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ANALYSIS OF FLEXIBLE PAVEMENT THICKNESS AT THE 3 NORTHRING ROAD JUNCTION- 3 GOLF ROAD-KASTURI ROAD IN BANJARBARU CITY

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ABSTRACT

On the Simpang 3 north ring road - Simpang 3 Jalan Golf - Jalan Kasturi which is the access road to the new Syamsudin Noor airport which is an international airport which will experience an increase in passengers which will result in an increase in traffic volume. This study aims to obtained flexible pavement thickness using the Road Pavement Design Manual Number 02/M/BM/2017 compared to PT T-01-2002-B and predict the remaining pavement life against traffic increases that occur in the coming year. then plan complementary buildings and road equipment and calculate the cost budget plan using the 2016 AHSP.

From the calculation results of the 2 methods there are differences in the thickness of the flexible pavement. In the calculation of flexible pavement thickness using the Road Pavement Design Manual method no. 02/M/BM/2017 namely AC WC = 4 cm; AC Binder = 6 cm; AC Base = 8CM; LPA = 30 cm and CBR Subgrade
= 0.73% with Support Layer = 1550. As for the calculation, results of the Pt T-01- 2002-B method, the results obtained are AC-WC pavement thickness = 4 cm, AC BC = 6 cm, AC Base = 15 cm, LPB = 15 cm. In addition, in writing this final project, it also discusses predicting the remaining life of the pavement and then planning complementary buildings and road equipment, for the results of the budget plan (RAB) with the result: Rp. 33,550,716,390.78 -

Keywords: Road Pavement Design Manual Number 02/M/BM/2017, prediction of remaining pavement, Complementary Buildings and Road Equipment, Cost Budget Plan.

1. INTRODUCTION

Over time, the pavement layer will decrease due to traffic, weather, environmental conditions, poor drainage and also poor subgrade conditions so that the level of service will decrease. Road pavement has a certain design design life. During the design life, the pavement will experience repeated loading. High traffic roads are reflected in higher annual average daily traffic (LHRT) which means the number of repetitions will increase. Precautions need to be taken, especially road maintenance.

On the Simpang 3 north ring road - Simpang 3 Jalan Golf - Jalan Kasturi which is the access road to the new Syamsudin Noor airport which is an international airport which will experience an increase in passengers which will result in an increase in traffic volume. This study aims to obtain flexible pavement thickness, predict the remaining pavement life against traffic increases that occur in the coming year and also to maintain structural performance and pavement thickness construction.

South Kalimantan Province requires the physical development of road infrastructure to support the economy and tourism in line with the increasing need for transportation facilities that connect regions to other regions. In this project, one of the roads or areas that needs improvement which is a vital object in South Kalimantan, namely the Simpang 3 north ring road - Simpang 3 Jalan Golf-Jalan Kasturi is an access road to Syamsudin Noor airport to support road users is a strategic road in development area in South Kalimantan, which is located in the sub-district of Landasan Ulin, Banjarbaru City.

The purpose of this study was to find out the results of the remaining flexible pavement life on the Average Daily Traffic (LHR) at the Simpang 3 North Ring Road - Simpang 3 Jalan Golf-Jalan Kasturi (STA 8+306 – 9+462), to get the thickness of the pavement layer. road using the flexible pavement method Road Pavement Design Manual Number 02/M/BM/2017 compared to PT T-01-2002-B, Obtaining the calculation of the Cost Budget Plan in accordance with the Analysis of Work Unit Prices (AHSP) for roads and bridges Permen PU No. .28 of 2016 and Designing Complementary Buildings and Road Equipment.

2. LITERATURE REVIEW

A. Pavement Type

Real soil in the field can rarely withstand repeated loads from vehicular traffic without major deformation. Because of that, a structure is needed that can protect the soil from the wheel load of the vehicle. A cross-section of the pavement structure can be seen in Figure 1.

Picture 1. Cross Section of Pavement Structure

Source: Hardiyatmo, 2015

The main function of the road pavement is to distribute the wheel load over the entire subgrade surface area wider than the wheel contact with the road pavement. In general, the function of road pavement is as follows:

1. For a strong structure to support traffic loads
2. To provide a flat surface for the rider
3. Provides roughness or slip resistance on the pavement surface
4. To distribute the vehicle load completely over the subgrade, to protect against overpressure.

B. Flexible Pavement

Flexible pavement is a pavement that generally uses a mixture of asphalt as the surface layer and granular material as the layer underneath (Bina Marga Road Pavement Manual 2017). The method used in this planning:

1. Road Pavement Design Manual No.02/M/BM/2017
2. Manual Pt T-01-2002-B

C. Decline in Planned Life

The remaining design life is the concept of damage caused by the number of repetitions

of traffic loads in Equivalent Standard Load (ESAL) units which are expected to pass within a certain period of time (AASHTO, 1993). Calculation of the percentage of the remaining life of the plan using the following equation. According to AASHTO 1993 the calculation of the remaining design life can be calculated based on the following equation:

$$RI = 100\left[1 - \left(\frac{Np}{N2}\right)\right]$$

RI = Percentage of remaining plan life

Np = Cumulative ESAL at the end of the year, and NI,5 = Cumulative ESAL at the end of the design life

D. Road Drainage System

Drainage system is a series of water structures whose function is to reduce and/or dispose of excess water from an area into water bodies or artificial infiltration. The drainage system building can be built on a receiving channel, a collection channel and a receiving water body.

