Analysis Of Road Damage And Its Improvement On The South Ring Road And West Ring Road Of Jambi City

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Abstract

Road damage is an event that causes a road pavement to become inconsistent with its original form. The purpose of this study is to analyze the differences between the PCI Method, the Bina Marga Method, and the Asphalt Institute Method. The three methods will be compared to determine the condition of the road pavement on the same road section. Then, the calculation process and results will be analyzed to determine which method is easier in conducting surveys and calculations. The results of the analysis on the South Ring Road and West Ring Road sections of Jambi City using the Bina Marga Method, the PCI Method, and the Asphalt Institute Method have relatively similar assessments in their handling. For handling road damage on the South Ring Road and West Ring Road sections of Jambi City, the PCI Method and the Asphalt Institute Method are used in their handling.

Keywords: Asphalt Institute Method, Bina Marga Method,Handling, PCI (Pavement Condition Index), Road Damage, South Ring Road and West Ring Road.

INTRODUCTION

Road damage is an event that causes a road pavement to become inconsistent with its original shape, thus causing the road pavement to become damaged, which affects the road's service life (Suyatno, 2023). In addition to affecting the service life, this road damage makes the road unsafe and uncomfortable for motorists to travel. Types of road damage include cracks, fat, potholes, wear, waviness, grain detachment, peeling of the surface layer, and so on (Hardiyatmo, 2007). Causes of road pavement damage include the large number of overloaded vehicles passing through the road, traffic volumes exceeding initial predictions, poor drainage systems, poor pavement construction material properties, extreme climates (e.g., high rainfall, freezing and thawing cycles, high humidity), unstable soil conditions, pavement layer planning that does not meet standards, work implementation processes that do not comply with specifications (Langgeng, 2020).

Based on information from the Jambi Provincial Public Works Agency, it was discovered that not all pavements on the South Ring Road and West Ring Road networks in Jambi City are in good condition. Further information indicates that government funds for preservation are limited, meaning that not all damaged roads can be repaired immediately, requiring priority for certain roads.

To predict pavement conditions effectively, an assessment method for identification must be used. This method serves as an indicator for assessing road damage. Several previous studies have been conducted to assess road conditions. Of the many studies to assess road conditions, some use the PCI (Pavement Condition Index) method (Delli, 2020; Toni, 2021), while others use two methods, namely the Bina Marga method and PCI (Nadhila, 2019; Ruhdi, 2020; Santosa, 2021; Aulia, 2021; Rudy, 2021; Edo, 2022; Rabiupa, 2023). Based on previous research, the most commonly used methods for assessing road pavement conditions are the PCI (Pavement Condition Index) method and the Bina Marga method. Hardiyatmo (2007) and Eduardus (2023) add another method that can be used to determine road damage, namely the Asphalt Institute method.

This study, in addition to assessing road conditions in Jambi Province, primarily analyzes the differences between the three methods. The three methods will be compared based on how they are used to determine road pavement conditions for the same road section. Then, the calculation process and results will be analyzed to determine which method is easier to conduct surveys and calculations, while the other method is relatively more difficult when applied to the study location. This study will also analyze whether the relatively difficult method has other advantages, such as more detailed or more accurate results (output). The purpose of comparing the three methods is to determine the road pavement value to determine the type and extent of road damage that has occurred, and to determine the appropriate type of maintenance/handling based on the ranking value.

The research location is the South Ring Road and West Ring Road of Jambi City. The South Ring Road is a road with a fairly high traffic volume with a class I arterial road type. This route is a route that is often used for the flow of goods transport in and out of Jambi City and the percentage of vehicle volume/day that passes through the South Ring Road is 68% motorcycles, 21% cars, and 11% heavy vehicles. The percentage of the volume of vehicles/day that passes through the West Ring Road consists of 72% motorcycles, 18% cars, and 10% heavy vehicles. Road damage that occurs will certainly affect the safety and comfort of road users. Based on data from P2JN, the length of the South Ring Road of Jambi City is 9.12 km and the length of the West Ring Road is 7.17 km. The types of road damage that occur are cracks and potholes.

