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Optimizing the Asphalt Strength Quality with Kenpave Software to Improve Community Mobility

Case Study: Road Jampang Tengah – Kiara Dua

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Abstract

Jampang Tengah – Kiara Dua road (Km. Bdg 139 + 000 – 142 + 000) is a secondary arterial road which is a logistics route for products and services, allowing many heavily laden vehicles to pass through this road and the lack of maintenance causes this road to quickly become damaged . This research was conducted to provide a road redesign plan with flexible pavement using the 2017 Bina Marga road pavement design manual method with a structural evaluation of the kenvape program. Based on the results of research using the 2017 Bina Marga method, the thickness of the AC-WC pavement was 4 cm, the AC-BC layer was 13.5 cm, the CTB top foundation layer was 15 cm thick, and the class A bottom layer was 15 cm thick. cm. From the results of structural evaluation using the kenpave program, it was found that the strain value at a depth of 9.9997 cm would experience fatigue cracking of 0.0001914, for the horizontal strain value at a depth of 9.9997 cm there would be groove damage of 0.0003486, for the vertical strain value at a depth of 52.0003 cm will experience permanent damage to the flexible pavement structural layer of 0.0002147.

Keywords: Bina Marga 2017, Flexible Pavement, Kenpave Program, Redesign, Design Life

1. INTRODUCTION

One of the most important components in life-supporting transportation activities is the road. The presence of Bina Marga can facilitate human mobility to move places or move goods and services from one place to another (Lia & Purwo, 2017; Fithra, 2017)

. Thing It is a reference for the development of a transportation system that must be improved starting from organized, safe, and effective development and supported by directed transportation development (Kholiq, 2014; Astuti et al., 2015; Dini, 2019).

This organized, safe and effective development is in line with technological advances that have a significant impact on Indonesia's transportation system, there are many facilities and infrastructure supporting transportation that are very effective and efficient to achieve balance between regions at their growth rate (Dini, 2019; Directorate General of Bina Marga, 2011; Pandey, 2013).

In line with technological developments that have an impact on transportation, one of them is Bina Marga that are needed to support the rate of economic growth and community development so that they can reach remote areas that are the center of agricultural production. Apart from easy transportation access to reach, one of which is road transportation access, we must also pay attention to problems that may occur in road transportation (Daryoto et al., 2015; Asalam et al., 2021; DPR RI Expertise Board; 2017).

The main problem of road damage in Indonesia is based on the findings of a 2011 research by the Directorate General of Bina Marga in collaboration with Indonesia Infrastructure The Initiative (IndII) states that flexural pavements are overloaded by 47%, maintenance quality by 20%, building quality by 15% and design factor by 18% (Smollett, 2017; Government of Indonesia, 2004).

The design of the road pavement is usually determined based on the planned life of the road plan. Bina Marga with high traffic volume are evidenced by high average annual daily traffic, indicating that the load will be repeated more often. This should be avoided by taking preventive measures, particularly with regard to road maintenance as the road surface is overloaded repeatedly over its lifetime (Government of Indonesia, 1980; Directorate General of Bina Marga, 1992; Condition, et al., 2023)

Judging from the main problem of road damage that occurs in Indonesia, the design of road pavement structures must be adjusted to Law No. 38 of 2004 concerning roads, namely road operators are obliged to provide services for road users. Therefore, it is very important to maintain the condition of the road pavement and stop damage to the road as early as possible (Sukirman, 2010; Directorate General of Bina Marga, 2017; Department of Public Works, 1997).

Things that must be done to minimize road damage by carrying out road maintenance normally and periodically, it aims to maintain the infrastructure built to remain in stable condition so that it can consistently provide good service to all road users[19][20][21]

(Ministry of Public Works and Public Housing, 2004; Missanjo et al., 2011; Department of Public Works, 2003).

In West Java province there is a secondary arterial road namely Jampang Tengah - Kiara Dua road (Km. Bdg 139 + 000 - Km. Bdg 142 + 000). This road is a secondary arterial road that becomes a logistics route for products and services so that it allows many heavy-loaded vehicles to pass through this road, for traffic density on this road is not too dense but the number of large loaded vehicles passing and lack of maintenance causes this road to be damaged quickly. In line with the explanation, related to the large traffic load and lack of maintenance on this road section causes a decrease in road quality and damage to road construction. The research entitled analysis of bending pavement redesign using the 2017 Bina Marga method with the evaluation of the structure of the kenvape program aims to redesign roads using the manual method of pavement design of 2017 to obtain optimal pavement structures and also uses empirical mechanistic techniques (approaches based on material characteristics and theoretical rules reinforced by the response of pavement structures from calculations against vehicle axis load) using the Kenpave application program to determine the strain value on the road structure and also to determine the planned life of the pavement structure redesign that can be used as an alternative by related parties (Bina Marga, 2002; Ramadhani, 2018; Sugiyono, 2013).