E. Road Marking (Pd T-12-2004-B)

For Road Marking refer to Pd T-12-2004-B

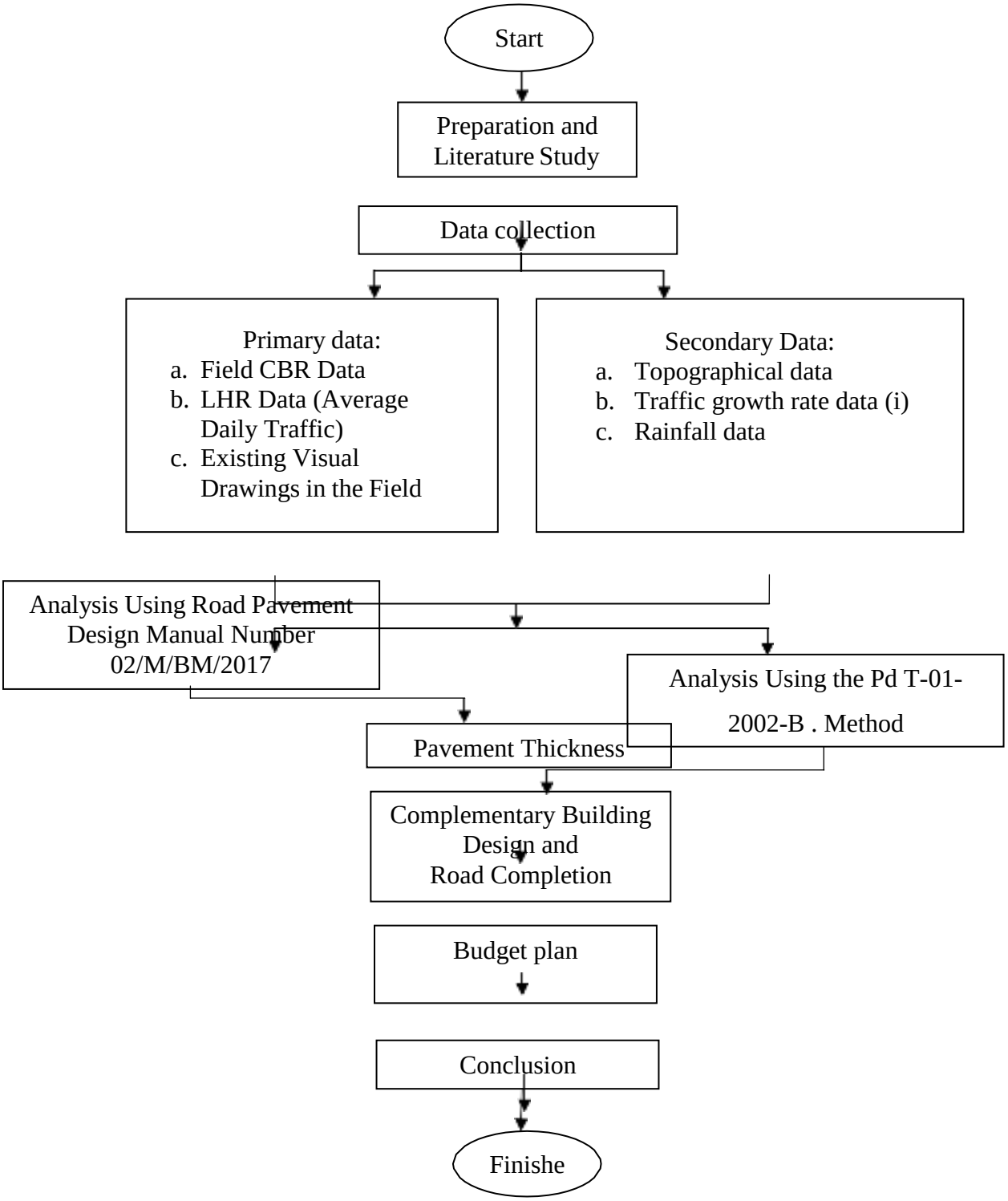
F. Street Lighting

The specification of street lighting refers to SNI 73911 of 2008. The purpose of the specification of street lighting is to obtain uniformity in planning street lighting, especially in urban areas so that street lighting is produced that can provide safety and comfort for road users. This street lighting specification regulates the provisions for street lighting.

F. Unit price analysis

Unit price analysis is the amount of costs needed to build a road segment in accordance with the Work Unit Price Analysis (AHSP) for roads and bridges Permen PU No. 28 of 2016. The unit price analysis determines the method of calculating wages, labor and materials. In making a unit price analysis, each unit of measurement requires the assumption of the work implementation method used so that the unit price analysis formula obtained reflects the actual price in the field. The unit price calculation must be in accordance with the technical specifications used, applicable regulations and local field conditions.

3. RESEARCH METHODOLOGY



Picture 2. Main Planning Flow Section

4. Results and Discussion

1. Traffic data for the Simpang 3 North Ring Road – Simpang 3 Jalan Golf – JalanKasturi.

Table 1. LHR2021 Jalan Simpang 3 Golf – Jalan Kasturi

Jenis Kendaraan	Survey Hari Normal		Survey Hari Libur		Total		LHR Tahun			Total Harian rata-rata/Hari	Total Terbanyak
	Arah Kiri	Arah Kanan	Arah Kiri	Arah Kanan	Hari Normal	Hari Libur	Hari Normal	Hari Libur	Total		
					24jam	24jam	(313x)	(52x)			
Sepeda Motor, Sekuter, roda 3	745	677	755	807	1422	1562	445086	81224	526310	1442	1562
Sedan, Wagon, Angkot, Pick-Up	675	631	669	729	1306	1398	408778	72696	481474	1319	1398
Bus Kecil	1	0	3	6	1	9	313	468	781	2	9
Bus Besar	4	0	1	0	4	1	1252	52	1304	4	4
Truk Ringan 2 Sumbu	32	30	25	37	62	62	19406	3224	22630	62	62
Truk Sedang 2 Sumbu	42	45	43	29	87	72	27231	3744	30975	85	87
Truk 3 Sumbu	13	13	4	3	26	7	8138	364	8502	23	26
								Jumlah	1071976	2937	3148

2. CBR Subgrade AnalysisTable 2. Subgrade CBR

No.	point	CBR Point
1	1	1.54
2	2	1.54
3	3	1.54
4	4	1.54
5	5	1.54
6	6	5.3
7	7	2.5
8	8	4.89
9	9	4
10	10	1.6
Amount		25.99

Average CBR = = = 2.59 $\frac{\textbf{Jumlah CBR titik } 25{,}99}{\textbf{Jumlah data} \qquad 10}$

