Flexible Pavement Improvement Analysis at Keduncino-Bandengan Road, Jepara Indonesia

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Abstract*: Kedungcino – Bandengan road is a road that connects Jepara - Bangsri National Highway to Bandengan tourist area. After observations on the field, the pavement conditions on Jalan Kedungcino - Bandengan were not good and the narrow body of the road made it difficult for two vehicles to pass. Currently a multipurpose building and a playground in the Bandengan tourist area are being established which is expected to increase the volume and load of vehicles that will pass Kedungcino – Bandengan road. Therefore, this study is intended to evaluate Kedungcino - Bandengan road ability in serving the flow of vehicles and planning an development in Kedungcino – Bandengan road. Kedungcino – Bandengan road are evaluated and analyzed. The road improvement plans are divided into several aspects. The improvement of pavement structure is based on Pedoman Perencanaan Tebal Perkerasan Lentur Pt T-01-2002-B (2002) which produces flexible pavement thickness. Whereas Pedoman Desain Perkerasan Jalan Lentur No. 002-P-BM-2011 are used to determine the overlay thickness. After evaluation, Kedungcino - Bandengan road is still feasible because it can accommodate the existing traffic flow. But to anticipate traffic flow increase that continues to occur due to the increasing number of tourists visiting the tourist area of Bandengan, a development is still needed on Kedungcino – Bandengan road. The results of road improvement planning are widening the road with a 11 cm surface course thickness (AC-WC = 5 cm and AC-BC = 6 cm), 15 cm base course thickness (class A broken stone), 15 cm subbase course thickness (class B sandrock) and 10 cm thickness of overlay.

***Index Terms*: Road evaluation, Road improvement, flexible pavement, Overlay**

I. INTRODUCTION

Road as one of important infrastructure to support government program in order to increase social economic society. Many factors could be a trigger a road damaging such as number of vehicle passes, type of loading to the pavement and soil types beneath the pavement [1] [2]. Dynamic response due to vehicle passed on the pavement could trigger a road damage due to repetition of loading phenomenon [3]. Road resistance is one of factors which have to consider for the maintenance of road infrastructure [4].

According to UU RI No. 13 [5] and PP No. 26 [6], roads are one of the land transportation infrastructures which have an important role for economic growth, socio-culture, development of tourism areas, and defense and security to support national development.

Jepara is one of the regencies in Central Java Province which has nature beauty and diversity. In an effort to develop the regional economy, it needs to be supported by the transportation infrastructures. One of them is through land transportation which can make goods and / or people movement easier, safely, comfortably and smoothly.

Kedungcino – Bandengan road is a road that connects the Jepara - Bangsri National Highway to the tourist area of Bandengan. After observations on the field, the pavement conditions on Jalan Kedungcino - Bandengan were not good and the narrow body of the road made it difficult for two vehicles to pass. Based on the information from the Jepara Regency government, a multipurpose building and a playground are currently being established in the Bandengan tourist area which is expected to increase the volume and load of vehicles that will pass Kedungcino – Bandengan road. Therefore, this study is intended to evaluate Kedungcino - Bandengan road ability in serving the flow of vehicles and planning an development in Kedungcino – Bandengan road.

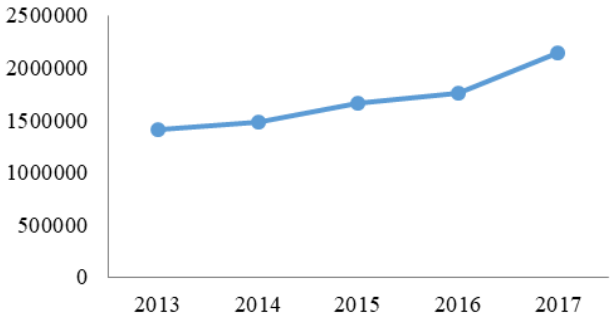

Fig 1: Tourist Statistics of Jepara District

Fig 2 : Study Area

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Fig 3:Pavement Condition

II. STUDY OF LITERATURE

A. Basic Planning

The analysis of the flexible pavement development refers to The Guidelines of Thickness Flexible Pavement Design Pt T-01-2002-B [7] to determine the thickness of the pavement. Whereas to determine the width of the cross section of the road refers to The Guidance of Flexible Pavement Design No. 002-P-BM-2011 [8].

