CERUCUK
Volume 7 No. 7 2023 (363-372)

Geometric Evaluation of Roads on the Gunung Batu Road Section of Tapin Regency (STA 0 +000 – 1+451)

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ABSTRACT

Gunung Batu road section is a section of road located in Binuang District, Tapin Regency which is included in the classification of local roads with hilly terrain conditions. The speed of the road geometric plan is 40 km / h. The purpose of this study is to evaluate the existing horizontal arrangement plan whether it meets the 1997 Bina Marga standards and provide an alternative design for horizontal and vertical alinyemen assisted by Autocad Civil 3D 2018 software.

The method used is to follow the reference standards from AASHTO 2011, but for the study criteria using the 1997 Bina Marga standard. The data collection methods carried out in the preparation of this Final Project Report are Literature Studies, Primary Data and Sequence Data.

Based on the results of the analysis, it showed that the Horizontal Alinyemen at the location under review had 26 bends with the Full Circle type, there were 18 bends that did not meet the geometric planning requirements where the bends did not meet the R min value (minimum radius) requirements for the use of the Full Circle bend type according to the planned speed. The alternative design given produces a trase of 1+445.59 km, a Horizontal Alinyemen of 22 bends (FC), a Vertical Alinyemen of 21 Convex arches and 21 Concave Arches. Analysis of the calculation results of the Cut and Fill design was obtained: Cut = 8458.13 m^3 and Fill = 3286.62 m^3.

***Keywords**:* Geometric Roads, Autocad Civil 3D 2018

1. INTRODUCTION

Road geometric planning is a process that emphasizes the planning of the physical shape of the ground, concerning aspects such as width, bends, ramps, visibility and also the combination of the parts. The imbalance of the growth rate of road traffic with the planned growth of road users results in a wide variety of serious problems if not noticed early on. Geometric problems of corners (Horizontal Alinyemen) for example, the planning of corners that are not in line with the growth of vehicles can create new problems. The occurrence of accidents is often caused by the many geometric bends, due to visibility, bend radius, road slump that is not in accordance with the guidelines of the 1997 Bina Marga and so on, so it is necessary to re-evaluate extreme corners.

Although at this time the highway construction planners are already using software, but it cannot be completely accurate. Therefore, it is necessary to re-evaluate to find out whether the bend meets the 1997 Bina Marga standards.

Based on the background above, this final project was compiled with the title "Geometric Evaluation of Roads on the Gunung Batu Road Section of Tapin Regency (STA 0 + 000 – 1 + 451)".

2. THEORITICAL STUDY

2.1 Horizontal Alinyemen (Situation/Plan)

A horizontal alinyemen is a projection of the perpendicular axis of the road on the paper plane/horizontal/map. Horizontal alinyemen is a road trase consisting of a straight section and a curved part (Bend). The curved part (bend) is divided into 3 types, namely Full Circle (FC), Spiral-Circle-Spiral (SCS), and Spiral-Spiral (SS).

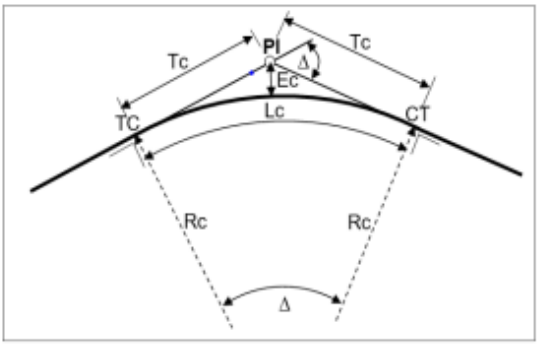

Figure 1. Full Circle Arch (Bina Marga, 1997)

In planning the bends of the Full Circle type, the equations that can be used are as follows:

$$Tc = Rc.\tan \frac{1}{2}\Delta \quad (1)$$

$$Ec = Tc.\tan \frac{1}{4}\Delta \quad (2)$$

$$Lc = \frac{\Delta.2.\pi.Rc}{360} \quad (3)$$

The requirement of the Full Circle type bend is e < 3% or p < 0.25 m.