- Normal

Method

Calculation of the standard deviation as follows:

$$S = \sqrt{\sum_{i-1}^{n} \frac{(X_i - \bar{X})^2}{n-1}}$$

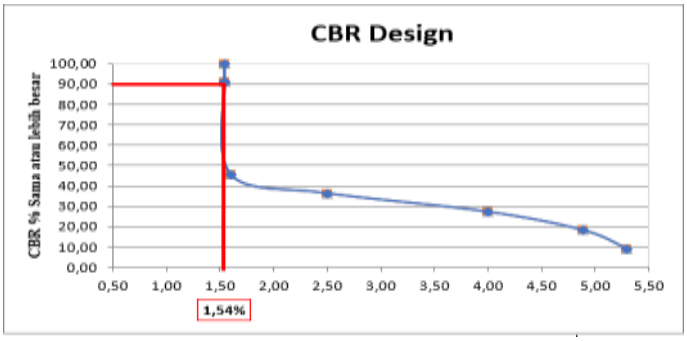
S = 0.63%

CBR characteristics = 1.54 – 1.282 x 0.63 = 0.73CBR characteristics = 0.73%

- Percentile Method

Table 3. Subgrade CBR Percentage Data

No.	CBR	The Same Or Bigger Amount	Percent (%) Equal or Greater CBR	CBR < 6%
1	1.54	10	11/11 x 100% = 100%	100.00
2	1.54	10	10/11 x 100% = 90.9%	90.9
3	1.54	10	9/11 x 100% = 81.8%	90.9
4	1.54	10	8/11 x 100% = 72.7%	90.9
5	1.54	10	8/11 x 100% = 72.7%	90.9
6	1.6	5	6/11 x 100% = 54.5%	45.5
7	2.5	4	5/11 x 100% = 45.5%	36.4
8	4	3	4/11 x 100% = 36.4%	27.3
9	4.89	2	3/11 x 100% = 27.3%	18.2
10	5.3	1	2/11 x 100% = 18.2%	9.1



Picture 3. Graph of Subgrade CBR Value Relationship Graphically From reading the CBR graph per segment, the CBR value of 90% is 1.54%,

A. Calculation of the remaining life of flexible pavement against Average Daily

Traffic (LHR) Design Manual Method 02/M/BM/2017

1. CESA Value Calculation

a. Traffic Growth Factor (R)

Traffic growth factor at Jalan Simpang 3 North Ring- Simpang 3 Jalan Golf- Jalan Kasturi Traffic Growth Factor (i) i is 5.14% because the road is an arterial road located in Banjarbaru City.

Growth factor for 20 years

$$R_{0.01\,i} = \frac{(1+0.01\,i)^{UR}-1}{0.01\,i} = \frac{(1+0.01(0.0514)^{20}-1}{0.01(0.0514)} = 34$$

b. Traffic Prediction Plan (LHRn)2 Axis Light Truck

LHR2022 = LHR2021 = LHR1 x (1+i)n

= 62 x (1+0.0514)1 = 65.19

Table 4. Traffic Prediction Plan

LHR	SmallBus	Big Bus	2 Axis Light Truck	2 Axis Medium Truck	3 AxisTruck
2021	2	4	62	85	23
2022	2.1	4.21	65.19	89.37	24.18
2023	2.21	4.42	68.54	93.96	25.43
2024	2.32	4.65	72.06	98.79	26.73
2025	2.44	4.89	75.76	103.87	109.21
2026	2.57	5.14	79.66	109.21	29.55
2027	2.7	5.4	83.75	114.82	120.72
2028	2.84	5.68	88.06	120.72	32.67
2029	2.99	5.97	92.58	126.93	34.35
2030	3.14	6.28	97.34	133.45	36.11
2031	3.3	6.6	102.35	140.31	37.97
2032	3.47	6.94	107.61	147.53	39.92
2033	3.65	7.3	113.14	155.11	41.97
2034	3.84	7.67	118.95	163.08	44.13
2035	4.03	8.07	125.07	171.46	46.4
2036	4.24	8.48	131.5	180.28	48.78
2037	4.46	8.92	138.25	189.54	51.29
2038	4.69	9.38	145.36	199.28	53.92
2039	4.93	9.86	152.83	209.53	56.7
2040	5.18	10.37	160.69	220.3	59.61
2041	5.45	10.9	168.95	231.62	62.67

c. Determining the ESAL Value for the prediction of the remaining pavement life Calculation of ESA or Equivalent Single Axle Load using the following formula:$(LHR_{JK}$ x VDFJK) x 365 x DD x DL x R.

ESAL5 Calculation for 2022

ESA5 Big Bus = $LHRT_{2022}$ x VDF5 = 4 x 8.5 = 34

Table 5. Equivalent Single Axle Load (ESAL) Value

	SmallBus	Big Bus	2 Axis LightTruck	2 Axis Medium Truck	3 AxisTruck
2021	2	34	1134.6	1504.5	338.1
2022	2.1	35.75	1192.92	1581.83	355,48
2023	2.21	37.59	1254.23	1663.14	373.75
2024	2.32	39.52	1318.7	1748,62	392.96
2025	2.44	41.55	1386,48	1838.5	413.16
2026	2.57	43.68	1457.75	1933	434.4
2027	2.7	45.93	1532.68	2032.36	456.72
2028	2.84	48.29	1611.46	2136.82	480.2
2029	2.99	50.77	1694.29	2245.65	504.88
2030	3.14	53.38	1781,37	2362.13	530.83
2031	3.3	56.13	1872.93	2483.54	558,12
2032	3.47	59.01	1969,2	2611,2	586.8
2033	3.65	62.04	2070.42	2745,41	616.97
2034	3.84	65.23	2176.84	2886.53	648,68
2035	4.03	68.59	2288.73	3034.9	682.02
2036	4.24	72.11	2406.37	3190.89	717.08
2037	4.46	75.82	2530.06	3354.9	753.93
2038	4.69	79.71	2660.1	3527.34	792.69
2039	4.93	83.81	2796.83	3708.65	833.43
2040	5.18	88,12	2940.59	3899.27	876.27
2041	5.45	92.65	3091.73	4099.7	921.31

