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ANALYSIS OF THE LEVEL OF ROAD DAMAGE ON THE TEUKU UMAR – DR WAHIDIN SUDIROHUSODO TUBAN (3.5 Km) USING THE PAVEMENT CONDITION INDEX (PCI) METHOD

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Abstract: *Roads are the most important aspect for the sustainability of distribution and economy, therefore it is necessary to have a review carried out so that the road remains in good condition for use. Many roads are still damaged, one of which is the Teuku Umar – Dr Wahidin Sudirohusodo road. Therefore, visual observations will be made by referring to the Pavement Condition Index (PCI) method. From the observation process, the types of damage that occurred were Cracking, Patholes, Raveling, Patching, Polished Aggregators, Rutting, Depression, and Bleeding. Where the damage rate refers to the PCI method of 38.6 and is dominated by cracking damage of 43.56% so that the repair method that can be taken is crack filling.*

1. INTRODUCTION

Tuban is one of the areas in east Java that participates in supporting the economy of the city with the second largest economy in Indonesia, this is what makes the vehicle load on this area large enough that it causes a lot of road damage. One of the roads that has suffered quite damage is the Teuku Umar - Dr Wahidin Sudirohusodo road, where at several points on this road it has been damaged so that motorists must be more careful when passing this road. The purpose of this study was to identify the types of damage that occurred on the Teuku Umar – Dr Wahidin Sudirohusodo Tuban road. Road damage can be divided into 2 types, namely Truktural damage and functional damage. [1] The following are the factors that can cause road damage[2] : 1. Traffic, where the busier the flow of traffic that exists, the heavier the bumps needed. 2. Water, can come from rainwater, groundwater, or poor drainage systems. 3. Road construction materials, where the selection of construction materials greatly affects the resistance of the road. 4. Climate. 5. Less stable bottom soils. Therefore, it is necessary to have a good road plan so that the road can meet the life of the manufacturing plan, normally the life of the road is 10-20 years, so the road must not be damaged at the age of the first 5 years after construction is completed. [3].

2. DATA AND METHOD

Location of Research

This research was conducted on the Teuku Umar – Dr Wahidin Sudirohusodo Tuban National road, where the length of this road is 3.5 Km and is divided into 35 segments.

Gambar 1. Location of research (Google Earth)

Tools of Research

This research was conducted with several tools for documentation and facilitated the process of recording and calculating, the tools needed include:

- Form survey PCI
- Camera
- Roll meter
- Ruller

Data Collecting

The data used are the types of damage obtained through direct surveys in the field, then the LHR data obtained by calculating the direct volume of vehicles crossing the observation area.

Implementation of Road Damage Survey

To conduct a road damage survey, of course, there are several steps including :

- Dividing the observation area, because the length of the observation area is 3.5 km, it will be divided into 35 segments, so that in 1 segment it has a length of 100 meters.
- Make observations and records of any damage that occurs.
- Identifying the type of damage.
- Measuring the area of damage.
- Measuring the severity of damage.
- Input in the survey form.

3. RESULT AND DISSCUSSION

Pavement Condition Index (PCI) Method.

Tabel 1. Types of Damage That Occur Segment I (Riskiya,2022)

Type of Damage	Distress Severity	Quantity (m)			
		Length	Width	Depth	Area
Patching	M	2.8	2.1	0	5.88
Patching	M	2.4	1.6	0	3.84
Patching	M	1.57	0.48	0	0.75
Patching	M	5.5	4	0	22
Patching	M	27.4	2	0	54.8
Aligator Cracking	H	6.7	0.6	0	4.02
Aligator Cracking	H	22.1	1	0	22.1
Aligator Cracking	H	22.4	4	0	89.6
Aligator Cracking	H	0.7	0.5	0	0.35
Raveling	L	0.7	0.7	0.01	0.0049
Patholes	L	0.45	0.2	0.06	0.0054
Patholes	L	0.9	0.5	0.01	0.0045
Block Cracking	H	12.5	2.5	0	31.25
Block Crackinng	H	10.6	3	0	31.8
Block Cracking	H	4	0.2	0	0.8

1. Density

Density calculations on each type of damage are based on the length and extent of damage and the extent of the damage and the extent of the damage. His life using formulas:

$$\text{Density} = \frac{Ld}{Ls} \text{x } 100\%$$

$$\text{Density} = \frac{Ad}{As} \text{x } 100\%$$

Information :

