VOLUME 4 | NUMBER 2 | MARCH 2022
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

Analysis of Road Damage Using the PCI Method (Case Study on Tambak Osowilangon Road)

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Abstract

Road is a land transportation infrastructure which includes all parts of the road, including complementary buildings and equipment intended for traffic that is at ground level, above ground or water level, above water level, except for trains, lorries and cable roads. The use of roads can help improve the economy, therefore periodic maintenance is needed. This research was conducted on the Tambak Osowilangon road using the location survey method and calculating the amount of damage and the PCI method. The results of this study are expected to be useful to determine the feasibility of the Tambak Osowilangon road as a benchmark for future improvements.

Keywords
Osowilangon, Pavement, PCI, Road Damage

1. Introduction

The highway is one of the important means of land transportation in daily life, in the Law of the Republic of Indonesia no. 38 of 2004 concerning road infrastructure, it is stated that roads as part of the national transportation system have an important role in realizing the development of the nation. In general, roads are built to facilitate community mobility in transportation and socio-economic activities in the community. The existence of roads is very necessary to support the pace of economic growth, trade, and other needs.

The sustainable use of roads will cause damage to roads that cause losses to road users so that they are not in accordance with the planned age of the road. Road damage requires research to determine the condition of the road surface by making visual observations. Road condition surveys need to be carried out periodically, both structural and non-structural, to determine the level of existing road services. Non-structural inspection aims to check the flatness (roughness), roughness (texture), and roughness (skid resistance).

Pavement Condition Index(PCI) is an estimate of road conditions with a rating system to state the actual pavement condition with reliable and objective data. This method is used to monitor damage on the highway because with this method accurate data is obtained according to the original conditions in the field. The PCI level is written as having a range of 0 to 100 with the criteria of perfect (excellent), very good (very good), good (good), moderate (fair), poor (poor), very poor (very poor), and failed (failed).

2. Methodology

2.1 Pavement Condition Index

Pavement Condition Index(PCI) is an estimate of road conditions with a rating system to state the actual pavement condition with reliable and objective data. The PCI method was developed in America by the US Army Corp of Engineers for airport pavements, highways and parking areas, because with this method accurate data and condition estimates are obtained according to conditions in the field. The PCI level is written as having a range of 0 to 100 with the criteria from Fail to Perfect According to Shahin and Ibrahim (2020) the condition of the pavement is divided into several levels as shown in the following table and diagram:

Table 1. PCI level

PCI value	Pavement Condition
0-10	Failed
10-25	Very Poor
25-40	Poor
40-55	Fair
55-70	Good
70-85	Very Good
85-100	Exellent

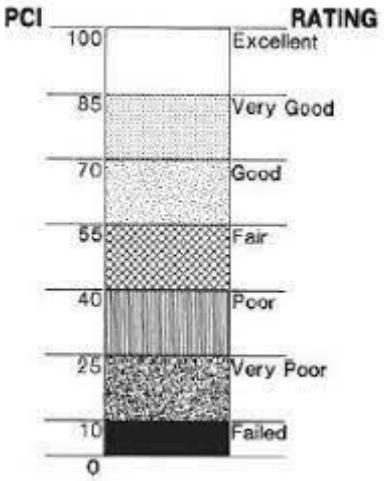

Figure 1. PCI Diagram

The PCI method provides information on pavement conditions only at the time of the survey, but cannot provide a predictive picture in the future. However, by conducting periodic condition surveys, information on pavement conditions can be useful for predicting future performance, as well as being used as input for more detailed measurements.