ESALTH5 Calculation for 2022

ESATH Big Bus = (ESAL4) x 365 x DD x DL x R

= (34) x 365x0.5x0.8x34

= 177451.09

Table 6. Cumulative Equivalent Standard Axis Trajectory

ESATH5	Small Bus	Big Bus	2 Axis Light Truck	2 Axis Medium Truck	3 Axis Truck
2021	5	3	41	53	11
2022	10438.3	177451.09	5921647,14	7852210.57	1764594.48
2023	10974.83	186572.07	6226019.8	8255814.2	1855294.64
2024	11538.93	196161,88	6546037.22	8680163.05	1950656.78
2025	12132.04	206244,6	6882503.53	9126233.43	2050920.54
2026	12755.62	216845.57	7236264.21	9595416.45	2156337.85
2027	13411.26	227991.43	7608208,19	10088620.86	2267173.62
2028	14100.6	239710.19	7999270.09	10607175.97	2383706.34
2029	14825.37	252031.3	8410432.58	11152384.81	2506228.85
2030	15587.39	264985.7	8842728.81	11725617.39	2635049.01
2031	16388.59	278605.97	9297245.07	12328314.13	2770490.53
2032	17230.96	292926.32	9775123.47	12961989,47	2912893.75
2033	18116.63	307982.73	10277564.81	13628235.73	3062616,48
2034	19047.83	323813.04	10805831.64	14328727.05	3220034.97
2035	200226,88	340457.03	11361251.39	15065223.62	3385544.77
2036	21056.27	357956.52	11945219.71	15839576.11	3559561.77
2037	22138.56	376355,49	12559204.01	16653730.33	3742523.25
2038	23276,48	395700,16	13204747.09	17509732.06	3934888,94
2039	24472.89	416039.15	13883471.09	18409732.29	4137142.23
2040	25730.8	437423.56	14597081.51	19355992.53	4349791.34
2041	27053.36	459907,13	15347371.5	20350890.55	4573370.62

d. Determining the Prediction of Remaining Pavement Life

After calculating the ESATH, the remaining life of the flexible pavement is calculated using the following formula:

RL= 100 $[1 - (\frac{Np}{N2})]$

RL2022 = 100 $[1 - (\frac{Np}{N2})]$

$=100\,[1 - (\frac{ESATH5k2022}{ESATH5k2041})]$

$= 100\,[1 - (\frac{15726341,57}{527767378,72})]$ = 97.02

Table 7. Recapitulation of Remaining Life

UR	Year	ESATH5	ESATH5 Cumulative	Remaining Life	Remaining Life(year)
1	2022	15726341.57	15726341.57	97.02	19.40
2	2023	16534675.53	32261017,11	93.89	18.78
3	2024	17384557.85	49645574.96	90.59	18,12
4	2025	18278124.13	67923699.09	87.13	17.43
5	2026	19217619.71	87141318,80	83.49	16.70
6	2027	20205405,36	107346724.16	79.66	15.93
7	2028	21243963,20	128590687.35	75.63	15,13
8	2029	22335902.90	150926590.26	71.40	14.28
9	2030	23483968,31	174410558,57	66.95	13.39
10	2031	24691044.29	199101602.86	62.27	12.45
11	2032	25960163.96	225061766.82	57.36	11.47
12	2033	27294516.39	252356283.21	52.18	10.44
13	2034	28697454.53	281053737.74	46.75	9.35
14	2035	30172503.69	311226241.43	41.03	8.21
15	2036	31723370.38	342949611.82	35.02	7.00
16	2037	33353951.62	376303563,44	28,70	5.74
17	2038	35068344.74	411371908,18	22.05	4.41
18	2039	36870857.65	448242765.83	15.07	3.01
19	2040	38766019.74	487008785.57	7.72	1.54
20	2041	40758593.15	527767378,72	0	0

After calculating the remaining life of the flexible pavement based on theaverage daily traffic data (LHR), it is then presented in the following graph:

Picture 4. Relationship between LHR and RL

It can be seen that the Simpang 3 North Ring Road- Simpang 3 Jalan Golf-Jalan Kasturi is planned with a design life of 20 years if seen in Figure 3 the graph of the relationship between LHR and the remaining life of flexible pavement at the beginning of the design life in 2022. *Remaining Life*amounted to 97.02% and was converted to the year of 19.40 years and at the end of the plan life in 2041, 0% was converted to the year of 0 years. So it can be concluded that the smaller the span towards the final year of the design life, the smaller the percentage of the remaining flexible pavement life will be*(Remaining Life)* so that the shorter the road service function for road users.

B. Calculation of Pavement Thickness Manual Method of Pavement Design 2017 Design age data for flexible pavement is 20 years and road foundation is 40 years, from the calculation of the normal method and CBR percentile used 0.73%, traffic growth (i) = 5.14

1. Traffic Growth Factor (R)

For road foundations with a design life of 40 years then: $R = \frac{(1+0.01(i))^{UR}-1}{0.01\,(i)} = \frac{(1+0.01\,x\,0.0514)^{40}-1}{0.01\,(0.0514)} = 40{,}40$

2. Determination of the Line Distribution Factor (DL) = 80% of the directiondistribution factor (DD) taken 0.5.

3. CESA calculation

Table 8. CESA5 Perhitungan calculation

Transportationtype	2-Way Average Daily Cross (2021)	LHR 2022	LHR 2023	VDF 5 factual	VDF 5 Normal	ESA5 ('2022-'2023)	ESA5 ('2023-'2041)
Small Bus	2	2.10	2.21	1.0	1.0	614.18	10974.83
Big Bus	4	4.21	4.42	8.5	4.7	10440.98	103163.38
2 Axis LightTruck	62	65.19	68.54	18.3	5.3	348421.71	1803164,20
2 Axis MediumTruck	85	89.37	93.96	17.7	5.4	462013,45	2518722.98
3 Axis Truck	23	24.18	25.43	14.7	5.2	103826.35	656294.70
					Number of ESA5	925316.66	5092320.09
					CESA5('2021-'2041)	6017636.75	

