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ANALYSIS OF PAVEMENT THICKNESS OF ROAD REHABILITATION PROJECT SP. LIANG ANGGANG –CITY BOUNDARY OF PELAIHARI SECTION 1 (STA. 3+700 - STA. 7+300) CITY OF BANJARBARU

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ABSTRACT

Roads are an important role for life, as road infrastructure there are still many problems such as less safe, comfortable and some are located in flood-prone areas. the case is like in the SP segment. Liang Anggang - Ds. Liang Anggang (Bts. Tanah Laut Regency) is a location affected by flooding, so it is necessary to raise the road body to the specified flood water level, so to overcome this problem it is necessary to raise the road body so that road infrastructure can support both the safety and comfort of road users. The purpose of this study was to re-plan the flexible pavement thickness using the Road Pavement Design Manual Method Number 02/M/BM/2017 and the Pt-T-01-2002B method, as well as to compare the calculation results and pavement thickness with the Planning Design.

The results of the planning using the Flexible Pavement Design Manual method Number 02/M/BM/2017, namely with a surface layer of AC–WC 40 mm, AC–BC 60 mm, AC–BASE 105 mm, Upper Foundation Layer with Class A Aggregate 300 mm and Support layer with optional fill of 550 mm, and Road Shoulders with Class S Aggregate Foundation layer of 205 mm. The Pt T 01-2002-B method requires a surface layer of 40 mm AC–WC, 70 mm AC–BC, Upper Foundation Layer with Class A Aggregate 210 mm, and Lower Foundation Layer with Class B Aggregate 230 mm. From the planning results of the two methods to be compared with the Plan Drawings, there are differences in the surface layer requirements where the Flexible Pavement Design Manual Method Number 02/M/BM/2017 with the Plan Drawings both use AC–WC, AC–BC, and AC-BASE. while the Pt T 01-2002-B method does not use AC-BASE. There is no difference in Upper Foundation Layer or both use Class A Aggregate Foundation, while significant differences occur in the sub-base layer as subgrade improvement, there is a difference, namely in the Flexible Pavement Design Manual method Number 02/M/BM/2017 and Plan Drawings using support layer using selected fill while the Pt T 01-2002-B method uses Class B Aggregate Lower Foundation Layer. The magnitude of the difference in pavement thickness occurs due to differences in pavement design and material selection, the Flexible Pavement Design Manual method Number 02/M/BM/2017 for the type of material has been determined in the table while the Pt T 01-2002-B method can plan the type of pavement material you want to planned.

Keywords: *Pavement thickness, Flexible pavement, Flexible Pavement Design Manual Method Number 02/M/BM/2017, Method Pt-T-2002-B*

1. INTRODUCTION

Roads are an important role for life, as road infrastructure there are still many problems such as less safe, comfortable, and some are located in flood-prone areas. The case is as in the intersection (SP). Liang Anggang - Liang Anggang Village (Tanah Laut Regency Boundary) is a location that is affected by flooding so that it is necessary to raise the road body to the specified flood water level, so to overcome this problem it is necessary to raise the road body so that road infrastructure can support both the safety and comfort of road users . The location of the activities of the Sp. Road Rehabilitation Package Package. Liang Anggang – Pelaihari City Boundary Section 1 is located on the Liang Anggang road section, which is located in the Liang Anggang sub-district, Banjarbaru City. For a sketch of the project location, see Figure 1 of the research location.