2. RESEARCH METHDOLOGY

A. Reseach Location

The location of this research is located on the Jampang Tengah - Kiara Dua road (Km. Bdg 139 + 000 - Km. Bdg 142 + 000) along 3 km from the direction of Bojongtipar, Jampang Tengah District, Sukabumi Regency to Bantar Agung, Jampang Tengah District, Sukabumi Regency, West Java Province, for details of the location can be seen in fig. 1 below.

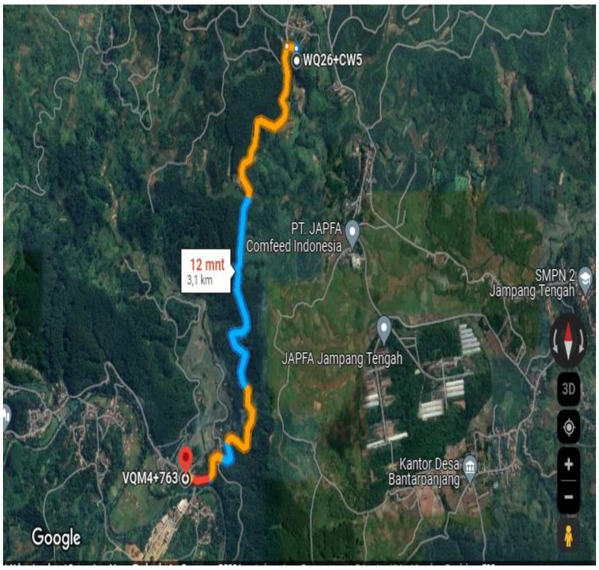

Figure 1 Research Location (source: google maps)

B. Research Flow

The following is the flow or course of research that serves to make it easier to understand the process of this research can be seen in the flow chart in fig 2 below :

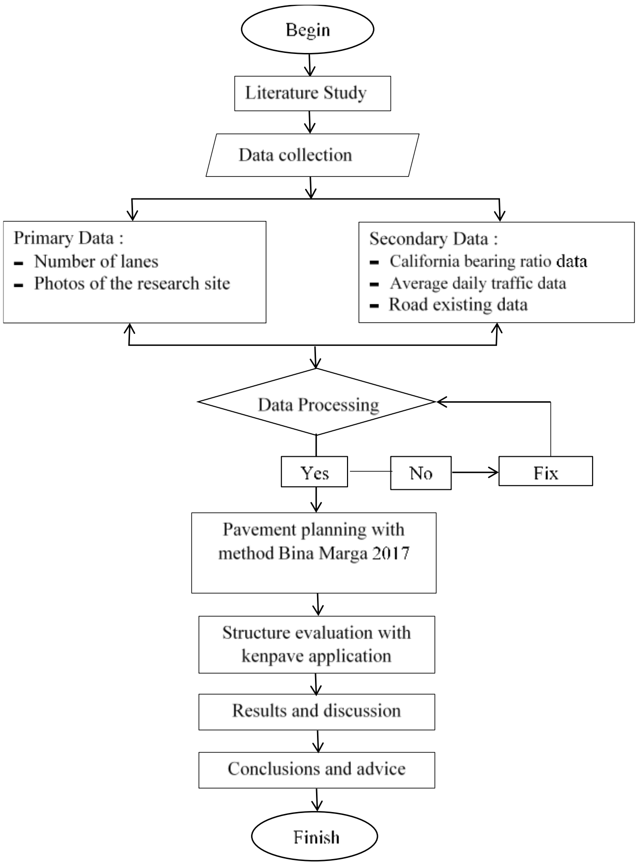

Figure 2 Research flow chart

3. RESULTS AND DISCUSSION

A. Planning Manual Method of Pavement Design of Bina Marga 2017

a) General Data

The following is general data used for flexible pavement planning using the 2017 Bina Marga road pavement design manual method:

Street Name : Jampang Tengah – Kiara dua road
Road stationing : km. Bdg 139+000 – Km. Bdg 142+000
Type of road : Secondary arterial roads in Kab. Sukabumi (Java Island)
Lane distribution : 2 lane = 100 % = 1
Directional distribution : 0,5
CBR subgrade : 8,75 %

b) Account

• Age Plan

Based on table of the planned life planning guidelines for bending pavement with the MDPJ Bina Marga 2017 method, bending pavement with pavement elements is selected, namely asphalt layer with a plan life of 20 years.