4. Determining the structure of the road foundation Table 9. Minimum Road Foundation Design Solution3

CBR Tanah dasar (%)	Kelas Kekuatan Tanah Dasar	Uraian Struktur Fondasi	Perkerasan Lentur: Beban lalu lintas pada lajur rencana dengan umur rencana 40 tahun (juta ESA5) < 2	Perkerasan Lentur: 2 - 4	Perkerasan Lentur: > 4	Perkerasan Kaku: Stabilisasi Semen [6]
			Tebal minimum perbaikan tanah dasar			
≥ 6	SG6	Perbaikan tanah dasar dapat berupa stabilisasi semen atau material timbunan pilihan (sesuai persyaratan Spesifikasi Umum Devisi 3 – Pekerjaan Tanah) (pemadatan lapisan ≤ 200 mm tebal gembur)	Tidak diperlukan perbaikan			150 mm stabilisasi di atas 150 mm material timbunan pilihan
5	SG5		-	-	100	
4	SG4		100	150	200	
3	SG3		150	200	300	
2,5	SG2.5		175	250	350	
Tanah ekspansif (potensi pengembangan > 5%)			400	500	600	Berlaku ketentuan yang sama dengan fondasi jalan perkerasan lentur
Perkerasan di atas tanah lunak[2]	SG1 [3]	Lapis penopang[4][5]	1000	1100	1200	
		-atau- lapis penopang dan geogrid [3]	650	750	850	
Tanah gambut dengan HRS atau DBST untuk perkerasan untuk jalan raya minor (nilai minimum – ketentuan lain berlaku)		Lapis penopang berbutir[4, 5]	1000	1250	1500	

(1) Desain harus mempertimbangkan semua hal yang kritikal; syarat tambahan mungkin berlaku.
(2) Ditandai dengan kepadatan dan CBR lapangan yang rendah.
(3) Menggunakan nilai CBR insitu, karena nilai CBR rendaman tidak relevan.
(4) Permukaan lapis penopang di atas tanah SG1 dan gambut diasumsikan mempunyai daya dukung setara nilai CBR 2.5%, dengan demikian ketentuan perbaikan tanah SG2.5 berlaku. Contoh: untuk lalu lintas rencana > 4 juta ESA, tanah SG1 memerlukan lapis penopang setebal 1200 mm untuk mencapai daya dukung setara SG2.5 dan selanjutnya perlu ditambah lagi setebal 350 mm untuk meningkatkan menjadi setara SG6.
(5) Tebal lapis penopang dapat dikurangi 300 mm jika tanah asal dipadatkan pada kondisi kering.

(6) Untuk perkerasan kaku, lapis permukaan material tanah dasar berbutir halus (klasifikasi A4 - A6) hingga kedalaman 150 mm harus berupa stabilisasi semen.

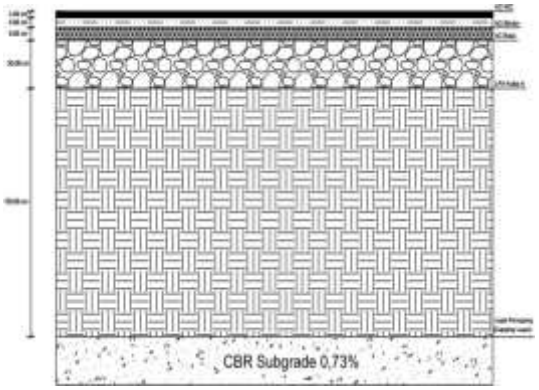
Based on CBR Subgrade = 0.73% value CESA5 foundation = 17774617.42, namely flexible pavement on soft soil, the subgrade strength class is SG1 alluvial, the road foundation structure uses a capping layer with a minimum thickness of 1200 mm increase in subgrade and subgrade CBR is conditioned by >6% then the increase in subgrade is increased by 350 mm.

5. Determining the pavement structure

In determining the pavement design using the 3B flexible pavement design, it is based on the 20-year design axis repetition (CESA5) =6.0176x 106, the pavement design chosen is based on table 5.

Table 10. Flexible Pavement Design – Asphalt with Grained Foundation.

	STRUKTUR PERKERASAN								
	FFF1	FFF2	FFF3	FFF4	FFF5	FFF6	FFF7	FFF8	FFF9
Solusi yang dipilih					**Lihat Catatan 2**				
Kumulatif beban sumbu 20 tahun pada lajur rencana (10^6 ESA5)	< 2	≥ 2 - 4	> 4 – 7	> 7 - 10	> 10 - 20	> 20 - 30	> 30 - 50	> 50 - 100	> 100 - 200
KETEBALAN LAPIS PERKERASAN (mm)									
AC WC	40	40	40	40	40	40	40	40	40
AC BC	60	60	60	60	60	60	60	60	60
AC Base	0	70	80	105	145	160	180	210	245
LPA Kelas A	400	300	300	300	300	300	300	300	300
Catatan	1		2		3				



Picture 5. Pavement Thickness Structure Design Manual 02/M/BM/2017

C. Calculation of Flexible Pavement Method Pt T 01-2002-B

Determining Surface Index

Determining Initial Surface Index (IP0), Taken 3.9

Determining Surface Finish Index (Ipt), Taken 2.5

Determining the Directional Distribution Factor (DD)For this design, DD 0.5 . is taken

Determining the Line Distribution Factor (DL)

Because on Jalan Simpang 3 North Ring – Simpang 3 Jalan Golf-Jalan Kasturi is of type 1 lane, 4 lanes, 2 directions, undivided (4/2 TB) then the value is 80% or DL = 0.8.

Determining Reliability Value (R), Standard Deviation (So), Standard Normal Deviate

(ZR), and Calculating Reliability Factor (FR) Reliability (R)

Because at Intersection 3 North Ring – Simpang 3 Jalan Golf-Jalan Kasturi is a function of urban arterial roads, the level of reliability ranges from 80% - 99% and the value is taken as 90%.