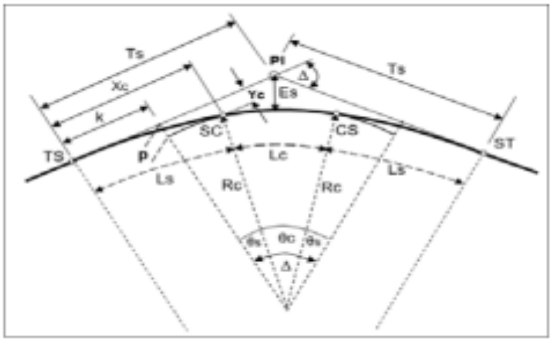

Figure 2. Spiral-Circle-Spiral Arch (Bina Marga, 1997)

Formula used:

$$Xc = Ls - \left(1 - \frac{Ls^3}{40Rc^2}\right) \quad (4)$$

$$Yc = \frac{Ls^2}{6\,Rc} \quad (5)$$

$$\Theta s = \frac{90}{\pi}\,\frac{Ls}{Rc} \quad (6)$$

$$p = \frac{Ls^2}{6\,Rc} - Rc\,(1 - \cos \Theta s) \quad (7)$$

$$k = Ls - \frac{Ls^3}{40\,Rc^2} - Rc \sin \Theta s \quad (8)$$

$$Ts = (Rc + p) \tan \frac{1}{2}\Delta + k \quad (9)$$

$$Es = (Rc + p) \sec \frac{1}{2}\Delta - Rc \quad (10)$$

$$Lc = \frac{(\Delta - 2\,\Theta s)}{180}\, x\, \pi\, x\, Rc \quad (11)$$

$$L_{total} = Lc + 2\,Ls \quad (12)$$

The conditions of the SCS type bend are:

$$L_{total} < 2.Ts \text{ atau } Lc \geq 20 \text{ m} \quad (13)$$

If Lc is obtained < 20 m, then it should not be used SCS type bends.

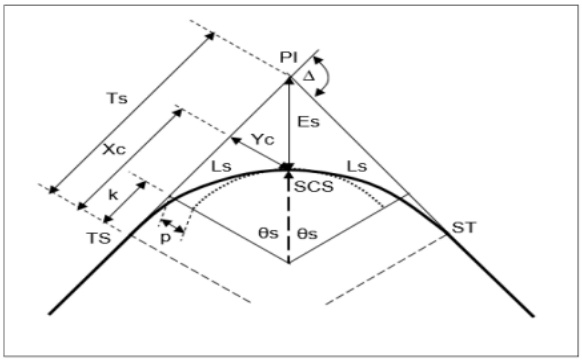

Figure 3. Spiral-Spiral Arch (Bina Marga, 1997)

The formula used is as follows:

$$Ls = \frac{\Theta s.\pi.Rc}{90} \quad (14)$$

p, k, Ts, and Es, can use formulas on the press. (7-10).

$$Lc = 0 \text{ and } \Theta s = 1/2\Delta \quad (15)$$

$$\text{Since } Lc = 0, \text{ then } L_{tot} = 2Ls \quad (16)$$

The condition of this type of bend is Ts > Ls. If obtained Ts > Ts, then it can be used.

2.2 Vertical Alinyemen

The vertical alinyemen consists of a landau section and a vertically curved part. Judging from the starting point of planning, the vertical ramp can be a positive ramp (climb), a negative ramp (descent) or a zero (flat) ramp. The vertical arch is divided into 2, namely the convex arch and the concave arch (TPGJAK, 1997).

2.3 AutoCAD Civil 3D

Sanra (2019) stated that AutoCAD Civil 3D is one of the software or computer programs that has many uses in the field of civil engineering, including to create road geometric planning schemes.

3. METHOD

The geometric evaluation of this road is located on Jalan Gunung Batu, Binuang District, Tapin Regency with a length of 1,451 km which is a local road class.

The data used in this study are primary data and secondary data obtained from related consultants. Primary data includes road geometric condition data while secondary data includes location/topographic maps, stationing coordinates data & bend coordinates and existing elevation data & plan elevation.

4. RESULTS AND DISCUSSION

4.1 Research Data

The data used in this road geometric research are primary data and secondary data obtained from related agencies. Primary data includes the Gunung Batu road section of Tapin Regency (STA 0 +000 – 1 +451), with local road functions, hilly terrain type (D), 2-lane 2-way road type without median, plan speed 40 km / h, normal transverse e 10%, maximum slump 10%, shoulder width 2 x 0.5 m, and pavement width 2 x 1.5 m.

