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A STUDY ON LEVEL OF RAILWAY ROAD DAMAGE WITH SUSTAINABLE PCI METHOD

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ABSTRACT

Assessment of road surface conditions is one the important steps to determine the type of revaluation program that needs to be done. This study aims to obtain the results of pavement value evaluation and follow-up plan to be taken. The method used is Method pavement condition index (PCI). The data used are observation data on location, the sequence of data processing starting from determining Damage Level, Hardening Condition Conditioning, and Classification of Pavement Quality, PCI value index consists of 0 to 100. Evaluation of road condition of Mayor HE Sukma Rd with PCI method resulted in 64% PCI value included in good category, but in samples there were 3.33% blow up damage, 13.33% corner break, logitudinal, tranverse, and diagonal cracks 23,33%, durability cracking 3,33%, patching large and utility cut 13,33%, scalling 3,33%, spalling tranverse and longitudinal joint equal to 13,33%. The follow-up plan that can be taken on the basis of the highest density of cracks is logitudinal, tranverse, and diagonal with cracking improvements exceeding 3 mm needs to be cleaned and filled with asphalt to prevent water infiltration into cracked cracks, if the cracks exceed 5 mm return the plate locally.

Keywords: PCI method; type of road damage; road condition assessment.

1. INTRODUCTION

A road is a land transportation infrastructure covering all parts of the road, including auxiliary buildings and equipment intended for traffic, located on the soil surface, above the soil surface, below ground and/or water, and above the water surface, trains, lorries, and cable roads. Increased economic needs and rapid movement of the community provide consequences (duties) to the central and regional governments to accelerate the provision and maintenance of transportation infrastructure in the form of roads and bridges are good [1-4]. Considering this matter, Mayor HE Sukma Rd is a very important road existence because in addition as a liaison between cities along the road there are factories that operate every day where the products are distributed every day with a vehicle transporters large enough because of observations that Mayor HE Sukma Rd suffered damage.

One of the stages in evaluating road surface condition is by assessing the existing condition of the road. The value of this road condition will be used as a reference to determine the type of revaluation program that must be done, whether it is an improvement program; periodic maintenance; or routine maintenance. The selection of appropriate road maintenance is done by assessing road surface conditions based on the type of damage that is determined visually [5].

What is the level of damage occurring in Mayor HE Sukma Rd Km. 1 Bogor and how to overcome the damage that occurred? The purpose of this study is to obtain the results of the evaluation of Mayor HE Sukma Rd Bogor, as well as obtaining the Follow-up Plan (RTL) required on Mayor HE Sukma Rd Bogor to repair the damage.

Pavement Condition Index (PCI) is an assessment system of pavement conditions based on type, extent and extent of damage occurring, and can be used as a reference in maintenance business. This PCI value has a range of zero to one hundred with excellent criteria, very good, good, fair, bad, very poor, and failed [6]. The types and extent of pavement damage for roads are: blow ups, corner breaks, long / trans / diagonal cracks, durability cracks, joint seal damage, patching, patching and utility cuts, popouts, pumping, scaling / map cracks/crazing, settlemet/fault, shattred slab, shrinkage cracks, spalling (transverse and longitudinal joint), spalling corners. The data taken to obtain PCI values are: Severity level, Density, Deduct Value, Total Deduct Value, Corrected Deduct Value), Classification of Pavement Quality. Level of Damage (Severity Level), is the level of damage to each type of damage. The level of damage used in PCI calculations is low severity level (L), medium severity level (M), and high severity level (H). Density or damage rate is the percentage of the extent of a type of damage to the area of a segment unit measured in square meters or meters length. The density value of a sibling damage type is also based on the extent of the damage[7]. The formula looks for density values:

Density:
$$\frac{\text{Number of broken concrete plates}}{\text{The number of concrete plates in the sample unit}} \times 100 \quad (1)$$

Deduct Value is a subtraction value for each type of damage obtained from the relationship curve between density and deduct value. Deduct value is also differentiated on the level of damage for each type of damage. Total Deduct Value (TDV) is the total value of the individual deduct value for each type of damage and the extent of damage existing in a research unit. Corrected Deduct Value (CDV) is obtained from the curve of the relationship between the TDV value and the CDV value with the curve selection corresponding to the amount of the individual value of deduct value which has a value

greater than two. If the CDV value is known, then the PCI value for each unit can be known with the formula:

$$PCI(s) = 100 - CDV \tag{2}$$

Classification of Quality of Pavement, obtained from the value (PCI) for each research unit can be known pavement quality of pavement unit segment based on certain condition that is excellent, very good, good, ugly, very poor, and failed [8].