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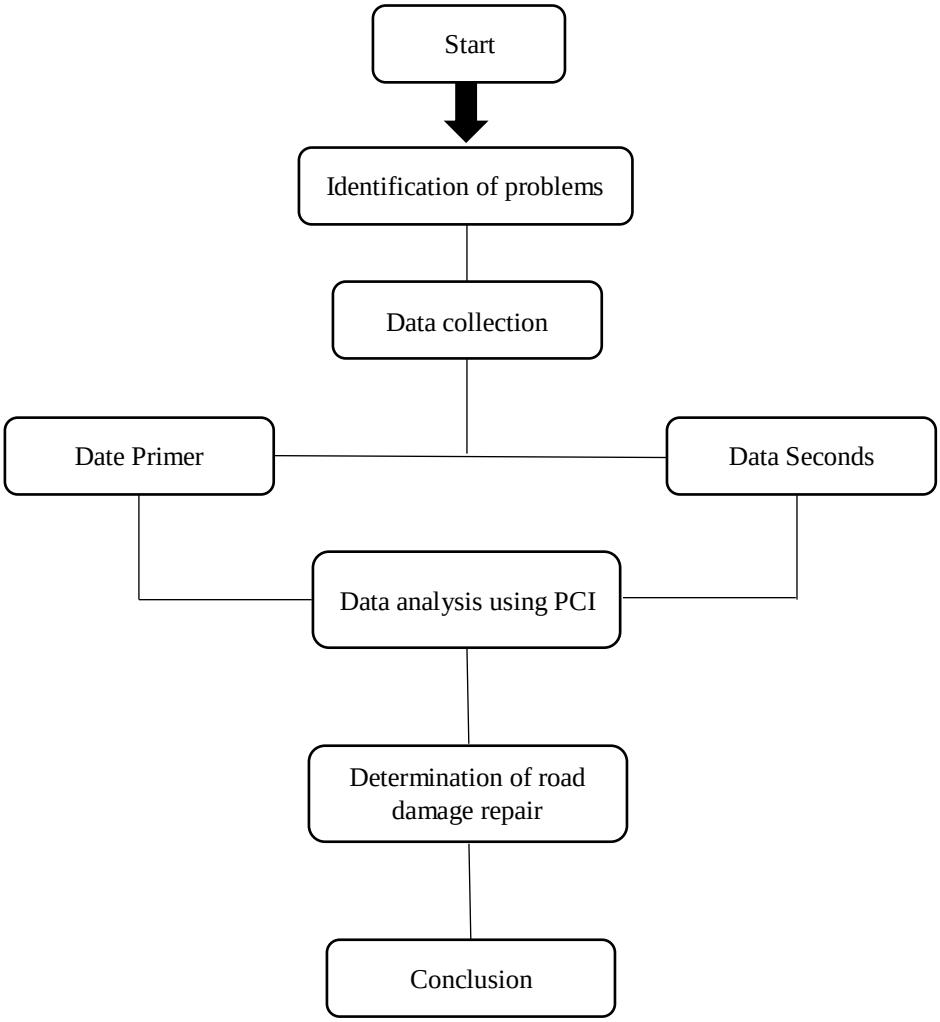
2.2 Research Chart



Flowchart 1. Research Chart

3. Result and Discussion

3.1 PCI Method

The following are the types of damage obtained after conducting a field survey on the Osowilangon road section STA 0+000 – 0+100:

Table 2. Density of Segment 1

Section	Code	Type of Road Damage	Size of each Damage			Damage Class
			P (m)	L (m)	A (m2)	
1+000 - 1+100	1	Alligator Cracking	4.3	0.8	3.44	L
	1	Alligator Cracking	23.6	3.1	73.16	M
	1	Alligator Cracking	19.8	2.4	47.52	M
	11	Patching & Util. Cut Patching	9.8	1.9	18.62	L
	1	Alligator Cracking	0.7	1	0.7	L
	1	Alligator Cracking	1.9	0.9	1.71	L
	1	Alligator Cracking	18.2	2.4	43.68	M
	13	Potholes	0.4	0.5	0.2	M
	6	Depression	2.8	1.4	3.92	L

3.2 Determining the Deduct Value (DV)

Deduct Value is the reduction value for each type of damage obtained from the curve of the relationship between density and severity of damage per type of damage in one segment. If the severity of the damage is different, then the highest level of damage is taken. Here is the DV for STA1+000 – 1+100

Table 3. Deduct Value of Segment 1

Type of Road Damage	Class	Deduct Value
Alligator Cracking	L	5.6
Alligator Cracking	M	50
Depression	L	4
Patching & Util. Cut Patching	L	3.6
Potholes	M	5
Total :		68.2

3.3 Determining the PCI Value

After getting the CDV value, the PCI value can be determined by: PCI = 100 – CDV = 100 – 42 = 58 So it can be concluded that STA 1+000 – 1+100 has a PCI value = 58 which means the pavement condition in that segment =Fair.

In this study, road damage was calculated on the Sijunjung road section starting from STA 0+000 – 1+900 (2 km) and the PCI calculation results obtained that the road section was in Fair condition. The calculation of the PCI value per km can be seen in the following table

Table 4. PCI Calculation

Segment	IS	CDV max	PCI	Condition Rating
1	0+000 - 0+100	42	58	Good
2	0+100 - 0+200	63	37	Poor
3	0+200 - 0+300	53	47	Fair
4	0+300 - 0+400	38	62	Good
5	0+400 - 0+500	44	56	Good
6	0+500 - 0+600	57	43	Fair
7	0+600 - 0+700	47	53	Fair
8	0+700 - 0+800	37	63	Good
9	0+800 - 0+900	40	60	Good
10	0+900 - 1+000	25	75	Very Good
11	1+000 - 1+100	24	76	Very Good
12	1+100 - 1+200	27	73	Very Good
13	1+200 - 1+300	85	15	Very Poor
14	1+300 - 1+400	77	23	Very Poor
15	1+400 - 1+500	55	45	Fair
16	1+500 - 1+600	34	66	Good
17	1+600 - 1+700	35	65	Good
18	1+700 - 1+800	53	47	Fair
19	1+800 - 1+900	33	67	Good
			54.2	Fair