4.2 Evaluation of Horizontal Alinyemen

Based on consultant data, it is known that there are 26 Full Circle type corners with a planned speed of 40 km / h. Geometric evaluation of roads using Bina Marga standards includes Distance Calculation, Azimuth Angle, Bearing Angle, Bend Type Selection, Visibility and Side Free Area.

Table 1. Horizontal Alinyemen Data Consultant

	Station	Easting	Northing	Direction (α)	Delta (Δ)	R (m)	V (Kmh)	Tc (m)	Es (m)	Lc (m)	e (%)	Ls1 (m)	Ls2 (m)	θ	Ts (m)	LT (m)	Jenis Tikungan
Pawal	0+000	289445.492	9648722.357	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T1	0+050.316	289489.454	9648697.882	119˚06'21"	22˚16'27"	130	40	25.593	2.495	50.539	5.8	-	-	-	-	-	FC
T2	0+093.340	289516.711	9648663.763	141˚22'48"	30˚51'08"	20	40	5.519	0.747	10.769	8	-	-	-	-	-	FC
T3	0+161.496	289580.79	9648639.769	110˚31'40"	6˚02'45"	130	40	6.865	0.181	13.718	5.9	-	-	-	-	-	FC
T4	0+222.583	289635.436	9648612.436	116˚34'26"	56˚46'13"	20	40	10.807	2.733	19.817	8	-	-	-	-	-	FC
T5	0+301.442	289644.785	9648532.323	173˚20'38"	35˚18'07"	20	40	6.364	0.988	12.323	8	-	-	-	-	-	FC
T6	0+345.735	289674.669	9648499.083	138˚02'31"	48˚04'24"	20	40	8.92	1.899	16.781	8	-	-	-	-	-	FC
T7	0+436.526	289664.884	9648407.756	186˚06'55"	6˚33'57"	600	40	34.416	0.986	68.756	N	-	-	-	-	-	FC
T8	0+533.629	289643.551	9648312.948	192˚40'52"	8˚14'57"	130	40	9.375	0.338	18.717	5.9	-	-	-	-	-	FC
T9	0+607.833	289637.815	9648238.934	184˚25'55"	45˚23'41"	20	20	8.365	1.679	15.846	8	-	-	-	-	-	FC
T10	0+646.394	289663.674	9648209.147	139˚02'14"	16˚32'55"	20	20	2.909	0.21	5.777	8	-	-	-	-	-	FC
T11	0+695.986	289684.189	9648163.953	155˚35'09"	26˚21'16"	60	40	14.048	1.623	27.598	7.8	-	-	-	-	-	FC
T12	0+749.314	289682.366	9648110.159	181˚56'25"	39˚10'49"	50	40	17.795	3.072	34.191	8	-	-	-	-	-	FC
T13	0+821.742	289727.042	9648051.385	142˚45'36"	39˚29'07"	30	40	10.767	1.874	20.675	8	-	-	-	-	-	FC
T14	0+858.447	289725.571	9648013.85	182˚14'43"	12˚53'44"	50	40	5.651	0.318	11.253	4	-	-	-	-	-	FC
T15	0+955.510	289700.206	9647920.11	195˚08'27"	66˚49'24"	35	40	23.088	6.929	40.82	8	-	-	-	-	-	FC
T16	0+993.701	289734.373	9647893.11	128˚19'03"	4˚33'11"	100	20	3.975	0.079	7.947	6.5	-	-	-	-	-	FC
T17	1+007.806	289744.714	9647883.511	132˚52'14"	21˚14'30"	20	20	3.75	0.349	7.415	8	-	-	-	-	-	FC
T18	1+025.844	289761.561	9647876.83	111˚37'44"	43˚40'57"	20	20	8.016	1.547	15.248	8	-	-	-	-	-	FC
T19	1+057.341	289775.045	9647847.5	155˚18'40"	10˚14'43"	130	40	11.654	0.521	23.245	5.8	-	-	-	-	-	FC
T20	1+106.059	289787.212	9647800.262	165˚32'23"	1˚41'45"	700	40	10.361	0.077	20.72	N	-	-	-	-	-	FC
T21	1+147.979	289796.462	9647759.374	167˚15'08"	8˚27'58"	200	40	14.803	0.547	29.552	4.7	-	-	-	-	-	FC
T22	1+219.96	289817.146	9647690.627	168˚14'18"	10˚39'07"	70	40	6.526	0.304	13.014	7.5	-	-	-	-	-	FC
T23	1+248.307	289827.969	9647664.386	157˚35'11"	19˚10'42"	20	20	3.379	0.283	6.695	8	-	-	-	-	-	FC
T24	1+286.04	289830.102	9647626.65	176˚45'54"	53˚36'24"	20	20	10.104	2.407	18.712	8	-	-	-	-	-	FC
T25	1+348.625	289883.748	9647591.601	123˚09'30"	82˚24'21"	25	20	21.888	8.228	35.956	8	-	-	-	-	-	FC
T26	1+428.756	289845.795	9647512.26	205˚33'51"	22˚11'28"	50	40	9.806	0.952	19.365	8	-	-	-	-	-	FC
Pakhir	1+475	289844.468	9647489.745	-	-	-	-	-	-	-	-	-	-	-	-	-	-

