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Analysis of Road Flexible Pavement Using The Bina Marga Method on Road Area of Aituto – Ainaro (Km 89 + 000 To Km 112 + 000) Timor Leste

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Abstract

The highway is one of the transportation infrastructure that is being used to support economic activities. However, often on the road there is damage to the pavement which makes the comfort of the rider disturbed. One of them is Jalan Aituto – Ainaro Timor – leste, this road is a connecting road from the district city to the village. The purpose of this study was to determine in planning the thickness of flexible pavement on the 1987 SKBI Component Analysis Method, the 2017 Highways Method and the Dimensions of Edge Channels. The method used is an unstructured observation method and data collection in the form of primary data about the condition of the area on the Aituto - Ainaro Timor - Leste Road and secondary data in the form of LHR data, CBR data, road geometric data and rainfall data. From the results of the analysis of the component analysis method, the surface layer uses Asphalt MS 340 with a thickness of AC-WC 5 cm AC-BC 5 cm, the upper foundation layer uses Aggregate Class A with a thickness of 20 cm, and the sub-base layer uses Aggregate Class B with a thickness of 10 cm. . Meanwhile, from the results of the 2017 Bina Marga analysis, it was obtained that the surface layer used AC - WC with a thickness of 4 cm and AC - BC with a thickness of 6 cm, the upper foundation layer used AC - Base with a thickness of 14 cm and the lower foundation layer used LPA class A with a thickness of 30 cm. . The shape of the edge channel is rectangular with the channel dimensions calculated from the calculation of the channel width 0.8 m, channel height 0.7 m and girder height 0.6 m. and sub-base layer using Aggregate Class B with a thickness of 10 cm. Meanwhile, from the results of the 2017 Bina Marga analysis, it was obtained that the surface layer used AC - WC with a thickness of 4 cm and AC - BC with a thickness of 6 cm, the upper foundation layer used AC - Base with a thickness of 14 cm and the lower foundation layer used LPA class A with a thickness of 30 cm. . The shape of the edge channel is rectangular with the channel dimensions calculated from the calculation of the channel width 0.8 m, channel height 0.7 m and girder height 0.6 m. and sub-base layer using Aggregate Class B with a thickness of 10 cm. Meanwhile, from the results of the 2017 Bina Marga analysis, it was obtained that the surface layer used AC - WC with a thickness of 4 cm and AC - BC with a thickness of 6 cm, the upper foundation layer used AC - Base with a thickness of 14 cm and the lower foundation layer used LPA class A with a thickness of 30 cm. . The shape of the edge channel is rectangular with the channel dimensions calculated from the calculation of the channel width 0.8 m, channel height 0.7 m and girder height 0.6 m.

Keywords
Bina Marga Method 2017, Pavement Thickness Analysis, 1987 SKBI Component Analysis

1. Preliminary

a. Background

Road pavement is one of the main structures that are important for road construction, where the pavement layer serves to withstand and accept the volume of traffic loads and spread it to the layer below it and forward it to the subgrade during the service life. Based on the binding material of the road pavement layer, it is divided into two categories, namely the flexible pavement layer using asphalt and the rigid pavement layer using cement.

A good pavement function certainly requires an effective pavement method so that the design and performance of the road runs optimally. Indonesia has regulations and guidelines in the planning of road pavement structures which are the result of modification and adjustment of methods from several developed countries such as the Road Note (UK)

b. Problem Formulation

Based on the background that has been described, the formulation of the problem to be studied is:

1. What is the thickness of the flexible pavement layer required in the Analysis method.
2. How is the comparison of the flexible pavement thickness for each method: the 1987 Component Analysis Method and the 2017 Road Pavement Manual?
3. What are the dimensions of the curb channel

c. Scope of problem

The problem constraints used in the study are:

1. This study uses secondary data and primary data in the form of LHR data and CBR data
2. The methods used in this research are:
   a. Component Analysis Method 1987
   b. Road Pavement Manual 2017
3. Planning of pavement layer thickness on AITUTO – AINARO Road Area (KM89 + 000 TO KM 112 + 000 TIMOR – LESTE".
4. This plan does not include road shoulder planning, road complementary buildings.
5. Not planning soil improvement methods

1.1 Research Objectives

The aims and objectives of this research are as follows;

1. Knowing the thickness of flexible pavement on the AITUTO - AINARO Road Area with the 1987 Component Analysis Method and the 2017 Road Pavement Manual.
2. Knowing the ratio of flexible pavement thickness of each Bina Marga method: 1987 Component Analysis Method and 2017 Road Pavement Manual.
3. Knowing how many dimensions of curbside channel.