Ld = Length of damage (m)

Ad = Total area of damage for each severity (m2)

As = Total area of sample units (m2)

Ls = Total length of sample units (m)

a. Patching
Medium

$$\text{Density} = \frac{87.27}{100 \, x \, 11} \text{x } 100\% = 9.70\ \%$$

b. Aligator Cracking
High

$$\text{Density} = \frac{116.07}{100 \, x \, 11} \text{x } 100\% = 12.90\ \%$$

c. Weathering and Raveling
Low

$$\text{Density} = \frac{0.0049}{100 \, x \, 11} \text{x } 100\% = 0.000445\ \%$$

d. Patholes
Low

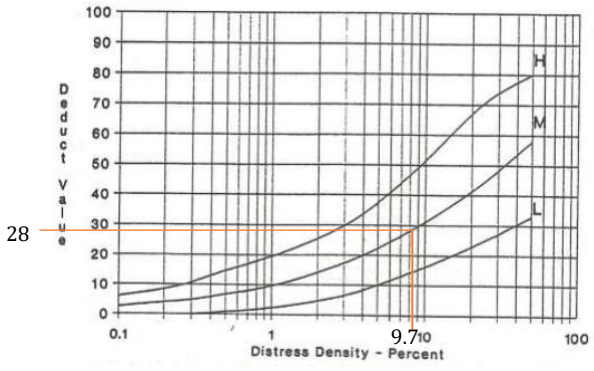
$$\text{Density} = \frac{0.07}{100 \, x \, 11} \text{x } 100\% = 0.0078\ \%$$

e. Blok cracking
High

$$\text{Density} = \frac{63.85}{100 \, x \, 11} \text{x } 100\% = 7.01\ \%$$

2. Deduct Value
Deduct value is determined based on the curve of the relationship between the DV and the degree of damage of each type of damage.

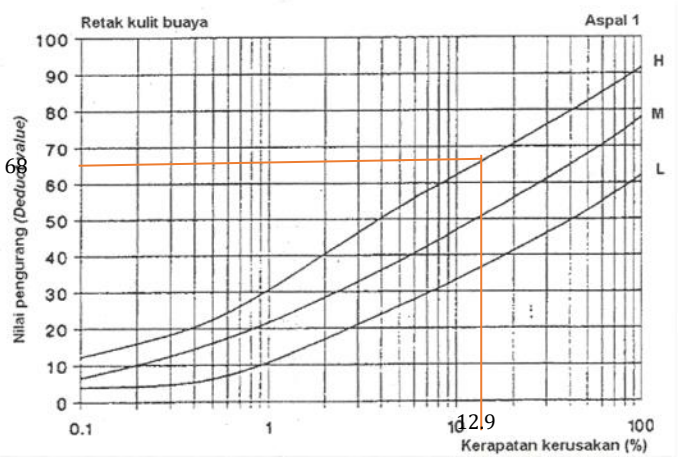
a. Patching



Tambalan(*Patching*)

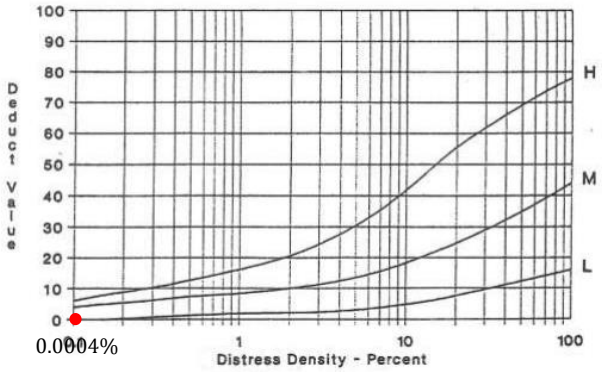
Based on the graph above obtained deduct value for the type of patch damage with the Medium category which has a density value of 9.67% is 28.