After recalculating with the same speed and radius using the standard method of Bina Marga 1997, the calculation results can be obtained as follows:

Table 2. T1 – T14 Evaluation Result Data

No	Perhitungan	T1	T2	T3	T4	T5	T6	T7
1).	Δ(°)	22.273	30.851	6.045	56.77	35.301	48.072	6.566
	Vr (km/jam)	40	40	40	40	40	40	40
	fmaks	0.166	0.166	0.166	0.166	0.166	0.166	0.166
	re maks	0.035	0.035	0.035	0.035	0.035	0.035	0.035
	Rmin (m)	47.360	47.360	47.360	47.360	47.360	47.360	47.360
	Rc (m)	130	20	130	20	20	20	600
	Dicoba *Full Circle* Cara 1 (Syarat Bina Marga e ≤ 3%)							
2).	Dmaks (°)	30.240	30.240	30.240	30.240	30.240	30.240	30.240
	Dd (°)	11.018	71.620	11.018	71.620	71.620	71.620	2.387
	ed (%)	6	-8	6	-8	-8	-8	1.5
	Dicoba Full Circle Cara 2 (Syarat Bina Marga p < 0.25 m)							
3).	Ls1 (m)	33.333	33.333	33.333	33.333	33.333	33.333	33.333
	Ls2 (m)	-0.193	148.730	-0.193	148.730	148.730	148.730	-21.403
	Ls3 (m)	25.397	25.397	25.397	25.397	25.397	25.397	25.397
	Ls Digunakan (m)	33.333	148.730	33.333	148.730	148.730	148.730	33.333
	P Check	0.356	46.048	0.356	46.048	46.048	46.048	0.077
	Cek Jenis Tikungan *Full Circle p<0.25*	Bukan F-C	F-C	Bukan F-C	F-C	F-C	F-C	F-C
	Tc	-	5.518	-	10.807	6.364	8.92	34.365
	Ec	-	0.747	-	2.733	0.988	1.899	0.983
	Lc	-	10.764	-	19.806	12.316	16.772	68.619
	Jika Bukan *Full Circle (F-C)*							
4).	Θs (°)	7.349	-	13.649	-	-	-	-
	Lc (m)	17.177	-	-19.625	-	-	-	-
	Cek Jenis Tikungan SS (Lc < 20 m)	S-S	-	S-S	-	-	-	-
5).	Xc (m)	-	-	-	-	-	-	-
	Yc (m)	-	-	-	-	-	-	-
	Θs (°)	11.137	-	3.023	-	-	-	-
	Ls (m)	50.510	-	13.709	-	-	-	-
	p (m)	0.823	-	0.06	-	-	-	-
	k (m)	25.210	-	6.85	-	-	-	-
	Ts (m)	50.963	-	13.718	-	-	-	-
	Es (m)	3.334	-	0.241	-	-	-	-
	Lc (m)	0	-	0	-	-	-	-
	Ltotal (m)	101.020	10.764	27.417	19.806	12.316	16.772	68.619
6).	Jarak Pandang Henti (Jh) (m)	46.046	46.046	46.046	46.046	46.046	46.046	46.046
7).	Jarak Pandang Menyiap (Jd) (m)	212.173	212.173	212.173	212.173	212.173	212.173	212.173
8).	Daerah Bebas Samping (m)	2.059	3.837	3.72	3.837	3.837	3.837	0.443