Standard Deviation (So), Based on Pt-T-01-2002-B the value of So given ranges from 0.4 to 0.5. From these provisions, the highest value of 0.5 is taken because the assumption of errors that occur is high.

Standard Normal Deviate (ZR)

then get the value of ZR for R = 90% that is -1.282

Determining the Bearing Capacity of Subgrade

In the previous calculation, the 90% CBR value was obtained, which was 0.73%. Meanwhile, for the planning of the pavement thickness using the Pt.T 01-2002-B method, the expected CBR value for the subgrade was 6%.

Determining the Resilient Modulus (MR) Value of Each LayerThe obtained values for the Resilient Modulus are as follows: MRsubgrade (pile) = 9000 psi.

MRbase = 122560 psi.MRsubbase = 17293 psi.

Finding W18 . ValueTable 11. LHR table

Looking for axle load standard for W18 per day plan lines per year:

Arah	Mobil	Bus Besar	Truk Ringan 2 Sumbu	Truk Sedang 2 Sumbu	Truk Berat 3 Sumbu
Konfigurasi Sumbu	1,1	1,2	1,1	1,2	1,2,2
Simpang 3 Golf-Jalan Kasturi	1348	5	57	85	17
Jalan Kasturi-Simpang 3 Golf	1366	0	67	74	16
Jumlah	2714	5	124	159	33
LHR di Bagi 2 Hari	1357	3	62	80	17

- Light vehicle = 1357 vehicle. × 0.0018 = 2.4426
- Big Bus = 3 vehicles x 0.4200 = 1.26
- Light truck = 62 vehicles. × 0.3001 = 18.6062
- Medium truck = 80 vehicles. × 6.0813 = 486,504
- Heavy truck = 17 vehicles. × 4.2311 = 71.9287

Total = 580.7415

W18 per day = DD x DL x W_{18} = 0.8 x 0.5 x 580.7415 = 232.2966

W18 per year = 365 x 232,2966 = 84788,259

Standard axle loads for design lanes during design life:

$$W18 = W18 \times \frac{((1+g)^n - 1)}{g} = 84788{,}259 \times \frac{((1+0{,}0514)^{20} - 1)}{0{,}0514}$$

= 2845447,365

= 2845447,365 standard axle load

Finding SN Value With SN . Value Determinant Log Formula

In the analysis of traffic that can be served by pavement construction, the logequation (W18) is used.

$$Log_{10}(W_{18}) = Z_R S_0 + 9{,}36 \times log_{10}(SN+1) - 0{,}20 + \frac{log_{10}\left(\frac{\Delta IP}{IP_0 - IP_f}\right)}{0{,}40 + \frac{1094}{(SN+1)^{5{,}19}}} + 2{,}32 \times log_{10}(M_R) - 8{,}07$$

Is known:

SN assumption	= 1.4
Zr	= -1,282
So	= 0.5
MR	= 122560 psi
IP	= IP0 – IPt = 3.9 – 2.5 = 1.4
Ipf	= 1.5
W18	= 2845447,365ESAL
Log10W18	= 6,454

From the formula, the following results are obtained6.454 = (-0.641) + 3.381 + (-0.020) + 3.735

6.454 = 6.454

SN value obtained SN1 = 1.4

From the calculation with the previous formula, the SN . value has been obtainedSN1 = 1.4

SN2 = 3.1

SN3 = 4

Determining the Drainage Coefficient

Table 12. Drainage coefficient (m) to modify the coefficient of relative strength of untreated base and subbase materials in flexible pavements.

DrainageQuality	Percentage of pavement structure time is affected by water content approaching saturation			
	< 1%	1 -5 %	5 -25%	>25%
Very well	1.40 – 1.35	1.35 – 1.30	1.30 – 1.20	1.20
Well	1.35 – 1.25	1.25 – 1.15	1.15 – 1.00	1.00
Currently	1.25 – 1.15	1.15 – 1.05	1.00 – 0.80	0.80
Bad	1.15 – 1.05	1.05 – 0.80	0.80 – 0.60	0.60
Ugly as hell	1.05 – 0.95	0.95 – 0.75	0.75 – 0.40	0.40

Source: AASHTO 1993

Based on table 7, the drainage coefficient for m3 and m2 is 1.25.

Determining the Minimum Thickness of Each Pavement

The minimum thickness of each pavement layer can be determined by thefollowing formula and calculations:

Surface Coating

$D1^* \geq \frac{SN1}{a_1}$

$\geq \frac{1,4}{0,4}$

3.5 inches

Take the thickness of D1 = 3.5 inches = 8.89 cm = 9 cm

Foundation Layer

$SN1^* = a_1 \times D1^*$

$= 0.40 \times 3.5$

$= 1.4$

$SN2^* = SN_2 - SN1^*$

$= 3.1 - 1.4$

$= 1.7$

$D_2^* \quad \frac{SN_2 - SN^*}{a_2 m_2}$

$\geq \left(\frac{1,7}{0,29\ x\ 1,25}\right)$

4.6897inch

Then take the minimum thickness D2 = 4.6897 inches = 11.9118 cm = 12 cm

Bottom Foundation

SN2* = D2* x a2 x m2

= 4.6897 x 0.29 x 1.25

= 1.7

D3* $\geq \left(\frac{SN_3^* - (SN^* + SN^*)}{a_3 m_3}\right)$

$\geq \left(\frac{\mathbf{4 - (1{,}4 + 1{,}7)}}{\mathbf{0{,}125\ x\ 1{,}25}}\right)$

5.76 inches

Then the minimum thickness is taken D3 = 5.76 inches = 14.6304 cm = 15 cmTable 13.