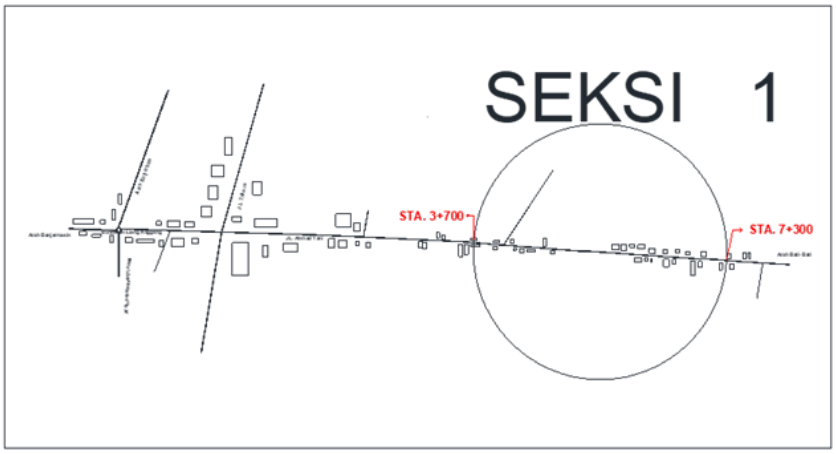

Figure 1 Research Locations

2. THEORITICAL STUDY

Based on the Law of the Republic of Indonesia Number 38 of 2004 which is a Law on Roads, roads are land and sea transportation facilities that are above the surface of land or water which include all parts of the road, complementary buildings and other complements. (Article 1 Paragraph 4 of Law No. 38/2004 street). Based on the design guidelines for flexible pavement thickness, the Road Pavement Design Manual method 02/M/BM/2017, roads as a means of land transportation are very important for the community so that roads are made to facilitate travel which can connect one area to another so that roads must made from various considerations such as structural requirements, economy, durability, convenience, and safety. The pavement itself is to

spread or distribute the wheel load to all areas without causing damage to the road construction, which can reduce the maximum stress that occurs in the subgrade (Manual Road Pavement Design 02/M/BM/2017).

The flexible pavement structure based on the Pt-T-01-2002-B method consists of a subbase course, a base course, and a surface course (Pt-T-01-2002 B method). The purpose of this study is to re-plan the flexible pavement thickness with the Road Pavement Design Manual method 02/M/BM/2017 and the Pt-T-01-2002B method, as well as a comparison of the calculation results, pavement thickness with Planning Design.

3. METHOD

This research starts from the preparation and study of literature, collecting data which includes primary data and secondary data (field CBR data, LHR data, and existing visual images in the field) and secondary data (topographic data on conditions around the field and traffic growth rate data and planning pictures).

Then proceed with processing the data and verifying the data obtained from the planning, so that the pavement thickness design is obtained from the two methods and then a comparison of the pavement thickness is carried out by the two methods of Road Pavement Design Manual Number 02/M/BM/2007 and the PT-T-01- method. 2002-B with drawings of the results of the planning in the field. After knowing the results of the comparison of the design, the final conclusion is obtained.

4. RESULT AND DISCUSSION

Roads average Daily Traffic Data, using data from field surveys on SP roads. Liang Anggang - Ds. Liang Anggang borders Tanah Laut Regency, LHR data obtained is survey data 7x24 hours.

Based on CBR analysis, from the field survey, 19 subgrade CBR data were obtained which were then processed to obtain CBR values for points on the surveyed

Calculation of Road Pavement Design Manual Method 02/M/BM/2017

- Determining the Design Age, Determining the design age of the new road pavement taken from the relationship between the type of pavement and the pavement elements in accordance with the road pavement guidelines number 02/M/BM/2017, from these

provisions, the design age for flexible pavement is 20 years and the road foundation for 40 years.

- Lane Distribution (DL), On the Liang Anggang road the lane distribution value is 80% 1 lane 2 directions
- Determine the CESA value, determine the traffic growth rate for the Kalimantan area of 5.14% and calculate the traffic growth multiplier factor: R(2019-2022) = 3.01544642 and R(2022-2042) = 21.00738724.
- Calculating cumulative equivalent single axle (CESA), from the calculation results obtained the value of CESA7.149516 and ESA 5.659.291.8.
- Determining the Type of Pavement, the type of pavement for selecting the pavement design age for 20 years, the ESA value of 5,659,291.8 or 5,659 x 106 is between >4-10 million, determining the pavement structure, then the selected pavement is AC thick 100mm with a foundation layer bulleted (ESA to the power of 5).
- Determining the Road Foundation Structure, determining the road foundation structure, it is known that the bearing capacity of the soil calculated is 4.2% with the subgrade strength class being SG4 with the road foundation structure using a supporting layer with a minimum thickness of 200 mm with an increase in the subgrade so that the CBR of the subgrade > 6% then add 350 mm thick.
- Pavement Thickness Design, pavement design based on the design chart in the road pavement design manual 02/M/BM/2017 the choice of the type of pavement selected according to field conditions used the chart in the Chart Design-3B table. Flexible pavement design.
- Shoulder design, the total thickness of the main lane pavement = 505 mm > 400 mm (minimum thickness), the surface thickness of the shoulder is a layer of S class aggregate as thick as 205 mm. It is covered with asphalt as thick as the main lane pavement.