METHODS

The research location was conducted on the South and West Ring Roads of Jambi City. The primary data obtained were survey data to identify types of road damage in the field. The collection of road damage identification data was carried out on June 16, 2025. The tools used were meter measuring instruments, notebooks, and mobile phones. Data were obtained by visiting the agencies/institutions directly, in this case the Jambi City Transportation Office and the Jambi City National Road Planning and Supervision Work Unit Office. The secondary data obtained were data on the length of the South Ring Road section, data on the length of the West Ring Road section, daily traffic volume data, road network map data, and vehicle type data based on the interview results.

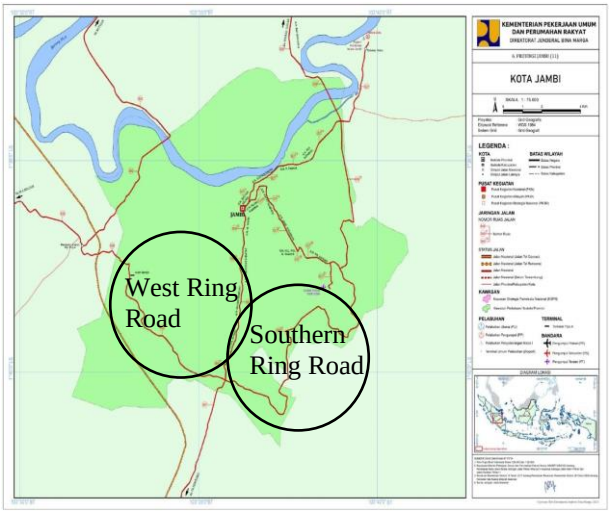

Figure 1. Location Map

Figure 2. Southern Ring Road

Figure 3. West Ring Road

RESULTS AND DISCUSSION

Results

Jambi City's South Ring Road and Jambi City's West Ring Road are class I arterial roads. These routes are frequently used for freight traffic entering and leaving Jambi City. The types of road damage that occur include potholes, alligator cracks, longitudinal cracks, and transverse cracks. The following is a breakdown of the South Ring Road and the West Ring Road in Jambi City:

Table 1 South Ring Road Damage Data

No	STA	Types Of Road Damage	Length Of Damage (m)	Width Of Damage (m)	High Damage (m)	Direction
1	01+295	Alligator Cracks	1	1,5		Left
2	01+300	Aligator Cracks	1,5	1,4		Left
3	01+575	Longitudinal Cracks	1,3	1,5		Left
4	01+780	Longitudinal Cracks	1,2	1,4		Right
5	01+955	Transverse Cracks	1,6	1,6		Right
6	02+245	Potholes	7,2	3,5	0,025	Left
7	02+720	Longitudinal Cracks	1,3	1,7		Left
8	02+895	Transverse Cracks	1,2	1,4		Right
9	02+965	Longitudinal Cracks	1,6	1,5		Right
10	03+170	Transverse Cracks	1,5	1,6		Left
11	03+535	Potholes	7,5	3,1	0,026	Left
12	04+225	Transverse Cracks	1,2	1,4		Right
13	04+360	Longitudinal Cracks	1,6	1,3		Right
14	05+100	Transverse Cracks	1,5	1,7		Left
15	05+455	Longitudinal Cracks	1,3	1,5		Left
16	05+620	Transverse Cracks	1,2	1		Right
17	06+245	Potholes	5,6	2,9	0,015	Right
18	06+440	Longitudinal Cracks	1,5	1,2		Left
19	06+785	Transverse Cracks	1,3	1,6		Left
20	06+950	Potholes	7,1	3,5	0,02	Right
21	07+135	Transverse Cracks	1,6	1,3		Right
22	07+350	Longitudinal Cracks	1,5	1,2		Right
23	07+585	Transverse Cracks	1,3	1,1		Left

