50	3.50	3.50	3.50
Jalan desa	1.00	1.00	1.00	1.00

Source: 2017 Pavement Design Manual

b. Traffic growth calculation (R)

To calculate the growth of traffic in the planned period can be calculated as follows:

Traffic Growth Factor (I) Year 2025 – 2045 = 5.14%

$$R = \frac{(1 + 0.01(i))^{UR} - 1}{0.01(i)}$$

$$R_{(2023-2025)} = \frac{(1 + 0.01(5.14\%)^2 - 1)}{0.01(5.14\%)} = 2,001$$

$$R_{(2025-2045)} = \frac{(1 + 0.01(5.14\%)^{20} - 1)}{0.01(5.14\%)} = 20,098$$

c. Calculation of the plan's daily traffic value

Determining the ESA value is then calculated using the formula:

$$CESA = (\Sigma LHRJK \times VDFJK) \times 365 \times DD \times DL \times R$$

The calculation of the CESA5 value is obtained from the results of ESA5 data for each type of vehicle, the results are shown in Table 4.4.

Table 4.4 CESA Calculation Results

Jenis Kendaraan	LHR 2023	LHR 2025	VDF5 faktual	VDF5 normal	ESA5 (23-25)	ESA5 (25-45)
Gol. 5B	87	97	1	1	50,821.06	569,254.67
Gol. 6A	380	421	0.55	0.55	122,087.37	1,358,875.45
Gol. 6B	224	248	8.5	4.7	1,112,221.77	12,371,019.04
Gol. 7A	55	61	36	10.7	1,156,617.17	12,887,456.27
Gol. 7B	0	0	0	0	0.00	0.00
Gol. 7C	18	20	20.4	10.2	214,499.91	2,394,390.78
Jumlah ESA	764	847			2,656,247.28	29,580,996.22
CESA					32,237,243	

Source: Calculation Results

ESA calculation analysis (25-45) type of vehicle class 6A. Here are the steps:

$$ESA_{(25-45)} = (380 \times 0.55) \times 365 \times 1 \times 0.8 \times 20,098$$

$$ESA_{(25-45)} = 1,358,875.45$$

From the calculation of the 20-year ESA value of 29,580,996.22 is between >10-30 million because in this study it is planned to use bending pavement, obtained chart-3 and chart-3B. Since the use of CTB is not economical and difficult to implement, it is recommended to use a -3B design chart. Solutions from FFF6 are considered more practical than solutions from Design plan -3 in certain construction situations.

Therefore, the design results of asphalt bending pavement with grained foundation layers obtained bottom foundation layers and foundation layer types with AC-WC = 40 mm, AC-BC = 60 mm, AC-Base = 160 mm and class A Aggregate Foundation Layer = 300 mm. The planned thick pavement design is shown in Figure 4.3.

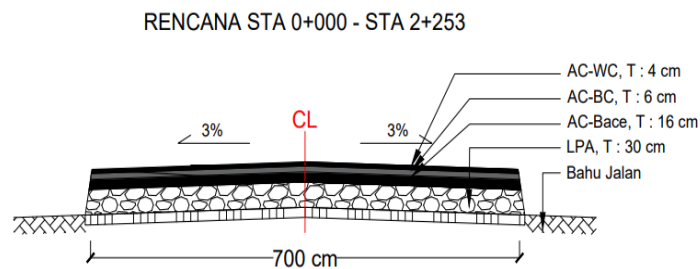


Figure 4.3 Typical Cross-Section Plans

5. CONCLUSION

The conclusion on this final project can be drawn as follows:

1. Based on the calculation of the 2021 Highways standard, of the 12 planned corners of the S-C-S and F-C types with a planned speed of 60 Km/H, there are 9 corners that do not meet the criteria for Highways. Re-planning the corners obtained a corner plan design consisting of 8 S-C-S corners and 4 F-C corners.
2. At the planning stage of geometric alternative design with the help of Autocad Civil 3D which includes planning the results of horizontal alignment with 10 bends type F-C and S-C-S with a planned speed at bends of 40 km/h. Meanwhile, in the vertical alignment planning, there were 44 arches consisting of 26 concave arches and 18 convex arches.
3. From the data obtained, namely LHR data from related agencies, the thickness of pavement that can be planned using the MDP 2017 method is AC-WC = 40 mm, AC-BC = 60 mm, AC-Base = 160 mm and Aggregate Foundation Layer class A = 300 mm.

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