No	Perhitungan	T8	T9	T10	T11	T12	T13	T14
1).	Δ(°)	8.250	45.394	16.547	26.356	39.181	39.484	12.897
	Vr (km/jam)	40	20	20	40	40	40	40
	fmaks	0.166	0.179	0.179	0.166	0.166	0.166	0.166
	re maks	0.035	0.035	0.035	0.035	0.035	0.035	0.035
	Rmin (m)	47.360	11.290	11.290	47.360	47.360	47.360	47.360
	Rc (m)	130	20	20	60	50	30	50
	Dicoba *Full Circle* Cara 1 (Syarat Bina Marga e ≤ 3%)							
2).	Dmaks (°)	30.240	126.880	126.880	30.240	30.240	30.240	30.240
	Dd (°)	11.018	71.620	71.620	23.873	28.648	47.746	28.648
	ed (%)	6	8	8	9	10	6.6	10
	Cek Jenis Tikungan *Full Circle*	Bukan F-C	Bukan F-C	Bukan F-C	Bukan F-C	Bukan F-C	Bukan F-C	Bukan F-C
	Dicoba Full Circle Cara 2 (Syarat Bina Marga p < 0.25 m)							
3).	Ls1 (m)	33.333	16.667	16.667	33.333	33.333	33.333	33.333
	Ls2 (m)	-0.193	8.365	8.365	31.397	43.130	90.063	43.130
	Ls3 (m)	25.397	12.698	12.698	25.397	25.397	25.397	25.397
	Ls Digunakan (m)	33.333	16.667	16.667	33.333	43.130	90.063	43.130
	P Check	0.356	0.579	0.579	0.772	1.55	11.266	1.55
	Jika Bukan *Full Circle (F-C)*							
4).	Θs (°)	7.349	23.885	23.885	15.924	24.724	86.048	24.724
	Lc (m)	-14.624	-0.829	-10.894	-5.747	-8.955	-69.400	-31.881
	Cek Jenis Tikungan SS (Lc < 20 m)	S-S	S-S	S-S	S-S	S-S	S-S	S-S
5).	Xc (m)	-	-	-	-	-	-	-
	Yc (m)	-	-	-	-	-	-	-
	Θs (°)	4.125	22.697	8.274	13.178	19.591	19.742	6.449
	Ls (m)	18.709	15.837	5.773	27.586	34.175	20.663	11.249
	p (m)	0.112	0.541	0.070	0.534	0.999	0.609	0.105
	k (m)	9.348	7.872	2.883	13.762	17.011	10.285	5.619
	Ts (m)	18.732	16.463	5.801	27.935	35.161	21.270	11.282
	Es (m)	0.450	2.266	0.281	2.171	4.132	2.520	0.424
	Lc (m)	-	-	-	-	-	-	-
	Ltotal (m)	37.418	31.674	11.546	55.172	68.350	41.326	22.498
6).	Jarak Pandang Henti (Jh) (m)	46.046	18.451	18.451	46.046	46.046	46.046	46.046
7).	Jarak Pandang Menyiap (Jd) (m)	212.173	105.413	105.413	212.173	212.173	212.173	212.173
8).	Daerah Bebas Samping (m)	2.828	2.255	3.907	4.477	5.368	10.519	10.752