• Multiplier of traffic growth

Determining cumulative traffic growth and calculating it in accordance with the 2017 MDPJ Bina Marga guidelines, the results obtained are in accordance with general data for flexible pavement redesign with arterial road types and the traffic growth rate expressed in percent per year for the island of Java according to Bina Marga 2017 is 4. 8%, the traffic growth multiplier in R (2023-2024) is 1% and the traffic growth multiplier in R (2024-2043) is 19.082%.

• Cumulative traffic load / equivalent standard axle (ESA)

Cumulative traffic load calculation is the process of determining the traffic growth value according to the plan age and calculating the equivalent standard axle value which can be seen in the table 1 below :

Tabel 1 Results of cumulative traffic load calculations

Vehicle Type	LHR	LHR	LHR	VDF 5	ESA 5
	2023	2024	2044	Aktual	UR 20
1	4088	4284.2	10440.9	0	0
2	824	863.6	2104.5	0	0
3	408	427.7	1042	0	0
4	177	185.5	452	0	0
5a	28	29.3	71.5	0	0
5b	5	5.2	12.8	1,0	46823.1

Vehicle Type	LHR 2023	LHR 2024	LHR 2044	VDF 5 Aktual	ESA 5 UR 20
6a	257	269.3	656.4	0,5	1203353.4
6b	8	8.4	20.4	9,2	689235.9
7a	45	47.2	114.9	19,0	8006748.6
7b	6	6.3	15.3	21,8	1224892.1
7c	4	4.2	10.2	34,4	1288571.5
8	25	26.2	63.8	0	0
				Jumlah ESA	12459624.5
				CESA	12459624.5
				CESA5	**$12.456.10^6$**

The results of the cumulative calculation of traffic vehicle axle loads or equivalent standard axle (ESA) according to the planned pavement age of 20 years with determination from the LHR of the first year (2023-2024) to the LHR 19 years later (2024-2043) which is calculated using equation 1, then determine the vehicle damage factor (VDF) value for commercial vehicles based on table 4.4 and then calculate the ESA5 value using equation 3 and obtain a CESA 5 value of 12,456,106.

• Type of pavement

Determining the type of pavement used in the flexible pavement redesign of the Jampang Tengah – Kiara Dua Km. Bdg 139+000 – Km. Bdg 142+000 can be adjusted to the 2017 Bina Marga pavement design manual guidelines. With the type of pavement used in accordance with the results of the cumulative vehicle axle load calculation of 12,456,106, which means the ESA value obtained is more than 10 million CESA and less than 30 million CESA then Asphalt cement with cement – treated base type of pavement is used with flexible pavement design chart chart 3 and a design life of 20 years in accordance with the 2017 Bina Marga road pavement design manual method.

• Base soil segments

Determining the subgrade segment in road redesign planning by calculating the California Bearing Ratio value of the subgrade from the dynamic cone penetrometer test multiplied by the minimum adjustment factor of the california bearing ratio value based on the dynamic cone penetrometer test to determine whether the subgrade on the road meets the minimum foundation design standards. So the design california bearing ratio value is 7.9% which can be used in the pavement foundation design process

• Pavement foundation

Based on the results of the california bearing ratio calculation for the subgrade using the percentile method, it is 8.75% and the results of the California Bearing Ratio design calculation for the subgrade segment is 7.9%, then the soil on the Jampang Tengah – Kiara Dua Km road. Bdg 139+000 – Km. Bdg 142+000 does not require repairs, and the foundation can be adjusted to the pavement design chart for flexible pavement in accordance with the 2017 Bina Marga road pavement design manual guidelines.

- Pavement thickness

In accordance with the 2017 Bina Marga guidelines for flexible pavement using design chart 3 with a CESA 5 value of 12,456,106, details for determining the thickness of the pavement layer can be seen in table 2 below :

Tabel 2 Flexible pavement thickness design

	F1
	For 10 – 30 million ESA5 traffic see design charts 3A – 3B and 3C
Cumulative axle load repetitions over 20 years on the design lane (10^6 ESA5)	>10-30
Types of bonded surfaces	AC
Type of foundation layer	*Cement treated base*
AC WC	40
AC BC[4]	60
AC BC or AC Base	75
CTB[3]	150
Class A aggregate foundation	150

B. Kenpave Program Structure Evaluation

The results of the evaluation of the 2017 Bina Marga flexible pavement planning structure using the kenpave application program above showed that the strain value in the pavement design with a vertical strain value at a depth of 9.9997 cm below the surface of the pavement will experience a type of fatigue crack of 0.0001914, for a horizontal strain value at a depth 9.9997 cm below the pavement surface will experience rutting damage of 0.0003486, and for vertical strain values at a depth of 52.0003 cm below the foundation layer, permanent deformation will occur.) of 0.0002147.