1.2 Research Benefits

This research can provide benefits as a comparative review in planning effective flexible pavement thickness using the Bina Marga method which may be used as reference material and consideration by related parties in formulating road construction techniques on the AITUTO - AINARO road area according to actual conditions.

2. Literature Review

2.1. Previous Research

Based on research from Muhamad Nauval Araka, Gerson Simbolan, Bagus Hario Setiadji, Ahmadi, (2015) entitled "Comparative Analysis of Flexible Pavement Thickness Planning Using the BinaMarga Method (Case Study of Jalan Piringsurat Batas Kedu Timur)". The results of the study using the (Bina Marga, 2002)method obtained a total pavement thickness of 55 cm, in the 2013 bina marga regulations the total pavement thickness was 94 cm. From this research, it can be concluded that the (Bina Marga, 2002)regulation does not have clear written reference parameters, but planning parameters are provided that can give planners the freedom to design the thickness of the pavement.

2.2 Pavement

Road pavement is a mixture of aggregate with binder used in serving the traffic load of vehicles. The aggregate used is crushed stone or split stone while the binding material used is asphalt, cement, or clay.

1. Subgrade
2. Lower Foundation Layer
3. Top Foundation Layer
4. Surface Coating

2.3. Design Parameters of Flexible Pavement Design

In the process of planning the thickness of flexible pavement there are several things that need to be considered and can affect the results of planning the pavement structure, including the following:

1. Road Function

Functional classification of roads in Indonesia based on the laws and regulations of (Anonim, 2009) can be distinguished into:

a. Primary Arterial Path
b. Secondary Arterial Path
c. Primary Local Road

d. Secondary local road
e. Primary Collector Street
f. Secondary Collector Street
g. Primary Neighborhood Road

2. Road Plan Life
3. Traffic Load
4. Bearing Capacity of Subgrade

2.4 Method of Analysis of SKBI1987 Components

The calculation of pavement thickness using the Bina Marga method uses the 1981 revised AASHTO' as the source which has been adjusted to environmental conditions, nature, soil properties, and types of layers used in Indonesia and is an improvement from the guidelines for Highway Flexible Pavement Thickness No.01/PD/B/1983

1. Traffic

Number of Lanes and Vehicle Distribution Coefficient (C)

The number of lanes is determined from the width of the road planning pavement

The vehicle distribution coefficient (C) for light vehicles and heavy vehicles passing on the planned roadway is determined

2. Axis Load Equivalent Figure

Equivalent Number (E) for each axle load group (each vehicle).

3. Traffic Load
   a. Average Daily Traffic (LHR)
   b. Initial Equivalent Cross (LEP)
   c. Final Equivalent Cross (LEA)
   d. Central Equivalent Cross (LET)
   e. Plan Equivalent Cross (LER)
4. What is CBR

CBR or California Bearing Ratio is a comparison between the penetration load of a layer of soil or pavement against standard materials carried out with the same depth and speed of penetration.

5. Determination of Subgrade Bearing Capacity (DDT) and the price of California Ratio (CBR)
   1) Analytical
   2) Graphically
6. Rational Factor

Rational Factor (FR) is the condition of the field which includes the form of alignment (bends and controls), the percentage of heavy vehicles that stop and the weather climate (rainfall).

7. Surface Index (Ip)

This Surface Index expresses the value of the flatness or smoothness and manageability of the surface related to the level of service for passing traffic.

8. Relative Strength Coefficient

The coefficient of relative strength (a) of each material and its use as a surface layer, top foundation, and sub foundation is determined by correlation according to the Marshall test, compressive strength, and CBR values.

9. Pavement Thickness Index

Pavement Thickness Index (ITP) is obtained by drawing a line on the nomogram graph, the selection of the nomogram is determined from the results of each IP0 and IPt values.