Table 3. Evaluation Result Data T15 – T126

No	Perhitungan	T15	T16	T17	T18	T19	T20	T21
1).	Δ(˚)	66.824	4.552	21.237	43.678	10.246	1.696	3.998
	Vr (km/jam)	40	20	20	20	40	40	40
	fmaks	0.166	0.179	0.179	0.179	0.166	0.166	0.166
	re maks	0.035	0.035	0.035	0.035	0.035	0.035	0.035
	Rmin (m)	47.360	11.290	11.290	11.290	47.360	47.360	47.360
	Rc (m)	35	100	20	20	130	700	200
	Dicoba *Full Circle* Cara 1 (Syarat Bina Marga e ≤ 3%)							
2).	Dmaks (˚)	30.240	126.880	126.880	126.880	30.240	30.240	30.240
	Dd (˚)	40.925	14.324	71.620	71.620	11.018	2.046	7.162
	ed (%)	9	2	8.103	8.103	6	1.3	4
	Cek Jenis Tikungan *Full Circle*	Bukan F-C	F-C	Bukan F-C	Bukan F-C	Bukan F-C	F-C	F-C
	Dicoba Full Circle Cara 2 (Syarat Bina Marga p < 0.25 m)							
3).	Ls1 (m)	33.333	16.667	16.667	16.667	33.333	33.333	33.333
	Ls2 (m)	73.301	-9.235	8.365	8.365	23.016	-22.241	-9.670
	Ls3 (m)	25.397	12.698	12.698	12.698	-0.193	25.397	25.397
	Ls Digunakan (m)	73.301	16.667	16.667	16.667	33.333	33.333	33.333
	P Check	6.397	0.116	0.579	0.579	0.356	0.066	0.231
	Cek Jenis Tikungan *Full Circle*	Bukan F-C	-	Bukan F-C	Bukan F-C	Bukan F-C	-	-
	Tc		3.974				10.361	6.981
	Ec		0.079				0.077	0.122
	Lc		7.941				20.71	13.949
	Jika Bukan *Full Circle (F-C)*							
4).	Θs (˚)	60.028	`	23.885	23.885	7.349	-	-
	Lc (m)	-32.502	-	-9.257	-1.428	-10.098	-	-
	Cek Jenis Tikungan SS (Lc < 20 m)	S-S	-	S-S	S-S	S-S	-	-
5).	Xc (m)	-	-	-	-	-	-	-
	Yc (m)	-	-	-	-	-	-	-
	Θs (˚)	33.412	-	10.619	21.839	5.123	-	-
	Ls (m)	40.800	-	7.409	15.239	23.236	-	-
	p (m)	2.142	-	0.115	0.5	0.173	-	-
	k (m)	20.141	-	3.699	7.578	11.609	-	-
	Ts (m)	44.643	-	7.47	15.793	23.279	-	-
	Es (m)	9.496	-	0.465	2.085	0.695	-	-
	Lc (m)	0	-	0	0	0	-	-
	Ltotal (m)	81.600	7.941	14.819	30.478	46.472	20.71	13.949
6).	Jarak Pandang Henti (Jh) (m)	46.046	18.451	18.451	18.451	46.046	46.046	46.046
7).	Jarak Pandang Menyiap (Jd) (m)	212.173	105.413	212.173	212.173	212.173	212.173	212.173
8).	Daerah Bebas Samping (m)	7.612	0.552	3.124	2.255	2.059	0.797	3.193

No	Perhitungan	T22	T23	T24	T25	T26
1).	Δ(˚)	5.668	19.178	53.607	82.406	22.191
	Vr (km/jam)	40	20	20	20	40
	fmaks	0.166	0.179	0.179	0.179	0.166
	re maks	0.035	0.035	0.035	0.035	0.035
	Rmin (m)	47.360	11.290	11.290	11.290	47.360
	Rc (m)	70	20	20	25	50
	Dicoba *Full Circle* Cara 1 (Syarat Bina Marga e ≤ 3%)					
2).	Dmaks (˚)	30.240	126.880	126.880	126.880	30.240
	Dd (˚)	20.463	71.620	71.620	57.296	28.648
	ed (%)	9	8.103	8.103	6.992	10
	Cek Jenis Tikungan *Full Circle*	Bukan F-C	Bukan F-C	Bukan F-C	Bukan F-C	Bukan F-C
	Dicoba Full Circle Cara 2 (Syarat Bina Marga p < 0.25 m)					
3).	Ls1 (m)	33.333	16.667	16.667	16.667	33.333
	Ls2 (m)	23.016	8.365	8.365	3.965	43.130
	Ls3 (m)	25.397	12.698	12.698	12.698	25.397
	Ls Digunakan (m)	33.333	16.667	16.667	16.667	43.130
	P Check	0.661	0.579	0.579	0.463	1.55
	Jika Bukan *Full Circle (F-C)*					
4).	Θs (˚)	13.649	23.885	23.885	19.108	24.724
	Lc (m)	-26.412	-9.976	3.083	19.115	-23.775
	Cek Jenis Tikungan SS (Lc < 20 m)	S-S	S-S	S-S	S-S	S-S
5).	Xc (m)	-	-	-	-	-
	Yc (m)	-	-	-	-	-
	Θs (˚)	2.834	9.589	28.304	41.023	11.096
	Ls (m)	6.921	6.691	19.75	35.781	19.355
	p (m)	0.028	0.094	0.859	2.396	0.314
	k (m)	3.459	3.341	9.785	17.54	9.661
	Ts (m)	6.925	6.735	21.019	41.374	19.528
	Es (m)	0.114	0.378	3.692	11.313	1.273
	Lc (m)	0	0	0	0	0
	Ltotal (m)	13.842	13.382	39.499	71.562	38.710
6).	Jarak Pandang Henti (Jh) (m)	46.046	18.451	18.451	18.451	46.046
7).	Jarak Pandang Menyiap (Jd) (m)	212.173	105.413	212.173	212.173	212.173
8).	Daerah Bebas Samping (m)	9.150	3.468	2.255	1.79	7.045

In table 2 – table 3, it can be concluded that out of the 26 corners of the Full Circle type, there are 18 corners that do not meet the criteria for the Full Circle type. The 18 bends are in the Spiral-Spiral type.