24	07+815	Potholes	7,4	3,7	0,027	Right
25	08+175	Longitudinal Cracks	1,6	1,2		Right
26	08+250	Transverse Cracks	1,5	1,4		Left
27	08+415	Potholes	7,9	3,5	0,02	Left
28	08+565	Transverse Cracks	1,2	1,2		Right
29	08+640	Potholes	5,5	2,9	0,017	Right
30	08+735	Longitudinal Cracks	1,5	1,2		Left
31	08+820	Transverse Cracks	1,3	1,5		Left
32	08+945	Potholes	5,1	3,2	0,016	Right

Table 2 West Ring Road Damage Data

No	STA	Types Of Road Damage	Length Of Damage (m)	Width Of Damage (m)	High Damage (m)	Direction
1	01+125	Alligator Cracks	1,4	1,6		Left
2	01+300	Aligator Cracks	1,5	1,4		Left
3	01+450	Longitudinal Cracks	1,5	1,7		Left
4	01+635	Longitudinal Cracks	1,3	1,6		Right
5	01+720	Transverse Cracks	1,6	1,8		Right
6	01+955	Potholes	7,5	3,2	0,024	Left
7	02+150	Longitudinal Cracks	1,4	1,3		Left
8	02+345	Transverse Cracks	1,5	1,8		Right
9	02+515	Longitudinal Cracks	1,6	1,4		Right
10	02+650	Transverse Cracks	1,5	1,7		Left
11	02+875	Potholes	7,3	3,6	0,025	Left
12	02+995	Transverse Cracks	1,3	1,7		Right
13	03+150	Longitudinal Cracks	1,6	1,8		Right
14	03+325	Transverse Cracks	1,5	1,7		Left
15	03+585	Longitudinal Cracks	1,6	1,8		Left
16	03+615	Transverse Cracks	1,2	1,5		Right
17	03+830	Potholes	5,5	3,1	0,017	Right
18	03+945	Longitudinal Cracks	1,5	1,7		Left
19	04+115	Transverse Cracks	1,4	1,6		Left
20	04+285	Potholes	7,4	3,2	0,014	Right
21	04+425	Transverse Cracks	1,6	1,8		Right
22	04+560	Longitudinal Cracks	1,5	1,2		Right
23	04+755	Transverse Cracks	1,3	1,7		Left
24	04+870	Potholes	7,3	3,4	0,025	Right
25	04+925	Longitudinal Cracks	1,5	1,6		Right
26	05+220	Transverse Cracks	1,6	1,7		Left
27	05+535	Potholes	7,5	3,2	0,022	Left
28	05+870	Transverse Cracks	1,2	1,5		Right
29	06+185	Potholes	5,4	3,3	0,015	Right
30	06+550	Longitudinal Cracks	1,5	1,7		Left
31	06+780	Transverse Cracks	1,6	1,8		Left
32	06+955	Potholes	5,3	3,4	0,016	Right

The following is traffic volume data for the South Ring Road of Jambi City:

Table 3 Traffic Volume Data for the South Ring Road Section (smp/day)

Vehicle Type	Number of Vehicles (vehicles/day)	Equivalent	LHR x Equivalent (smp/day)
Motorcycle	5000	0,5	2500
Private vehicle	1500	1	1500
Two-axle Heavy Vehicle	250	1,3	325
Three-Axle Heavy Vehicle	550	1,3	715
	Amount		5040

The following is traffic volume data for the West Ring Road of Jambi City:

Table 4 Traffic Volume Data for the West Ring Road Section (smp/day)

Vehicle Type	Number of Vehicles (vehicles/day)	Equivalent	LHR x Equivalent (smp/day)
Motorcycle	5728	0,5	2864
Private vehicle	1451	1	1451
Two-axle Heavy Vehicle	228	1,3	296
Three-Axle Heavy Vehicle	536	1,3	697
	Amount		5308