2. RESEARCH METHODS

The ordering of this method is carried out by conducting a pre-survey where at the time of pre-survey is the time to prepare the data to be retrieved, personnel for data retrieval, and what kind of data to be taken at the research location.

The data were collected by observation method at the research location of Mayor HE Sukma Rd with the number of samples there is this research is as many as 30 plates with the sample unit chamber located at STA 0 + 800 up to STA 0 + 859.3 with a width of 10 meter road segment divided into 3 rows of plates [9]. Primary data taken from the samples studied is road damage data used to determine the type of damage and the level of damage whether entered in the category of low, medium, or high in accordance with the damage that occurred. Data processing is divided into 3 (three) parts that consist of the level of damage (severity level) obtained from the data survey results in the location processed and presented in the table to be able to identify the type of damage and damage rates. The second step is to assess the pavement condition (Density, Deduct Value, Total Deduct Value, Corrected Deduct Value) for the density step used

equation 1, for the deduct value to get the result using the graph, as well as the corrected deduct value (CDV) value to find the value is used graph of the relationship between CDV with total deduct value (TDV). The third step is to determine the classification of pavement quality using equation 2, then the PCI value is obtained and can see the qualification of its through qualification of available PCI index [10]. Evaluation of the results is to check the calculations that have been done whether it is appropriate steps to get the results appropriate to the condition of the sample location. The conclusions and suggestions are to draw conclusions from the results obtained at the time of the study and provide the advice needed to address the emerging problems.

3. RESULTS AND DISCUSSIONS

Processing Evaluation of the extent of this damage begins by conducting (1) a survey on the location of the study to obtain data on the type of plate damage and severity level, (2) followed by calculating the density to obtain the percentage of damage on each type of damage occurring the same as equation 1, (3) after the density value is followed by finding the value of deduct value by using the graph between density and deduct value, (4) the deduct value data obtained is summed and connected with the corrected deduct value (CDV) graph, (4) the next step is value 100 with CDV value like equation 2

3.1 Result of evaluation condition Mayor HE Sukma Rd

In this study, 30 plate plates were used with plates located at STA 0 + 800 - STA 0 + 859,3 with varying plate length as can be seen in Table-1.

No.	T 4 ²	Plate	size (M)	Transfelario	Cell	I and of demonstra
Plates	Location of pate	Р	L	Type of damage	Code	Level of damage
1	STA 0+800 - STA 0+805	5,00	3,5	Durability Cracking	64	Low
2	STA 0+800 - STA 0+805	5,00	3	Blow up	61	Medium
3	STA 0+800 - STA 0+805	5,00	3,5	No damage		
4	STA 0+805 - STA 0+809.5	4,95	3,5	No damage		
5	STA 0+805 - STA 0+809.5	4,95	3	No damage		
6	STA 0+805 - STA 0+809,5	4,95	3,5	Patching Large and Utility Cut 67 High		High
7	STA 0+809,5 - STA 0+814,88	4,93	3,5	No damage		
8	STA 0+809,5 - STA 0+814,88	4,93	3	No damage		
				Patching Large and Utility Cut	67	High
9	STA 0+809,5 -STA 0+814,88	4,93	3,5	Cracks Logitudinal,Tran verse, and Diagonal	63	High

Table-1. Survey data of damage rates.