4.3 Horizontal Alinyemen Design

After being redesigned using AutoCAD Civil 3D software with a planned speed of 30 km / h, the total traffic length became 1,445 km. There are 22 corners with the Full Circle type.

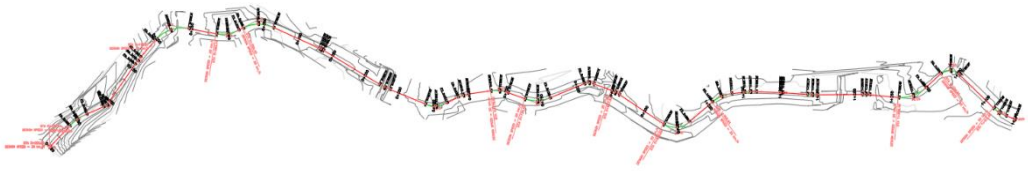

Figure 6. Alternative Design of Horizontal Alinyemen

4.4 Vertical Alinyemen Design.

Typical of vertical alinyemen is a concave and convex parabola. From the design obtained the total number of 42 pieces, consisting of 21 convex and 21 concave.

Table 4. Vertical Alinyemen Data

	PVI Station	PVI Elevation	Grade In	Grade Out	A (Grade Change)	Profile Curve Type	Profile Curve Length	K Value	Curve Radius
1	0+000.00m	58.430m		-12.53%					
2	0+022.70m	55.585m	-12.53%	-12.73%	0.20%	Crest	43.133m	213.968	21396.839m
3	0+056.31m	51.305m	-12.73%	-9.24%	3.49%	Sag	22.883m	6.551	655.062m
4	0+098.79m	47.380m	-9.24%	-9.74%	0.50%	Crest	58.969m	118.220	11821.962m
5	0+215.19m	36.044m	-9.74%	-13.90%	4.17%	Crest	7.945m	1.907	190.748m
6	0+219.37m	35.462m	-13.90%	-1.30%	12.60%	Sag	0.397m	0.032	3.152m
7	0+228.83m	35.339m	-1.30%	-1.55%	0.25%	Crest	4.800m	19.567	1956.692m
8	0+231.36m	35.300m	-1.55%	-0.35%	1.19%	Sag	0.240m	0.201	20.085m
9	0+262.03m	35.192m	-0.35%	7.63%	7.98%	Sag	58.050m	7.275	727.507m
10	0+320.04m	39.616m	7.63%	0.07%	7.56%	Crest	55.080m	7.287	728.716m
11	0+370.94m	39.651m	0.07%	-7.00%	7.07%	Crest	44.382m	6.279	627.938m
12	0+410.82m	36.859m	-7.00%	-3.57%	3.43%	Sag	33.606m	9.785	978.467m
13	0+508.58m	33.374m	-3.57%	4.26%	7.83%	Sag	32.366m	4.135	413.528m
14	0+525.61m	34.100m	4.26%	-0.00%	4.26%	Crest	1.618m	0.380	37.976m
15	0+533.58m	34.100m	-0.00%	-2.37%	2.37%	Crest	13.611m	5.732	573.209m
16	0+553.46m	33.628m	-2.37%	5.13%	7.51%	Sag	24.835m	3.308	330.844m
17	0+596.62m	35.843m	5.13%	-1.01%	6.15%	Crest	58.408m	9.505	950.474m
18	0+657.67m	35.224m	-1.01%	-0.49%	0.52%	Sag	60.500m	115.687	11568.672m
19	0+708.76m	34.974m	-0.49%	0.86%	1.35%	Sag	39.610m	29.302	2930.223m
20	0+799.90m	35.759m	0.86%	-3.49%	4.35%	Crest	62.193m	14.304	1430.426m
21	0+832.64m	34.618m	-3.49%	10.77%	14.26%	Sag	3.110m	0.218	21.805m
22	0+838.41m	35.240m	10.77%	0.00%	10.77%	Crest	7.600m	0.705	70.531m
23	0+842.41m	35.240m	0.00%	-7.44%	7.44%	Crest	0.380m	0.051	5.106m
24	0+849.69m	34.698m	-7.44%	3.59%	11.04%	Sag	13.483m	1.222	122.169m
25	0+925.60m	37.426m	3.59%	2.30%	1.29%	Crest	92.311m	71.443	7144.303m
26	0+974.18m	38.545m	2.30%	7.17%	4.87%	Sag	4.616m	0.947	94.728m
27	1+005.34m	40.780m	7.17%	-3.78%	10.96%	Crest	54.814m	5.002	500.208m
28	1+051.70m	39.026m	-3.78%	-1.42%	2.36%	Sag	36.025m	15.234	1523.432m
29	1+109.95m	38.199m	-1.42%	-0.03%	1.39%	Sag	76.442m	54.930	5492.972m
30	1+166.29m	38.184m	-0.03%	-2.04%	2.02%	Crest	25.502m	12.650	1265.001m
31	1+179.71m	37.910m	-2.04%	-0.00%	2.04%	Sag	1.275m	0.624	62.412m
32	1+182.73m	37.910m	-0.00%	2.07%	2.07%	Sag	4.527m	2.188	218.791m
33	1+216.68m	38.612m	2.07%	11.16%	9.09%	Sag	21.407m	2.354	235.415m
34	1+227.94m	39.870m	11.16%	-2.93%	14.09%	Crest	1.070m	0.076	7.594m
35	1+235.27m	39.655m	-2.93%	-7.92%	4.99%	Crest	12.908m	2.586	258.630m
36	1+242.15m	39.110m	-7.92%	7.82%	15.74%	Sag	0.810m	0.051	5.147m
37	1+281.27m	42.170m	7.82%	2.77%	5.05%	Crest	73.558m	14.567	1456.734m
38	1+327.08m	43.440m	2.77%	5.03%	2.26%	Sag	17.163m	7.587	758.740m
39	1+347.00m	44.442m	5.03%	1.11%	3.93%	Crest	3.101m	0.790	78.964m
40	1+348.64m	44.461m	1.11%	-3.54%	4.64%	Crest	0.155m	0.033	3.339m
41	1+355.78m	44.208m	-3.54%	2.07%	5.61%	Sag	13.435m	2.394	239.412m
42	1+393.97m	45.000m	2.07%	3.74%	1.67%	Sag	59.792m	35.802	3580.238m
43	1+427.03m	46.238m	3.74%	1.11%	2.63%	Crest	6.017m	2.288	228.779m
44	1+445.59m	46.445m	1.11%						