10. Pavement component analysis

This pavement planning calculation is based on the relative strength of each long-term pavement layer, where the determination of pavement thickness is stated by the ITP.

2.5 Road Pavement Manual 2017

The 2017 Road Pavement Design Manual is a complement and revision of the 2013 Road Pavement Design Manual and uses Pt T-01-2002-B and Pd T-14-2003 pavements as the source by sharpening the following aspects: determination of design life, discounted lifecycle low cost, practical construction, and efficient use of materials.

2.6 Channel Dimensions

The effect of water on road pavement due to the penetration of rainwater through cracks, joints, pavement surfaces. Effect of trapped water in the pavement structure

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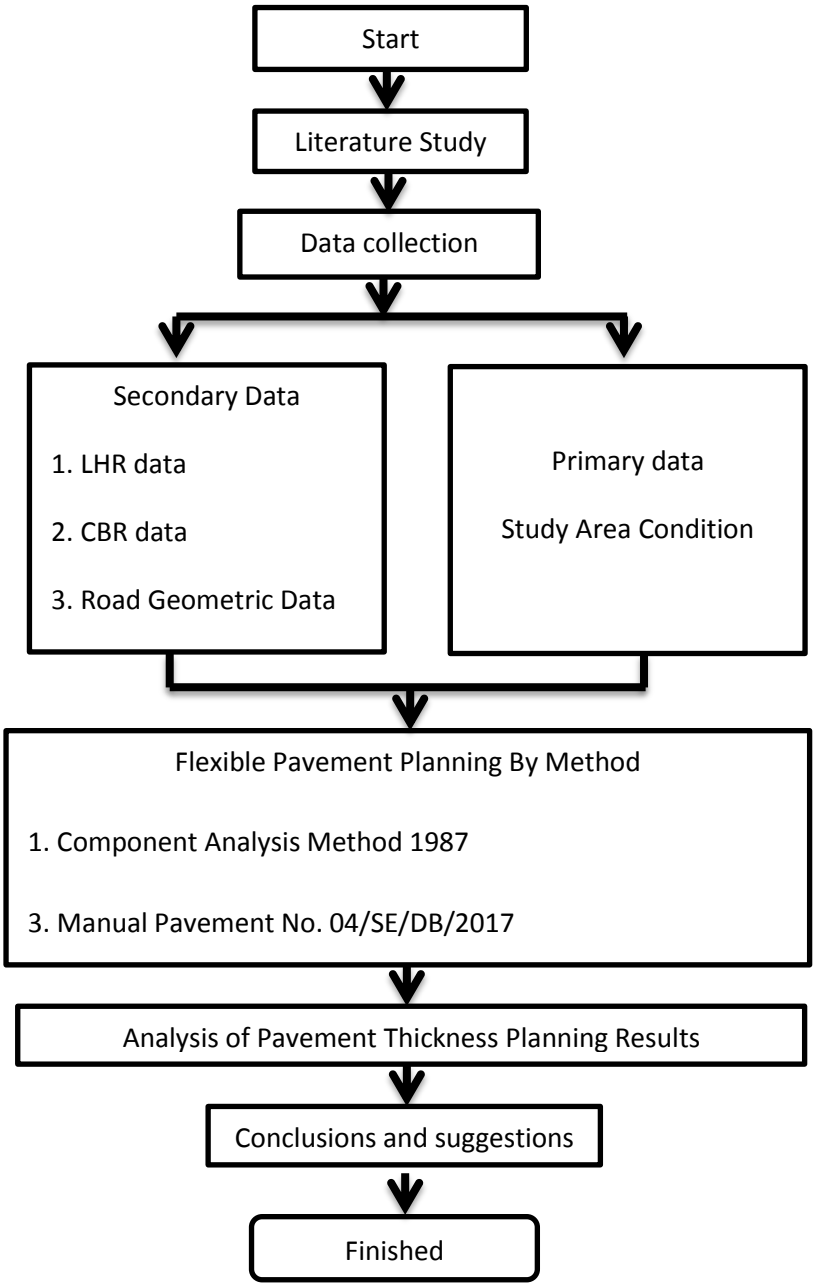
3. Research Methods