4. CONCLUSION

The thickness of the bending pavement layer using the manual method of 2017 Bina Marga road pavement design obtained the results of the thickness of the surface layer of Asphalt Concrete-Wearing Course of 4 cm, the layer of Asphalt Concrete-Binder Course and Asphalt Concrete – Base of 13.5 cm, the thickness of the upper foundation layer with Cement treated based material with a thickness of 15 cm, and a layer of bottom foundation with class A aggregate material with a thickness of 15 cm. From the results of the evaluation of the 2017 Bina Marga flexural pavement planning structure using the kenpave application program above, a strain value was obtained in the pavement design with a vertical strain value at a depth of 9.9997 cm below the pavement surface will experience a type of fatigue cracking of 0.0001914, for a horizontal strain value at a depth of 9.9997 cm below the pavement surface will experience rutting damage of 0.0003486, and for vertical strain values at a depth of 52.0003 cm below the foundation layer will experience permanent deformation of 0.0002147. The age of the plan used for the redesign of thick layers of bending pavement using the manual method of pavement design of Bina Marga 2017 related to the selection of the age of the road plan adjusted to the type of pavement taken and also the material used, it is obtained that the appropriate plan age for the type of bending pavement is 20 years of plan life.

REFERENCE

Asalam, D., Employee, D., & Muhajirah. (2021). Damage analysis of the Talabiu-Simpasai road section of Bima Regency using the Provincial and Regency Road Management System (PKRMS) application.

Astuti, S. I., Arso, S. P., & Wigati, P. A. (2015). National transportation system (Sistranas): Analysis of minimum service standards in outpatient installations at Semarang City Hospital.

Bina Marga. (2002). Guidelines for planning thick pavement bending (No. Pt-01-2002 B).

Condition, P., Pada, I., Jalan, R., & Cimahi, K. (2023). Journal of Civil Engineering - Architecture, 22(1), 9–14.

Daryoto, D., Widodo, S., & Mayuni, S. (2015). Study of road damage conditions on the surface layer using the Bina Marga method (Case study of Jalan Harapan Jaya section, Pontianak City). Jurnal Mahasiswa Teknik Sipil Universitas Tanjungpura.

Department of Public Works. (1997). Manual of Indonesian road capacity (MKJI 1997) (pp. 1–573).

Department of Public Works. (2003). Cement concrete road pavement planning (Pd T-14-2003) (p. 51).

Dini, Y. Z. (2019). Bina Marga and development of transportation modes in Kudus Regency in 1994–2015.

Directorate General of Bina Marga. (2011). Construction and building manual No.001-01/BM/2011 (pp. 1–134). Ministry of Public Works.

Directorate General of Bina Marga. (1992). Geometric planning standards for urban roads (pp. 1–148).

Directorate General of Bina Marga. (2017). Manual of road pavement design (No. 02/M/BM/2017).

DPR RI Expertise Board. (2017). DPR RI expertise board visits Banyuwangi. B. Expertise

Smollett, T. (2017). No. 38. Work. Tobias Smollett Poems, Play. Brit., 38(5), 428–536.

Fithra, H. (2017). Road network connectivity in regional development in the North Zone of Aceh.

Government of Indonesia. (2004). Law No. 38 of 2004 concerning roads.

Government of Indonesia. (1980). Act No. 13 of 1980.

Kholiq, A. (2014). Thick pavement planning for highway bending between Bina Marga and AASHTO '93 (Case study: Panyingkiran-Baribis Ajalengka North Ring Road).

Lia, N., & Purwo, M. (2017). Performance evaluation of flexural pavement structures using Kenpave application (pp. 1–10).

Ministry of Public Works and Public Housing. (2004). Traffic enumeration survey by manual (Pd. T-19-2004-B): Construction and building guidelines.

Missanjo, E., et al. (2011). PermenPU 19/2011 - Road technical requirements and road technical planning criteria. Forest Ecology and Management, 3(1), 1.

Pandey, S. V. (2013). Regional road damage due to overloading load. Civil Tech, 11(58), 1–8.

Ramadhani, R. I. (2018). Evaluation of thick pavement bending with highway method 2013 and mechanistic-empirical method using Kenpave program on Jogja-Solo road section [Undergraduate thesis, Islamic University of Indonesia].

Sugiyono. (2013). According to Sugiyono (2013), the frame of thought is a line of thinking... Jurnal Educator, 54–103.

Sukirman, S. (2010). Highway bending pavement thick planning.