Flexible Pavement Design Method Pt T 01-2002-B

- Determining the Surface Index, the type of surface index is divided into two, namely:
    1. Determining the Initial Surface Index (IPo), taken the IPo value of 3.9 by determining the surface index at the beginning of the design life (IPo) which is 3.9 - 3.5 with unevenness (IRI, m/km) > 1.0.

2. Determining the final surface index (IPt), the IPt value is obtained based on the road classification and including arterial roads of 2.5, a value of 2.5 is taken which means the surface is still quite stable and good.

- Determining the Directional Distribution Factor (DD), the value of DD is between 0.3 to 0.7, then 0.5 is taken for planning.
- Determining the Lane Distribution Factor (DL), the Liang Anggang-Bati-bati road is of the type 1 Lane-2 Lane-2 Undivided Direction (2/2 TB) with standard axle loads in the planned lane taken the value of 80% or DL = 0,8.
- Determining the Reliability Value (R), the Liang Anggang - Bati-bati road section includes the function of an arterial road with a reliability level ranging from 75% - 95% for Planning, the middle value is taken because the location shows the road that serves the most traffic, then the value is taken, namely 85%
- Standard Deviation (So), the value of the range of So given is 0.4 - 0.5 from these provisions, the highest value is 0.5.
- Standard Normal Deviate (ZR), the value of the standard normal deviation (standard normal deviate) for a certain level of reliability, then with a reliability of 85%, the ZR value is -1.037.
- Reliability Factor (FR), Reliability Factor is determined using the following formula:

  FR = $10^{-ZR(So)}$ = $10^{-(-1,037)(0,5)}$ = 3,30

- Determining the bearing capacity of the subgrade, the average CBR value of the subgrade is 90%, which is 5.33%.
- Determining the Resilient Modulus (MR) Value of Each Layer, from the CBR value correlated to MR which acts as a parameter used in planning with the following calculation:

  MR (psi) = 1500 x CBR

  = 1500 x 5,33 = 7995 psi

- Determine the relative coefficient of layer

1. Laston Surface
   - Layer - Aus Layer/AC-WC with a value of1= 0.400
   - Intermediate Layer/AC-BC with a value of1= 0.344

2. Foundation Layer: Class A Aggregate Foundation with a value of a_2= 0,290
3. Lower Foundation Layer/ Class B Aggregate with a value a_3= 0,125

Estimating the relative coefficient values for the Base and Subbase as follows:

a_2 = 0,249 ($\log_{10}$ EBS) – 0,977

0,290 = 0,249 ($\log_{10}$ EBS) – 0,977

1,267 = 0,249 ($\log_{10}$ EBS)

^{10}Log EBS = 5,08835

EBS = $10^{5,08835}$

EBS = 122560 psi

MR_{base} = EBS = 122560 psi

a_3 = 0,227 ($\log_{10}$ EBS) – 0,837

0,125 = 0,227 ($\log_{10}$ EBS) – 0,837

0,962 = 0,227 ($\log_{10}$ EBS)

^{10}Log EBS = 4,23788

EBS = $10^{4,23788}$

EBS = 17293 psi

$MR_{subbase}$ = EBS = 17293 psi

- Determining the value of W18, the calculation is presented in the form of a table as follows.