3.1 Research Flowchart



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4. Results And Discussion

4.1 Average Daily Traffic Data Aituto,Ainaro Timor – Leste

Table 1. LHR data for Aituto Street, Ainaro Timor – Leste (2015 – 2020)

Transportation type	LHR 2015	LHR 2016	LHR 2017	LHR 2018	LHR 2019	LHR 2020
2 ton car	170	185	201	220	233	246
Big 3 ton bus	28	29	31	32	33	34
Small Truck 2 axle 6 ton	37	39	41	43	45	46
Big Truck 2 Axis 13 tons	40	41	44	45	47	48

Source: PT Chongqing international corporation (CICO)

1. Traffic Growth

In accordance with current data obtained from Ministerio Das Obras Publicas on Aituto Street, Ainaro Timor - Leste

Car

Traffic Growth $= \frac{246-233}{233} x100 = 5{,}57\%$

Bus

Traffic Growth = $\frac{34-33}{33} x100 = 3{,}03\%$

2 Axis Small Truck 6 tons

Traffic Growth = $\frac{46-45}{45} x100 = 2{,}22\%$

2 Axis Big Truck 13 tons

Traffic Growth = $\frac{48-47}{47}$x100 $= 2{,}12\%$

2. Pavement Thickness Arrangement Planning

To design a flexible pavement layer, in general, the minimum thickness of the surface layer is determined based on table 2.10 and the top foundation layer based on table 2.11 with the ITP value, the minimum thickness of each layer is determined as follows:

Surface coating
Type (Asphalt MS 340 kg)
(al): 0.26
Minimum thickness (D1) = 7.5 cm, then D1 = 10 cm
Top foundation layer
Type : Aggregate class A
(a2) : 0.14
Minimum thickness (D2) = 20 cm
Sub foundation layer
Type : Class B Aggregate
(a3) : 0.13
So, the thickness of the sub-base layer is calculated using equation 2.8 as follows:

ITP = a1.D1 + a2.D2 + a3.D3
6.7 = (0.26 x 10) + (0.14 x 20) + (0.13 x D3)
6.7 = 2.6 + 2.8 + 0.13 x D3
6.7-2.6-2.8 = 0.13D3
6.5 = 0.13D3
D3 = $\frac{1,3}{0,13} = 10\ cm$

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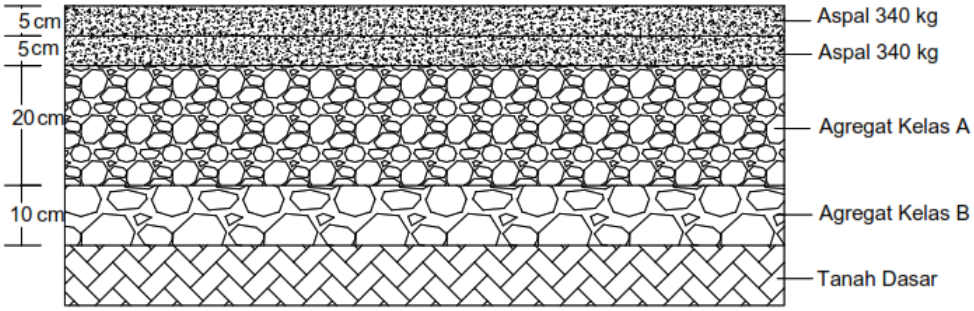

Figure 1. Pavement Thickness Based on the 1987 SKBI

4.2 Manual Pavement Calculation of Road Pavement (REVISION JUNE 2017) No.04/SE/Db/2017

1. Traffic Plan
   a. Planned life
   b. Traffic growth factor (R)
   c. Distribution factor and lane capacity
   d. Cumulative standard axle load (CESA)

Table 2. Cesa Value Calculation

Transportation type	LHR 2019	VDF4	VDF5	VDF4	VDF5
2 Ton Car	246	0.3	0.2	152,643	305,286
Big Bus 3 ton	34	1.0	1.0	210.97	210.97
Small Truck 2 Axis 6 Ton	46	0.8	0.8	228,344	228,344
2 Axis Big Truck 13 Ton	48	1.6	1.7	476.544	844.169
Total	-	-	-	1068	1588,769

2. Selection of Pavement Structure

From the calculation results obtained ESA5 20 years =1588,769 > 10 – 30 million ESA, then from Table 2.32 the pavement type was selected using the 3 flexible pavement design chart. Then the ESA5 value is included in the FFF5 struktur structure

From Table 4.8 for the selection of the type of pavement using design chart 3. Where in the design chart 3 types of pavement use AC – modified WC or modified SMA with CBT (ESA rank).