B. Standard Axle Load (w18)

To obtain traffic plan, the following formulation is used:

$$w18 = D_D \times D_L \times \hat{w}18 \quad (1)$$

where,

D_D = direction distribution factor

D_L = lane distribution factor

$\hat{w}18$ = cumulative standard axle load

C. Cumulative Standard Single Axle Load (Wt)

$$Wt = w18 \times \frac{(1+g)^n - 1}{i} \quad (2)$$

where,

g = Traffic growth (%)

D. Resilient Modulus (M_R)

According to The Guidelines of Thickness Flexible Pavement Design Pt T-01-2002-B [7], the strength and durability of the pavement are very dependent on the properties and carrying capacity of the soil. Resilient Modulus is the subgrade parameter used in pavement planning.

$$M_R(\text{psi}) = 1500 \times \text{CBR} \quad (3)$$

III. DISCUSSION AND RESULT

Primary data is a data obtained through direct surveys on the field. Primary data is used to determine the actual conditions on the field. Primary data includes:

A. Traffic data

Traffic data is obtained by doing 40 hours of traffic survey. The survey results are recapitulated and added to both directions, to determine the peak flow and hours that occur.

Traffic data is used to determine the number of lanes, pavement width, roadside width and thickness of the pavement layer. The average daily traffic is 18761 vehicles / day.

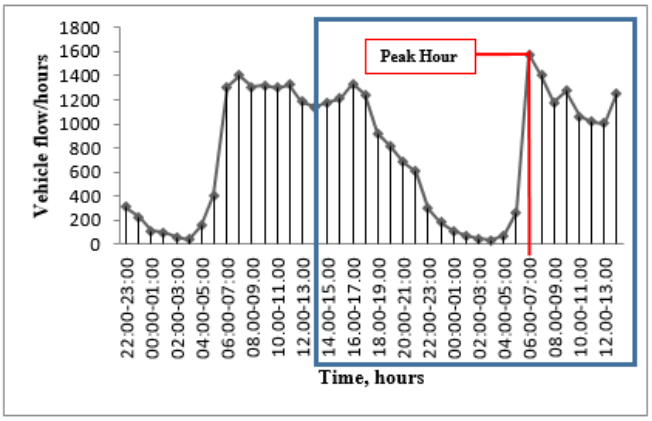

Fig 4: 40 Hours Traffic Chart

B. California Bearing Ratio Data (CBR)

Table 1. CBR field testing results

CBR value in this study were obtained by performing a dynamic cone penetrometer test based on ASTM D6951-03 [9] using a dynamic cone penetrometer on Kedungcino - Bandengan road by taking samples every 100 m using 30º conus.

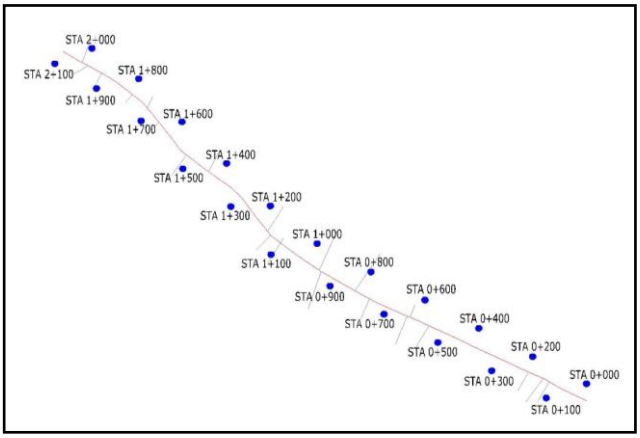

Fig 6: Dynamic Cone Penetrometer Test Location

Fig 7:Dynamic Cone Penetrometer Test

Table 1 : Dynamic Cone Penetration Test Data

The results of the dynamic cone penetrometer test are used to determine the 90% CBR value for the design. The 90% CBR value is 10.7%

Location	CBR Value		≥	Percentage (%)
STA 0+900	9,818	9,818	7	100
STA 0+200	10,486	10,788	6	86
STA 0+500	10,898			
STA 1+800	10,981			
STA 1+900	11,146	11,432	5	71
STA 0+800	11,229			
STA 0+600	11,396			
STA 1+600	11,956			
STA 1+300	12,165	12,354	4	57
STA 0+700	12,197			
STA 1+100	12,197			
STA 0+000	12,856			
STA 1+200	13,095	13,540	3	43
STA 2+100	13,397			
STA 2+000	13,557			
STA 0+100	13,687			
STA 0+300	13,964			
STA 1+400	14,042	14,235	2	29
STA 1+000	14,073			
STA 1+700	14,119			
STA 0+400	14,707			
STA 1+500	18,799	18,799	1	14

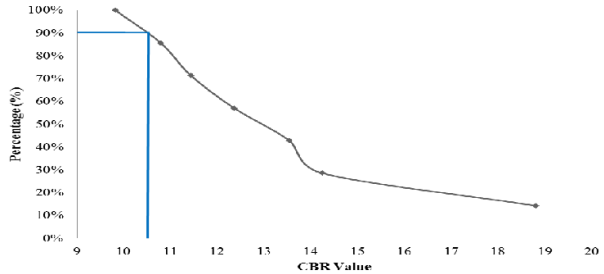

Fig. 8: 90% CBR Value Chart

C. Road Classification

Judging from its function, Kedungcino – Bandengan road is a secondary collector road. According to Indonesian Regulation No. 34 Year 2006, collector roads are public roads that used to serve transportation with the characteristics of medium distance travel and medium average speeds.