Table 1 Vehicle Axle Loading Data

Goal. Vehicle	Type of Vehicle (axle configuration)	Axle Load			Total Axle Load (Tons)
		SB I	SB II	SB III	
2	Sedan, Jeep dan Station Wagon (1.1)	1	1		2
5b	Big Bus (1.2)	3,06	5,94		9
6a	Truck 2 Axis (4 Wheels) (1.1)	2,822	5,478		8,3
6b	Truck 2 Axis (6 Wheels) (1.2)	6,188	12,012		18,2
7a	Truck 3 Axis (1.2.2)	6,25	18,75		25
7b	Trailer Truck (1.2.2-2.2)	4,716	10,472	10,472	26,2
7c	Truck Semi Trailer (1.2.2.2)	7,56	11,76	22,68	42

Source: (Vehicle Axle Load,2022)

Determining the Axis Equivalent Figures of the vehicle (E) presented in the Table.

Table 2 Number Axis Equivalent (E)

Goal. Vehicle	Type (axis configuration)	Vehicle Axis Equivalent Value			E Total
		SB I	SB II	SB III	
2	Sedan, Jeep dan Station Wagon (1.1)	0,0013	0,0013		0,0025
5b	Big Bus (1.2)	0,1111	1,5778		1,6889
6a	Truck 2 Axis (4 Wheels) (1.1)	0,0804	1,1413		1,2216
6b	Truck 2 Axis (6 Wheels) (1.2)	1,8582	26,3850		28,2433
7a	Truck 3 Axis (1.2.2)	1,9338	156,6396		158,5734
7b	Trailer Truck (1.2.2-2.2)	0,6269	15,2411	15,241	31,1090
7c	Truck Semi Trailer (1.2.2.2)	4,1398	24,2396	335,327	363,7066

Source: (Results of the 2022 Vehicle Axle Load Calculation, 2022)

Table 3 Calculation of W18

Goal. Vehicle	LHR Vehicle/ Day	E Total	D_D	D_L	$\frac{((1+g)^n-1)}{g}$	Number of Days in a Year	W_{18}
1	2	3	4	5	6	7	8=2x3x4x5x6x7
2	1172	0,0025	0,5	0,8	33,559	365	14556,90
5b	4	1,6889	0,5	0,8	33,559	365	34281,61
6a	241	1,2216	0,5	0,8	33,559	365	1441660,95
6b	39	28,2433	0,5	0,8	33,559	365	5436400,45
7a	15	158,5734	0,5	0,8	33,559	365	11321251,60
7b	2	31,1090	0,5	0,8	33,559	365	239520,45
7c	7	363,7066	0,5	0,8	33,559	365	12219579,59
Jumlah							**30707251,54**

Source : (Calculation Results W18, 2022)

Determining the SN

Value The SN value is determined based on the data from the results of the previous calculation steps as follows:

W18 = 30.707.251 ESAL

Zr = -1,037

So = 0,5

R = 85 %

ΔIP = IP0 – IPt = 3,9 – 2,5 = 1,4

MRbase = 122560 psi.

MRsubbase = 17293 psi

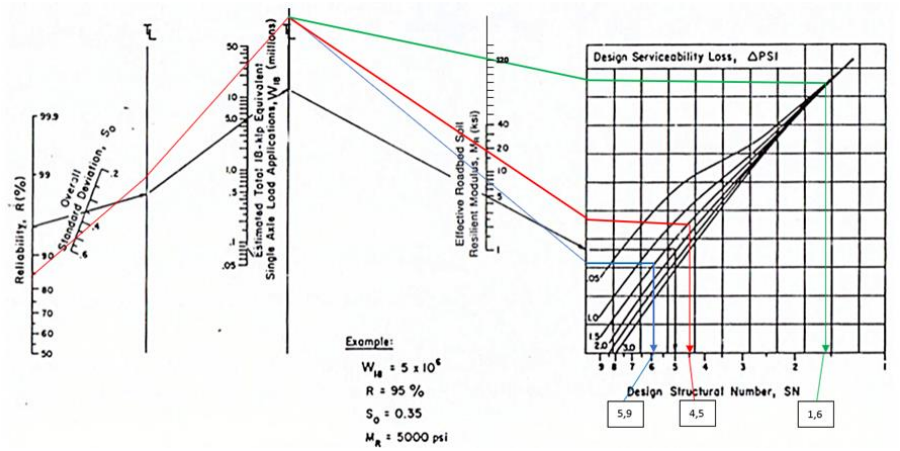

Figure 2 Determining the SN value using the Nomogram

From the nomogram above, the SN values for each layer are as follows:

SN1 = 1,6 , SN2 = 4,5 , SN3 = 5,9.