3. Drainage Coefficient (M)

It is planned that the Aituto, Ainaro Timor - Leste road is equipped with excellent drainage channels, stagnant water disappears within 2 hours, with a water content close to saturation of 1% - 5%, the drainage coefficient value is based on table 2.19 is taken 1.

4. Road foundation design procedure

The result of the subgrade CBR is 17.12% from table 2.21, so the subgrade CBR on the Aituto road, Ainaro Timor - Leste is included in the subgrade strength class SG6, which means that there is no need to increase the subgrade.

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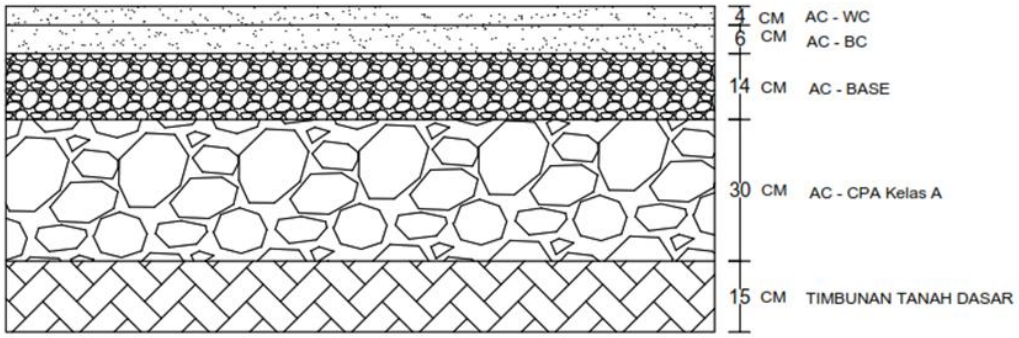

Figure 2. Road Pavement Manual /2017

4.5 Discussion

Based on road pavement planning which refers to the 1987 Component Analysis Method, the flexible pavement design on the surface layer uses MS 744 kg with a thickness of AC – WC 5 cm AC – BC 5 cm, the top foundation layer uses Class A Aggregate with a thickness of 20 cm, the sub foundation layer using Class B Aggregate with a thickness of 15 cm. The planning of the disrupted road pavement in the 2017 Road Pavement Manual Method obtained a flexible pavement arrangement design with a design chart 3b obtained a flexible pavement arrangement design on the surface layer using AC - WC with a thickness of 4 cm and AC - BC with a thickness of 6 cm, the top foundation layer using AC – Base with a thickness of 8 cm, and the sub-base layer using LPA class A with a thickness of 30 cm.

5. Conclusion

Based on the calculation of 2 methods of flexible pavement thickness are as follows:

1. Based on road pavement planning that refers to the 1987 Component Analysis Method, the design of the flexible pavement arrangement in the surface layer uses Asphalt MS 340 kg with a thickness of 7.5 cm, the upper foundation layer uses class A aggregate with a thickness of 20 cm, the sub-base layer uses class C aggregate with a thickness of 20 cm. 10 cm thick.
2. From the two methods, different results were obtained, namely based on road pavement planning which refers to the 2017 Road Pavement Manual Method, the flexible pavement arrangement design with the 3B design chart obtained the flexible pavement arrangement design on the surface layer using AC - WC with a thickness of 4 cm and AC - BC with a thickness of 6 cm, the upper foundation layer using AC - Base with a thickness of 14 cm, and the lower foundation layer using LPA class A with a thickness of 30 cm.
3. Based on the results of the calculation of the dimensions of the drainage channel using a method that is in accordance with the rules used in planning drainage, it is found that the channel width is 0.8 m, the channel height is 0.7 m and the buffer height is 0.6 m with a rectangular channel shape.

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