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10	STA 0+814 - STA 0+819,2	4,32	3,5	Corner Break	62	Low
11	STA 0+814 - STA 0+819,2	4,32	3	No damage		
12	STA 0+814 - STA 0+819,2	4,32	3,5		No damage	
13	STA 0+819,2 - STA 0+824,62	5,42	3,5	Corner Break	62	Low
14	STA 0+819,2 - STA 0+824,62	5,42	3	Patching Large and Utility Cut	67	High
15	STA 0+819,2 - STA 0+824,62	5,42	3,5	Cracks Logitudinal,Tran verse, and Diagonal	63	High
16	STA 0+824,62 - STA 0+831,94	7,32	3,5		No damage	
17	STA 0+824,62 - STA 0+831,94	7,32	3	Spalling Tranverse and Longitudinal Joint	74	Medium
18	STA 0+824,62 - STA 0+831,94	7,32	3,5	Cracks Logitudinal,Tran verse, and Diagonal	63	High
19	STA 0+824,62 - STA 0+844,08	12,14	3,5	Cracks Logitudinal,Tran verse, and Diagonal	63	Low
20	STA 0+824,62 - STA 0+844,08	12,14	3	Cracks Logitudinal,Tran verse, and Diagonal	63	Low
				Corner Break	62	Low
21	STA 0+824,62 - STA 0+844,08	12,14	3,5	Cracks Logitudinal,Tran verse, and Diagonal	63	Low
22	STA 0+844,08-STA 0+849,25	5,17	3,5	No damage		
23	STA 0+844,08-STA 0+849,25	5,17	3	Spalling Tranverse and Longitudinal Joint	74	Medium
24	STA 0+844,08-STA 0+849,25	5,17	3,5	Corner Break	62	High
25	STA 0+849,25-STA 0+854,5	5,25	3,5	Scalling	70	Medium
26	STA 0+849,25-STA 0+854,5	5,25	3	Corner Break	62	Low
27	STA 0+849,25-STA 0+854,5	5,25	3,5	Patching Large and Utility Cut	67	High
				Corner Break	62	High
28	STA 0+854,5- STA 0+859,3	4,80	3,5	Spalling Tranverse and Longitudinal Joint	74	Medium
29	STA 0+854,5- STA 0+859,3	4,80	3	Spalling Tranverse and Longitudinal Joint	74	Low
30	STA 0+854,5- STA 0+859,3	4,80	3,5	Cracks Logitudinal,Tran verse,	63	High

The next calculation step is to determine the value of density based on the survey data table, where the damage is summed and grouped according to type. For the

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calculation step based on equation 1, the calculation results are presented in Table-2.

No.	Type of damage	Code	Value Density
1	Blow up	61	3,33 %
2	Corner Break	62	13,33 %
3	Cracks Logitudinal, Tranverse, and Diagonal	63	23,33 %
4	Durability Cracking	64	3,33 %
5	Patching Large and Utility Cut	67	13,33 %
6	Scalling	70	3,33 %
7	Spalling Tranverse and Longitudinal Joint	74	13,33 %

Table-2. Data Result Percentage Density.

Determining the value of deduct value based on graph of density relationship with deduct value. Then the results presented in Table-3.

No.	Type of damage	No. Plate	Code	Deduct Value
1	Blow up	2	61	7
2	Corner Break	10,13,24,27	62	17
3	Cracks Logitudinal,Tranverse, and Diagonal	9,15,18,,19,20,21, 30	63	31
4	Durability Cracking	1	64	1
5	Patching Large and Utility Cut	6,9,14,27	67	20
6	Spalling Tranverse and Longitudinal Joint	17,23,28,29	74	5
7	Scalling	25	70	3
	84			

Table-3. Result of value of Deduct value	Table-3.	Result	of Value	of Deduct	Value.
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The basis of the calculation above table is Figure-1.



Figure-1. The graph of the deduct value used.

By obtaining the value of deduct value and summing to total deduct value (TDV) then we can find

corrected deduct value (CDV) value based on graph of TDV and CDV relationship.



Figure-2. The graph of the deduct value used.

Table-4. The CDV Value obtained.

Number of plate	Deduct Value	Total	Q	CDV
30 Sample	7 13 31 1 20 5 3	84	6	36

By obtaining corrected deduct value (CDV) value, we can determine the value of pavement condition index (PCI) based on equation 2, then it is presented in Table-5.