3.4 Metode Asphalt Institute

From the results of the PCI calculation, a value of 54.2 is obtained which means it is sufficient, so for recommendations for improvement using the methodAsphalt Instituteis like the picture below

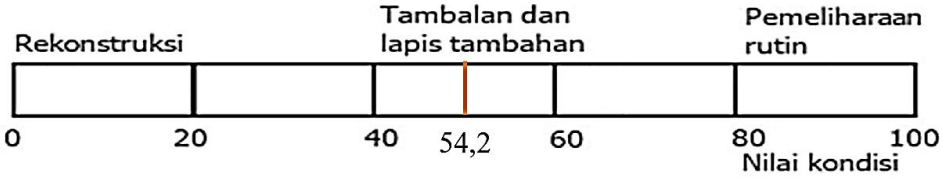


Figure 2. Asphalt Institute Method

Which shows the road is in sufficient condition, then the road which is damaged with potholes needs to be patched and overlaid so that the former patch and cracks and other damages that occur along the road are covered. by hotmix asphalt so that water does not quickly seep into the road layer which causes the damage to be getting worse.

3.5 Road Repair Value

By knowing the results of the recommendations from the calculation of the Asphalt Institute Method, it can be concluded that the repair only includes patching and re-coating, with a detailed price of around Rp. 75,000 for overlay or re-coating. Patching will be carried out on potentially dangerous roads such as damage to holes and cracks, then the value of repairing the Tambak Osowilangon road is as shown in the following table

Table 5. Road Repair Value

No	Damage type	Level	Damage Area (m2)	Repair Price (m2)
1	Alligator Cracking	L	505	Rp 37,875,000
2	Patching & Util. Cut Patching	H	70	IDR 5,250,000
3	Patching & Util. Cut Patching	L	305	Rp 22,875,000
4	Potholes	L	3.57	IDR 267,750
5	Long & Trans Cracking	L	14.6	Rp 1,095,000
6	Rutting	H	10.9	IDR 817,500
7	Rutting	L	153.2	IDR 11,490,000
				IDR 79,670,250

3.6 Road Damage Factor

After we know the PCI value & Damage Value, it is also necessary to know the factors that cause damage to Jalan Tambak Osowilangon. Interviews were conducted using a purposive technique with five key informants conducted around Jalan Tambak Osowilangon. The informants who were interviewed intensively used names using initials, namely RB, TN, SH, LQ and LR.

Data that were not collected through interviews were supplemented with data from direct participant observations conducted between December and January. All data in this survey is described as follows, based on the focus of the survey questions:

1. Type of motorized vehicle?

All interviewees answered that they passed Tambak Osowilangon road using 2-wheeled vehicles or motorbikes.

2. How often do you pass by Jalan Tambak Osowilangon?

Because there are 2 resource persons who work across the cities of Surabaya and Gresik, on average they pass through the Tambak Osowilangon road 3-4 days a week. And 3 resource persons are natives of the Tambak Langon road, so they pass that road every day.

3. Experience passing the Tambak Osowilangon road?

On average, the respondents answered poorly, the number of potholes and road damage made it uncomfortable for the interviewees to pass through the Tambak Osowilangon road, especially when the rainy season often floods.

4. The factors that made the Tambak Osowilangon road into what it is today?

All interviewees answered that the large volume of vehicles caused the road conditions to worsen. The addition of flooding and the lack of maintenance of the roads and drainage system there resulted in the

Tambak Osowilangon road becoming even worse. (Dinata, Rahmawati, and M 2017)

4. Conclussion and Suggestions

4.1 Conclusion

1. The damage that occurred on Jalan Tambak Osowilangon was dominated by crocodile skin damage (Alligator cracking) of 29.37%, Depression of 17.9%, Groove (Rutting) of 13.5% and patching of 17%. . In addition, the damage caused by not being carried out properly and appropriately in response to (Road Maintenance) (puncture damage due to minor damage of unknown cause, such as a gap becoming a hole).
2. After analyzing the calculation using the PCI method, the average PCI value is 54.2 which indicates the condition of the road pavement is in Fair condition.
3. After obtaining the results of field analysis and calculating values according to the PCI method, the condition of the road damage provides recommendations for road repairs using the Asphalt Institute MS-17 method, namely patching and overlaying with a total repair value of Rp.79,670,250
4. The factors that caused the Tambak Osowilangon road to be damaged according to the results of surveys and interviews were the large volume of large vehicles and the frequent rains, causing flooding every rainy season.

4.2 Suggestion

From the findings of the evaluation of the level of damage to the Jalan Tambak Osowilangon section, the researchers tried to provide limited suggestions for the damage that occurred on the road section. The suggestions that can be given are:

1. In order for this road to remain in good condition, it is necessary to review the existing maintenance system by creating a programmed maintenance system that is actually in accordance with the identification of the damage that occurred in order to save the existing road repair budget.
2. For further research, this method (PCI) can be compared with other methods such as Highways and Asphalt Institute to determine road surface conditions

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