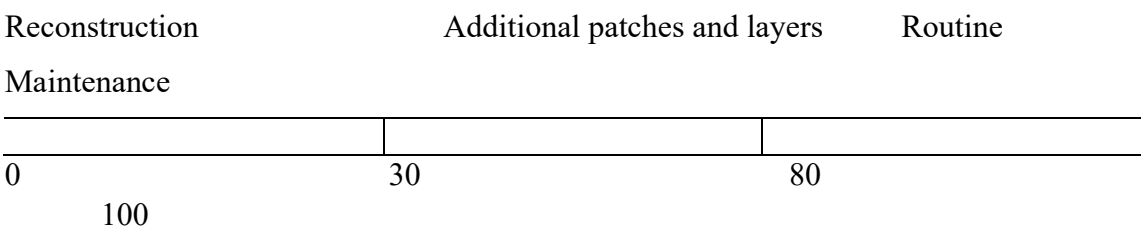

Figure 4. Condition Value Categories As Indicators Of Maintenance Type

1. South Ring Road

Based on ASTM D5340-98, the sample is determined with a sample length of 50 meters and a width of 6 meters, resulting in a sample area of 300 m^2.

Road Length = 9120 meters
Road Width = 6 meters
Total Area = Length x Width
= 9120 m x 6 m
= 54720 m2
Determining Sample Alternatives (As)
Sample Length = 50 meters
Sample Width = 6 meters

Flexible Pavement Sampling Standard (ASTM D5340-98), Based on ASTM D5340-98, Sample Unit Area: 450 ± 180 m^2

Sample Unit Area: 450 ± 180 m2
Sample Area (As) = Length × Width
= 50 m × 6 m
= 300 m2
Therefore, the sample area is 300 m2 < 450 m^2

A. Bina Marga Method

Table 5 Types and Number of Damages to the South Ring Road Segment 1 (STA 01 + 295)

Types of Road Damage	Numbers for Damage Type	Figures for Damage Width	Figures for the extent of damage	Numbers For Depth	Figures for Subsidence Length	Damage Figures
Alligator Cracks	5	3	1	-	-	5
Longitudinal Cracks	-	-	-	-	-	-
Transverse Cracks	-	-	-	-	-	-
Potholes	-	-	-	-	-	-
Total Damage Figures						5

The total number of damages obtained was 5 with a road condition value of 2.
Priority Order (UP) = 17 – (LHR Class + Road Condition)
= 17 – (6 + 2)
= 9

Based on the UP (Priority Order) obtained, it is ≥7 so it is included in the routine maintenance program road maintenance category.

B. Asphalt Institute Method

The total damage score for segment 1 is:
= (crack width / segment width) x 100%
= (1.5 / 300) x 100 = 0.46%

In the Asphalt Institute's rating system, the rating is called the Pavement Condition Rating (PCR). The PCR score is obtained by subtracting the total damage score from 100. With a total damage score of 0.46, the resulting condition score is:

Condition Score = 100 – Total Damage Score
= 100 – 0.46
Condition Score = 99.54, The analysis yielded a road condition score of 99.54, including maintenance.

C. PCI (Pavement Condition Index) Method

The following is the Deductible Value for the South Ring Road section:
Density (D): 0.5%
STA: 01 + 245
Damage Level: R
Obtained:
Deductible Value (DV): 5%. This can be seen in the following graph figure 5 and figure 6.