D. Existing Road Evaluation

1) Pavement Condition

According to Pedoman Desain Perkerasan jalan Lentur No. 002-P-BM-2011 [8], the minimum width for collector roads is 6.0 meters. From the observations on the field, the narrowest existing pavement is 3.8 meters which hard for 2 vehicles to pass, so it is necessary to expand the road width. The condition of the existing pavement is also not good because there were pavement that has a hair crack or a hole, therefore an overlay is needed on the pavement.

Table 2. The condition of exixting overlay

No.	STA	Pavement Type	Pavement Width (m)	Pavement Condition
1	0+100	AC	4	Good
2	0+200	AC	4,1	Good
3	0+300	AC	4,1	Good
4	0+400	AC	4,2	Good
5	0+500	AC	3,8	Good
6	0+600	AC	3,9	Perforated
7	0+700	AC	3,9	Good
8	0+800	AC	4	Good
9	0+900	AC	4,2	Perforated
10	1+000	AC	3,9	Perforated
11	1+100	AC	3,9	Good
12	1+200	AC	3,9	Good
13	1+300	AC	4	Perforated
14	1+400	AC	4	Good
15	1+500	AC	3,8	Good
16	1+600	AC	3,9	Perforated
17	1+700	AC	3,8	Perforated
18	1+800	AC	4	Good
19	1+900	AC	4	Good
20	2+000	AC	3,9	Good
21	2+100	AC	4	Good

E. Flexible Pavement Improvement Plan

1. Road alignment (Trace)

The planned road alignment is still the same as existing road alignment because the horizontal alignment condition is still good.

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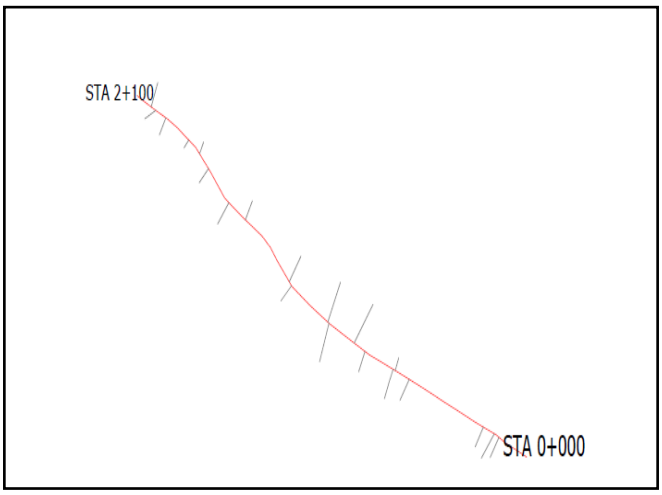

Figure 9. Road Alignment (Trace)

2. Cross Section of the Road

a). Path Width

The ideal traffic lane for collector roads is 6.0 meters. So the minimum width on the Kedungcino - Bandengan road is 6.0 meters.

b). Roadside

The ideal roadside width for collector roads is 2 x 1.5 meters (right and left). So the minimum width of the roadside for each side on the Kedungcino - Bandengan road is 1.5 meters.

E. Pavement Structure

Pavement improvement consists of two plans, increasing the width of the road with flexible pavement and overlay.

1) Road Widening with Flexible Pavement

a) Traffic growth Factor (g)

According to Manual Road Design Number 02 MBM 2013, the traffic growth factor for collector roads is 2.5%.

b) Reliability (R) and Standard Deviation (Zr)

The reliability level for collector roads is 80-95%. The level of reliability used is 95%. Standard deviation for 95% reliability level is -1.645.

c) *Overall* Standard Deviation (So)

According to The Guidelines of Thickness Flexible Pavement Design Pt T-01-2002-B [7], the standard deviation range is 0.40 - 0.50. The standard deviation used is 0.45.

IV. Conclusions

a. 90 % CBR value of Kedungcino – Bandengan road is 10,7%.
b. After the analysis, to anticipate traffic flow increase that continues to occur due to the increasing number of tourists visiting the tourist area of Bandengan, it is still necessary to develop Kedungcino – Bandengan road pavement.

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