Pavement Thickness Calculation Results

Table 14. Cross Section Section Pavement Thickness Pt T 01-2002-B

No.	Layer	SN value	A	D min (cm)	D (inch)	D(cm)
1	AC - WC	1.4	0.400	10	3.5	4
	AC - BC					6
2	Foundation Layer (AC – BASE)	3.1	0.290	15	4.6897	15
3	Lower Foundation Layer (Class B Aggregate)	4.0	0.125	15	5.76	15
4	Ground	-	-	-		

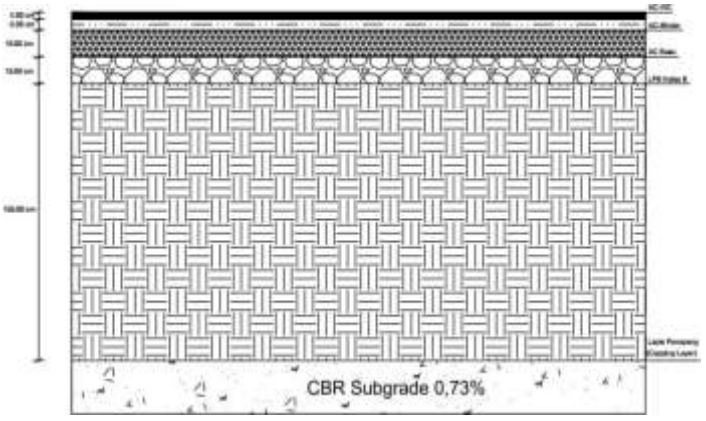


Table 15. The results of the calculation of pavement thickness Design Manual 02/M/BM/2017, Pt T 01-2002-B Method and Consultant Plan Drawings

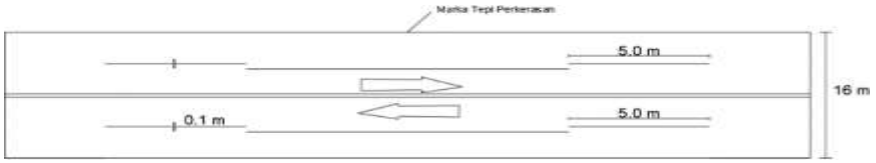
No	Main LayerComponents	MDP2017 (cm)	Pt T 01-2002-B			ConsultantPlan Drawing(cm)
				Value D*(cm)		
1	AC - WC	4	4	10	D1*	4
2	AC -BC	6	6			-
3	AC - BASE	8	15	15	D2*	7.5
4	CLASS A FOUNDATIONLAYER	30	-	-		20
5	FOUNDATION LAYER UNDER CLASS B	-	15	15	D3*	-
6	SUPPORT LAYER	155	-	-	-	-

D. Design of Auxiliary Buildings and Road Equipment

Road Marking Planning with Pd Method. T-12-2004-B

The type to be chosen depends on the pavement conditions and the environmentaround the road segment. The 3 types of markers that will be planned include:

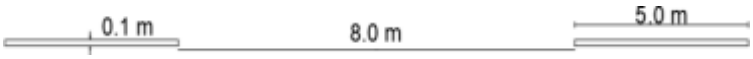
Determining the Type of Marking used on the Edge of the Pavement



Picture 6. Placement of Longitudinal Markings and Double Lines AlternateMedian Top View

Road markings taken at the edge of the road are full line longitudinal markings witha minimum length of 20 m, full width 0.1 m.

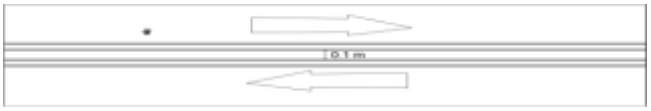
Determining the Type of Lane Separator Marking



Picture 7. Placement of Longitudinal Marking and Median Substitution DoubleLines Side View

Road markings that separate the long line of the dotted line are 5.0 m and the distance of the dashed line is 8.0 m.

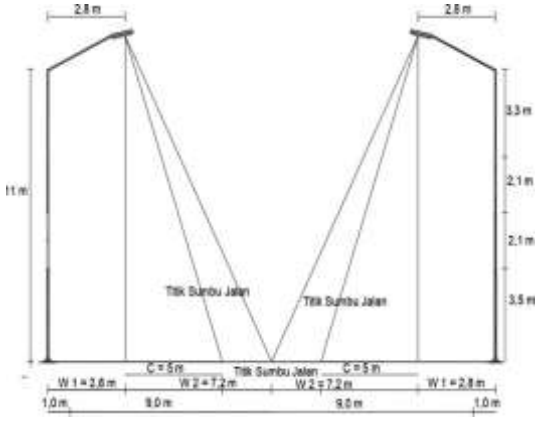
Path Separator Mark Type Determination



Picture 8.Median Substitution Line top view

The median substitute road marking is a complete double line parallel to the distance between adjacent longitudinal lines or double lines, a minimum of 0.1 meters and a maximum of 0.18 meters.

Planning of Street Lighting with SNI 7391:2008 method.



Picture 9.Location of Street Lights

The length of the road that is reviewed at the intersection of North Ring Road - Simpang 3 Golf - Kasturi Road (STA 8+306 – STA 9+462) for the installation of street lighting is 1156 m long. The number of light points (poles) can be calculated by the formula:

$$T = \frac{L}{S} + 1 = \frac{1156}{50} + 1 = 24 \text{ unit}$$

Remarks: T = lamppost (unit)

L = Length of Road under consideration (m)S = distance between design piles (m)

Because it is planned with a single pole and facing each other, then we get 24 x 2 =pole unit with a total of 48 lamps.

Planning a Road Drainage System with the Pd method. T-02-2006-BThe calculation results :

I = 177.36 mm/hourA = 0.15305 km2

C = 0.396

Calculation of Water Flow Discharge (Q)