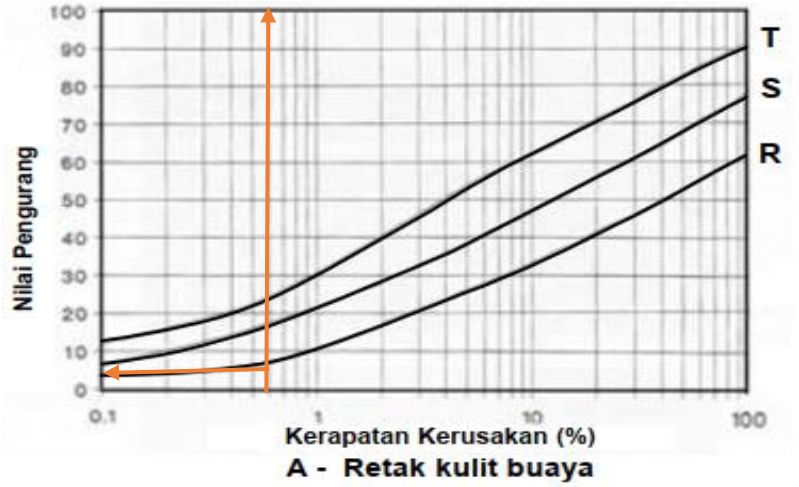

Figure 5. Graph of reduction value (NP) of asphalt pavement STA 01 +295

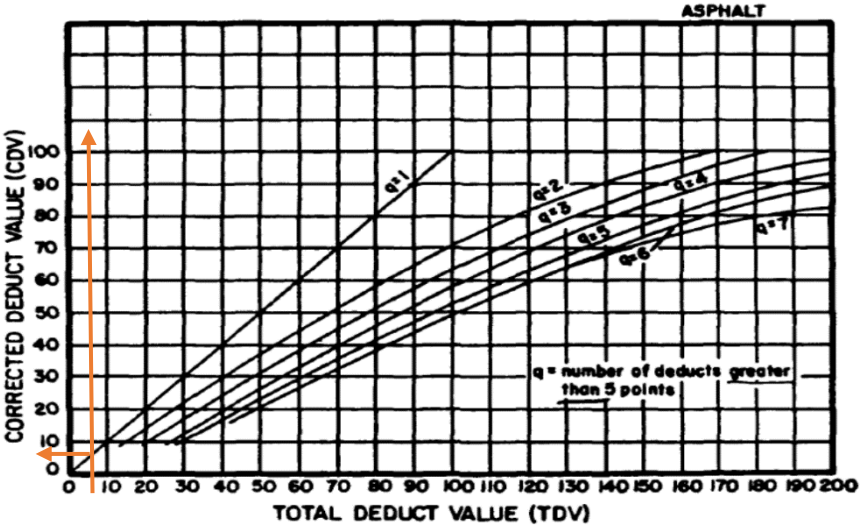

Figure 6. Graph of Corrected Deduct Value (CDV) STA 01 + 295

2. West Ring Road

Based on ASTM D5340-98, the sample is determined with a length of 50 meters and a width of 6 meters, resulting in a sample area of 300 m^2.

Road Length = 7170 meters
Road Width = 6 meters
Total Area = Length x Width
= 7170 m x 6 m
= 43020 m2
Determining Sample Alternatives (As)
Sample Length = 50 meters
Sample Width = 6 meters

Flexible pavement sampling standard (ASTM D5340-98), Sample Unit Area: 450 ± 180 m^2
Sample Area (As) = Length × Width
= 50 m × 6 m
= 300 m^2

A. Bina Marga Method

Table 6 Types and Number of Damages to the West Ring Road Segment 1 (STA 01 + 125)

Types of Road Damage	Numbers for Damage Type	Figures for Damage Width	Figures for the extent of damage	Numbers For Depth	Figures for Subsidence Length	Damage Figures
Alligator Cracks	5	2	1	-	-	5
Longitudinal Cracks	-	-	-	-	-	-
Transverse Cracks	-	-	-	-	-	-
Potholes	-	-	-	-	-	-
Total Damage Figure						5

The total damage was 5 with a road condition rating of 2.

Priority Order (UP) = 17 – (LHR Class + Road Condition)
= 17 – (6 + 2)
= 9

Based on the UP (Priority Order) obtained, it is ≥7 so it is included in the routine maintenance program road maintenance category.

B. Asphalt Institute Method

The total damage value is :

= (crack width/segment width) x 100%
= (1.5 / 300) x 100 = 0.46%
With a total damage score of 0.46, the resulting condition score is:
Condition Score = 100 – Total Damage Score
= 100 – 0.46
Condition Score = 99.54
The analysis results yielded a road condition score of 99.54, including maintenance.