4.5 Excavation and Embankment

From the results obtained based on the data of the consultant of the area and volume for the excavated and stockpiled area on the Gunung Batu road section, Tapin Sta Regency 0 + 000 - 1 + 451 there is only a heap of 298.875 m^3. Meanwhile, the results of the Excavation design amounted to 8458.13 m^3 and the Heap of 3286.62 m^3.

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

The conclusions that can be drawn from this final project report are:

1. After being evaluated based on the calculations of the 1997 Bina Marga standard, out of 26 Full Circle type corners with a planned speed of 40 km / h, there were 18 corners that did not meet the criteria for the Full Circle bend type. The 18 bends belong to the Spiral-Spiral type. After re-imagining at the same speed, all Ls (transitional curves) of the Spiral-Spiral type bend touch the arm of the corner afterwards, therefore it is necessary to have a decrease in speed and the selection of the right bend radius.
2. The result of the alternative design of the Horizontal Alinyemen is a trase length of 1 + 445.59 , with 22 bends of the Full Circle type with a planned speed of 30 km / h. With a maximum superelevation of 7.4%. And the maximum slump on the terrain is 10%.
3. The result of the alternative design of vertical alinyemen is that there are 42 arches consisting of 21 convex arches and 21 vekung arches. With a Dig as big as of 8458.13 m^3 and Heap of 3286.62 m^3.

5.2 Suggestions

1. The results of the evaluation of calculations on the Gunung Batu road section of Tapin Regency STA 0 + 000 - 1 + 451 at the corners reviewed are still different from the 1997 Bina Marga standards, for this reason, it is necessary to suggest the need to be reviewed in the selection of types of corners that are in accordance with standard specifications and references in order to maximize the level of safety and comfort for road users.
2. It is necessary to have a speed drop notification sign at a corner where there is a change in speed.
3. To obtain good results, you must pay attention to determining road traffic because it will greatly affect the volume of work.

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