No	Number of plates	CDV Maks	100- CDV	PCI
1	30 Plate STA 0+800 – STA 0+859,3	36	64	Good)

 Table-5. PCI Value Calculation.

Figure 3 given below depicts the condition of the pavement condition index scale. There are 5 types namely, excellent, very good, good, fair, poor, very poor and failed.



Figure-3. Qualification of PCI Value.

PCI value for 30 sample plates on highway Mayjen H.E. Sukma Rd on STA 0 + 800 - STA 0 + 859.3 is 64, where the value is included in good category based on qualification of PCI value.

3.2 Follow Up Plan

The follow-up plan is the plan performed or the treatment needed to cope with the damage that occurred in the sample under study[11]. There are 7 types of damage that occurred in 30 samples in detail. We use the standardization obtained from rigid pavement procedures from Directorate General of Highways [12].

3.3 Type of blow up damage

The method of repair is by patching in the depth of the Partial or the entire plate if the state of the plate is still not too severe, if the condition is severe enough it can be done replacement of the plate, for example damage to blow up occurred on plate sample number 2.

3.4 Corner break

The repair procedure is For cracks exceeding 3 mm cracks cleaned and filled with asphalt to prevent water infilation into crack slits, when the gap is already exceeding 5 mm it can be rebuilt plate locally, for example damage Corner Break occurs on the sample plate number 10,13,24 and 27. So it needs to be understood that for every road implementation and repair it requires safe and smooth traffic [13-16].

3.5 Logitudinal, tranverse, and diagonal cracks

Procedure of repair is for cracks exceeding 3 mm cracks cleaned and filled with asphalt to prevent water infiltration into crack slits, if the gap has exceeded 5 mm then it can be rebuilt plate locally. damage to Corner Break occurs on sample plates of numbers 9, 15, 18, 19, 20, 21 and 30.

The spalling tranverse and longitudinal joints of the repair procedure are by patching at depths to a depth of chunks greater than 50 mm, a thin additional coating for less than 50 mm of chips, for example damage to Spalling Tranverse and Longitudinal Joint occurs on sample plate number 17, 23, 28, 29.

3.6 Durability cracking

The repair procedure is by filling at all depths, for reconstructed connections, and if severe damage can be done replacement of concrete plates. This damage occurs on the number 1 sample plate.

3.7 Patching large and utility cut

Procedures for improvement are patches dismantled and bottom layer compacted again, then patched while temporary repairs can be done by patching the damaged pavement on the surface. This damage occurs in sample plates of numbers 6, 9,14 and 27. Scalling Procedure of repair for Scalling type of damage is by partial filling or in depth, at damages of about 10 mm for transient repair is used covering the asphalt emulsion solution, if the inner pavement damage must be covered with asphalt concrete as an overlay, and the last time the fault has been very severe it can be done replacement plate locally. This damage occurs on the sample plate number 25.

4. CONCLUSIONS

With the evaluation of the level of road damage on Mayor H.E. Sukma Rd with a sample of 30 plates (STA 0 + 800 - STA 0 + 859.3), has a pavement condition index (PCI) of 64 and is categorized as good, highway Mayjen H.E. Sukma Rd has a length of 13 km which is incorporated into the Sukabumi highway and into the administrative area of Bogor Regency Government, the results illustrate for 30 samples of plates studied rather than whole. The breakdowns for 30 sample samples studied were blow up 3.33%, corner break 13.33%, logitudinal cracks, tranverse and diagonal 23.33%, durability cracking 3.33%, patching large and utility cut 13,33%, spalling tranverse and longitudinal joint 13,33%, scaling 3,33%. The method used for the follow-up plan for the damage occurred refers to the rigid pavement number 10/T/BNKT/1991 issued by the Directorate General of Highways.

Based on the results of the evaluation of the damage done, we present some recommendations that may be useful for Bogor City Government and Bogor Regency Government to be able to immediately handle the damage that occurred to reduce the accident rate, conduct periodic pavement survey conditions in order to predict the performance of the road in the future will come.



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