C. PCI (Pavement Condition Index) Method

The following is the Deductible Value for the West Ring Road section :

STA : 01 + 125
Density (D) : 0.75%
Deterioration Level : R
Obtained :
Deductible Value (DV): 5%. This can be seen in the following graph figure.7 and figure. 8

Figure 7. Graph of reduction value (NP) of asphalt pavement STA 01 + 125

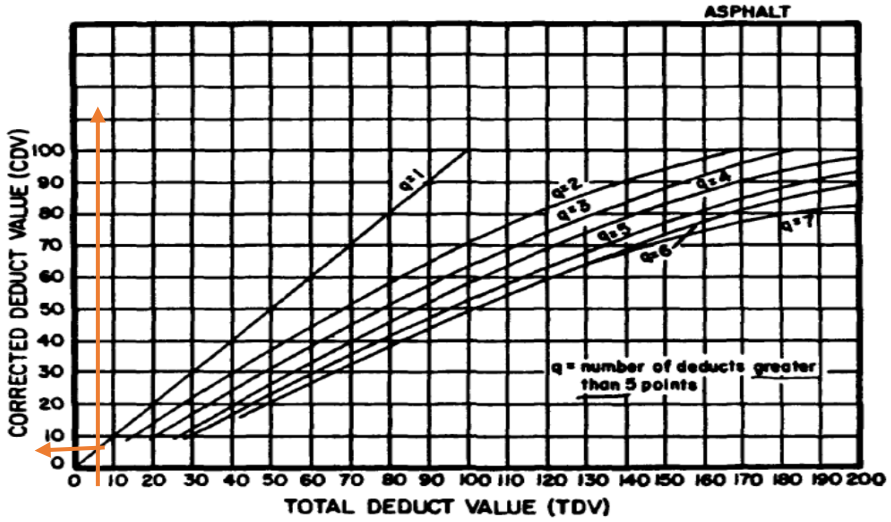

Figure 8. Graph of Corrected Deduct Value (CDV) STA 01 + 125

Discussion :
The following are the results of the analysis of road handling on the South Ring Road and West Ring Road in Jambi City:

Table 7 Road Handling Analysis Results Recap South Ring Road

No	Segment (STA)	Types of Road Damage	Method		
			Bina Marga	Asphalt Institute	PCI
1	Segment 1 (STA 01 + 295)	Alligator Cracks	The road condition score obtained was 10, which is considered good. Routine maintenance, such as patching or sealing cracks, is required.	The road condition score obtained was 99.47, categorized as good with minimal damage. Routine maintenance is carried out, which includes repair activities such as patching.	The road condition score obtained was 95, which is categorized as good with minimal damage. The repairs are patching.
2	Segment 2 (STA 01 + 955)	Transverse Cracks	The road condition score obtained was 10, which is considered good. Routine maintenance, such as patching or sealing cracks, is required.	The road condition score obtained was 99.47, categorized as good with minimal damage. Routine maintenance is carried out, which includes repair activities such as patching.	The road condition score obtained was 96, which is categorized as good with minimal damage. The repairs are patching.
3	Segment 3 (STA 02 + 965)	Longitudinal Cracks	The road condition score obtained was 9, which is considered good. Routine maintenance, such as patching or sealing cracks, is required.	The road condition score obtained was 99.5, which is considered good with minimal damage. Routine maintenance is carried out, which includes repair activities such as patching.	The road condition score obtained was 96, which is categorized as good with minimal damage. The repairs are patching.
4	Segment 4 (STA 07 + 815)	Potholes	The road condition score obtained was 9, which is considered good. Routine maintenance is required.	The road condition score obtained was 98.77, which is considered good with minimal damage. Routine maintenance is required.	The road condition score obtained was 45, which is in the fair road condition category. Maintenance is required.
5	Segment 5 (STA 08 + 415)	Potholes	The road condition score obtained was 9, which is considered good. Routine maintenance is the mainstay of the maintenance process.	The road condition score obtained was 98.84, which is considered good with minimal damage. Routine maintenance is required.	The road condition score obtained was 45, which is in the fair road condition category. Maintenance is required.