- Determining the Drainage Coefficient, for Good drainage quality (water lost in 1 day) and the drainage coefficient value is 1.25
- Determining the Minimum Thickness of Each Pavement

$D_1^* \geq \frac{SN_1}{a_1}$

$\geq \frac{1,6}{0,4}$

$\geq$ 4 inci= 10,16 cm = 11 cm

$SN_1^* = a_1 \times D_1^*$

$= 0,400 \times 4$

$= 1,6$

$SN_2^* = D_2^* \times a_2 \times m_2$

$= 8 \times 0,290 \times 1,25$

$= 2,9$

$D_3^* \geq \left(\frac{SN_3 - (SN_1^* + SN_2^*)}{a_3 m_3}\right)$

$\geq \left(\frac{5,9 - (1,6 + 2,9)}{0,125 \times 1,25}\right)$

$\geq$ 8,96 inci= 22,76 cm = 23 cm

$SN_2^* = SN_2 - SN_1^*$

$= 4,5 - 1,6$

$= 2,9$

$D_2^* \geq \frac{SN_2 - SN_1^*}{a_2 m_2}$

$\geq \frac{4,5-1,6}{0,290\ x\ 1,25}$

$\geq$ 8 inci = 20,32 cm = 21 cm

Comparison of Flexible Pavement Thickness

Table 4 Pavement Thickness Results

Layer Components	Plan Design (mm)	MDP 2017 (mm)	Pt T 01-2002- B (mm)			Minimum Thickness (mm)
				Nilai D*		
AC – WC	40	40	40	110	D1*	40
AC – BC	60	60	70			60
AC – Base	80	105	-	-		100
Aggregate Class A	350	300	210	210	D2*	150
Aggregate Class B	-	-	230	230	D_3*	100
Capping Layer	Varies	200	-			Depends on CBR
		350	-			

Source : (Results of the 2022 Flexible Pavement Thickness Calculation)

5.CONCLUSIONS

The results of the planning using the Flexible Pavement Design Manual Number 02/M/BM/2017, namely the Surface Layer AC – WC 40 mm, AC – BC 60 mm, AC – BASE 105 mm, Upper Foundation Layer with Class A Aggregate 300 mm and Foundation Layer Bottom with 550 mm optional fill, and Road Shoulders with 205 mm Class S Aggregate Foundation. Using the Pt T 01-2002-B method, namely with AC – WC 40 mm, AC – BC 70 mm, Upper Foundation Layer with Class A Aggregate 210 mm, and Lower Foundation Layer with Class B Aggregate 230 mm.

From the results of the planning of the two methods to be compared with the Plan Drawings, there are differences in the surface layer requirements where the Flexible Pavement Design Manual Method Number 02/M/BM/2017 with the Plan Drawings both use AC–WC, AC–BC, and AC-BASE. while the Pt T 01-2002-B method does not use AC-BASE. There is no difference in the Upper Foundation Layer or both use Class A Aggregate Foundation Layers, while significant differences occur in the subbase layer as subgrade improvement, there is a difference, namely in the Flexible Pavement Design Manual method Number 02/M/BM/2017 and Plan Design using support layer using selected fill while the Pt T 01-2002-B method uses Class B Aggregate Lower Foundation Layer.

The magnitude of the difference in pavement thickness occurs due to differences in pavement design and material selection where the Flexible Pavement Design Manual method Number 02/M/BM/2017 where the type of material has been determined in the

table while the Pt T 01-2002-B method can plan the type of pavement material you want to plan.

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