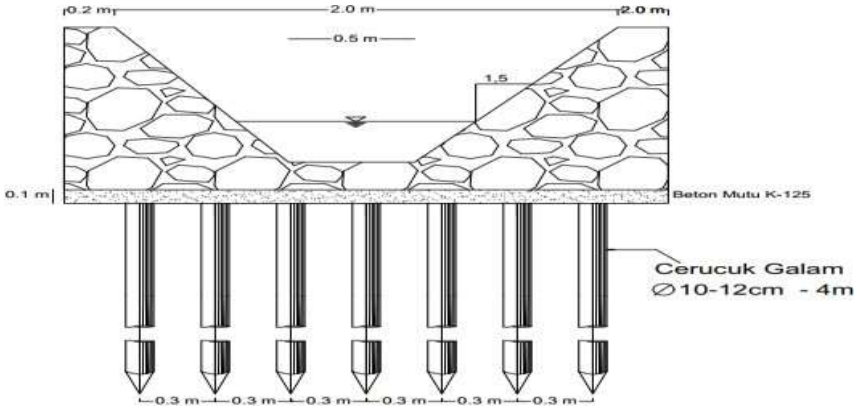
$Q = \frac{1}{3,6} \overline{C.I.A}$

Q = x 0.396 x 177.36 x 0.15305 = 2.986 $\frac{1}{3,6}$ —

Channel Dimension Calculation Result Data

Qchannel	= 0.305 m^3/second
Qaliran	= 2,986 m^3/second
Channel width (B)	= 2 m
Channel width (b)	= 0.5 m
Guard height	= 0.5 m
Wet cross-sectional area	= 1 m^2
Around	= 3.803 m
Hydraulic spokes	= 0.2 m
Channel speed	= 0.309 m^3/second
Longitudinal channel slope	= 0.1%

Drainage Channel Cross Section Gambar



Picture 10. Drainage Channel Cross

E. Calculation of the Cost Budget Plan

REKAPITULASI
PERKIRAAN HARGA PEKERJAAN

Nama Paket ; Pembangunan Jalan Simpang 3 Lingkar Utara - Simpang 3 Jalan Golf - Jalan Kasturi

Prop/Kab/Kodya ; Banjarbaru

No. Divisi	Uraian	Jumlah Harga Pekerjaan (Rupiah)
1	Umum	0,00
2	Drainase	4.300.787.559,03
3	Pekerjaan Tanah	12.772.440.278,12
4	Pelebaran Perkerasan dan Bahu Jalan	0,00
5	Perkerasan Non Aspal	6.392.061.898,01
6	Perkerasan Aspal	6.470.053.333,97
7	Struktur	0,00
8	Pengembalian Kondisi dan Pekerjaan Minor	565.308.195,21
9	Pekerjaan Harian	0,00
10	Pekerjaan Pemeliharaan Rutin	0,00
(A) Jumlah Harga Pekerjaan *(termasuk Biaya Umum dan Keuntungan)*		30.500.651.264,35
(B) Pajak Pertambahan Nilai (PPN) = 10% x (A)		3.050.065.126,43
(C) JUMLAH TOTAL HARGA PEKERJAAN = (A) + (B)		33.550.716.390,78
Terbilang : (Tiga Puluh Tiga Miliar Lima Ratus Lima Puluh Juta Tujuh Ratus Enam Belas Ribu Tiga Ratus Sembilan Puluh Rupiah		

From the results of the calculation of the RAB for the construction of the Simpang 3 North Ring Road- Simpang 3 Jalan Golf-Jalan Kasturi based on the Design Manual 02/M/BM/2017 along 1.1 km is Rp. 33,550,716,390 (Thirty Three Billion Five Hundred Fifty Million Seven Hundred Sixteen Thousand Three Hundred Ninety Rupiah).

5. Closing

Conclusion

1. Based on the results of the analysis of the prediction of the planned life of the Average Daily Traffic (LHR) data on the Simpang 3 North Ring Road - Jalan Golf - Jalan Kasturi intersection, it is planned with a planned life of 20 years at the beginning of the planned life in 2022. Remaining Life is 97.02% and converted to the year of 19.40 years and at the end of the design life in 2041 by 0% converted to the year of 0 years. So it can be concluded that if the smaller the range towards the final year of the design life, the smaller the percentage of the remaining life of flexible pavement (Remaining Life) so that the road service function will also be shorter for road users. So that during the design life the road remains in good condition,routine maintenance must be carried out.
2. From the calculation results of the 2 methods there are differences in the thickness of the flexible pavement. In the calculation of flexible pavement thickness using the Road Pavement Design Manual method no. 02/M/BM/2017

namely AC WC = 4 cm; AC Binder = 6 cm; AC Base = 8CM; LPA = 30 cm and CBR Subgrade = 0.73% with Support Layer = 1550. As for the calculation results of the Pt T-01-2002-B method, the results obtained are AC-WC pavement thickness = 4 cm, AC BC = 6 cm, AC Base = 15 cm, LPB = 15 cm.

3. From the results of planning complementary buildings and road equipment. First, the road markings, in planning the road markings taken on the edge of the road, are full line longitudinal markings with a minimum length of 20 m, full width 0.1 m, for road markings separating the lanes, the length of the dotted line is 5.0 m and the distance of the line gap. the dashed line is 8.0 m and for the alternate road marking, the median is the complete double linemarking parallel to the distance between adjacent longitudinal lines or double lines, a minimum of 0.1 meters and a maximum of 0.18 meters. The second is Public Street Lighting. As for the type of lamp used is the type of SON/SON-T 400 W. The lampposts are installed on two sides of the road. Single pole handlebars are used with ornament length of 2.8 and pole height of 11 m, for a distance between lamps of 50 m.Qchannel = 0.305 m3/second and Qstream = 16.3824 m2/second.
4. The Budget Plan (RAB) for the construction of Jalan Simpang 3 North Ring-Road Golf-Jalan Kasturi based on Design Manual 02/M/BM/2017 along 1,156 km is Rp. 33,550,716,390(Thirty Three Billion Five Hundred Fifty Million Seven Hundred Sixteen Thousand Three Hundred Ninety Rupiah)

Suggestions

1. In road pavement planning, accuracy is needed in analyzing the data that will be used, especially in calculating the average daily traffic as the cumulative standard load used. Should pay attention to correct data collection techniques and proper justification to reduce errors (errors) in planning so that the results of road pavement planning are effective and efficient and it is hoped that for further research, the calculation of the estimated life of the plan with other methods can be made so that it can be taken into consideration. in predicting the life of flexible pavement.
2. In the design of flexible pavement, it must refer to the existing specifications so that the optimum design is obtained. Meanwhile, if the design does not meet the standards in the specifications, a correct solution to the problem is needed so that

there is no loss in terms of the implementation method as well as the budget.

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