Table 8 Road Handling Analysis Results Recap West Ring Road

No	Segment (STA)	Types Of Road Damgae	Method		
			Bina Marga	Asphalt Institute	PCI
1	Segment 1 (STA 01 + 125)	Alligator Cracks	The road condition score obtained was 9, which is considered good. Routine maintenance, such as patching or sealing cracks, is required.	The road condition score obtained was 99.47, categorized as good with minimal damage. Routine maintenance is carried out, which includes repair activities such as patching.	The road condition score obtained was 95, which is categorized as good with minimal damage. The repairs are patching.
2	Segment 2 (STA 01 + 450)	Transverse Cracks	The road condition score obtained was 10, which is considered good. Routine maintenance, such as patching or sealing cracks, is required.	The road condition score obtained was 99.44, which is considered good with minimal damage. Routine maintenance is carried out, which includes repair activities such as patching.	The road condition score obtained was 96, which is categorized as good with minimal damage. The repairs are patching.
3	Segment 3 (STA 01 + 720)	Longitudinal Cracks	The road condition score obtained was 10, which is considered good. Routine maintenance, such as patching or sealing cracks, is required.	The road condition score obtained was 99.4, which is considered good with minimal damage. Routine maintenance is carried out, which includes repair activities such as patching.	The road condition score obtained was 96, which is categorized as good with minimal damage. The repairs are patching.
4	Segment 4 (STA 02 + 875)	Potholes	The road condition score obtained was 9, which is considered good. Routine maintenance is required.	The road condition score obtained was 98.77, which is considered good with minimal damage. Routine maintenance is required.	The road condition score obtained was 50, which is included in the fair road condition category. Maintenance is the mainstay of the treatment.
5	Segment 5 (STA 04 + 870)	Potholes	The road condition score obtained was 10, which is in the good road condition category. Routine maintenance is the mainstay of the maintenance process.	The road condition score obtained was 98.87, which is considered good with minimal damage. Routine maintenance is required.	The road condition score obtained was 45, which is in the fair road condition category. Maintenance is required.

Based on the analysis results of the South Ring Road and West Ring Road sections of Jambi City using the Bina Marga Method, the PCI (Pavement Condition Index) Method, and the Asphalt Institute Method, the assessments for road damage management on the South Ring Road and West Ring Road sections of Jambi City are relatively similar.

CONCLUSION

Based on the results of the analysis and discussion in this study, several conclusions can be drawn as follows:

1. Traffic conditions related to the volume and type of vehicles on the South Ring Road and West Ring Road sections are determined by volume (number of vehicles per day) and vehicle type (motorcycles, private vehicles, two-axle vehicles, three-axle vehicles). The vehicle volume on the South Ring Road section is 5040 smp/day. Meanwhile, the traffic volume on the West Ring Road section is 5308 smp/day.

2. The results of the identification of the types of damage on the South Ring Road and West Ring Road of Jambi City based on field surveys are alligator cracks, longitudinal cracks, transverse cracks, potholes.

3. The alternative priority results for handling damage to the South Ring Road and West Ring Road sections of Jambi City are routine maintenance which includes damage repair activities such as patching.

4. The analysis results obtained using the three methods produce each assessment in analyzing road damage on the South Ring Road and West Ring Road Sections of Jambi City. One of the assessments on the South Ring Road Section is Segment 1 (STA 01+295) The Bina Marga Method produces a road condition value of 10 which is included in the good road condition category; The Asphalt Institute Method produces a road condition value of 99.47 which is included in the good road category; The PCI (Pavement Condition Index) Method produces a road condition value of 95 which is included in the good road category. Meanwhile, for the West Ring Road Section segment 1 (STA 01+125) The Bina Marga Method produces a value of 9 which is included in the good category; The Asphalt Institute Method produces a value of 99.47 which is included in the good category; The PCI (Pavement Condition Index) Method produces a value of 95 which is included in the good road category. The handling for the South Ring Road and West Ring Road Sections is a routine maintenance program that includes damage repair activities such as patching.

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