b. Aligator Cracking



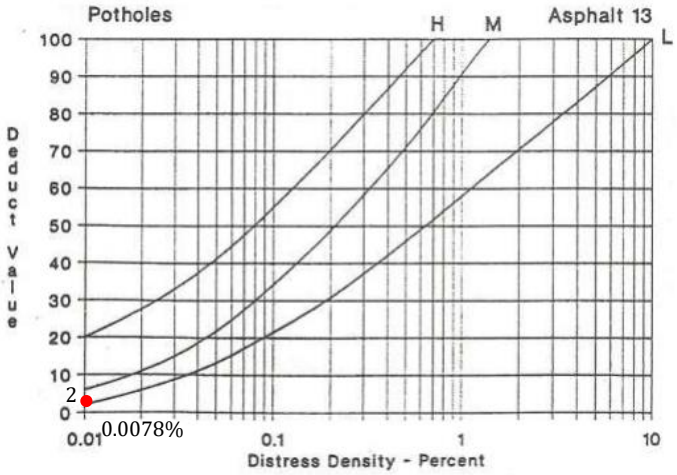
Based on the graph above obtained deduct value for high category aligator crack damage with a density value of 12.90% is 68.

c. Weathering and Revelling



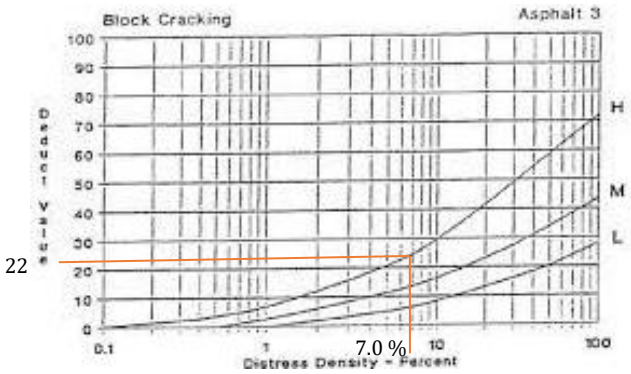
From the deduct value graph for the type of damage raveling with a density value of 0.00045% above obtained a deduct value of 0.

d. Patholes



From the graph above obtained deduct value for the type of patholes damage with a density of 0.0078% is 2.

e. Block Cracking



From the graph deduct value of the type of damage cracked block above with a density of 7.0% then the deduct value obtained is 22.

The following is a table of Type of Damage, Severity Level, Density, and Decut Value

Table 2. Type s, Severity of Damage As Well As Quantity, Density and subtraction value in Segment I

SURVEY DATA FORM FOR ROAD WITH ASPHALT PAVEMENT			
Road : Teuku Umar	Weather : Sunny	Segment I	Length of Segment: 100 m2
Surveyor : Riskiya N.J	Date : 15/03/22		Area : 1100 m2
Type of damage			
1. Aligator Cracking (m2)	8. Joint Reflection Cracking (m2)	14. Railroad Cracking (m2)	
2. Bleeding (m2)	9. Lane/Shoulder Drop Off (m2)	15. Ruts (m2)	
3. Block Cracking (m2)	10. Transversal/Longitudinal Cracking(m2)	16. Shoving (m2)	
4. Bump and Sags (m2)	11. Patching (m2)	17. Slippage Cracking(m2)	
5. Corrugation (m2)	12. Polhised Agregate (m2)	18. Swell \(m2)	
6. Depression (m2)	13. Patholes (m2)	19. Raveling (m2)	
7. Edge Cracking (m2)			

Disstress Severity	Quantity					Total	Density %	Deduct Value
11M	5.88	3.84	0.7536	22	54.8	87.2736	7.933964	28
1H	4.02	22.1	89.6	0.35		116.07	10.55182	68
19L	0.0049					0.0049	0.0004%	0
13L	0.0054			0.0045		0.07	0.006364	2
3H	31.25		31.8	0.8		63.85	5.804545	22

3. TDV (Total Deduct Value)

Before determining the total subtraction value is determined in advance the maximum permission reduction value (m) to limit the total DV value. If the value of m > of the number of DV then used all DV values, if the value of m < of the number of DV then the total value of DV as much as m.

$$m = 1 + \frac{9}{98} x\ (100 - HDV_1)$$

HDV_1 = DV highest unit 1

From table 4.4 obtained the highest DV value of unit 1 is 68, then:

$m = 1 + \frac{9}{98}x\ (100 - 68) = 3.94 < 5$ (5, part of DV)

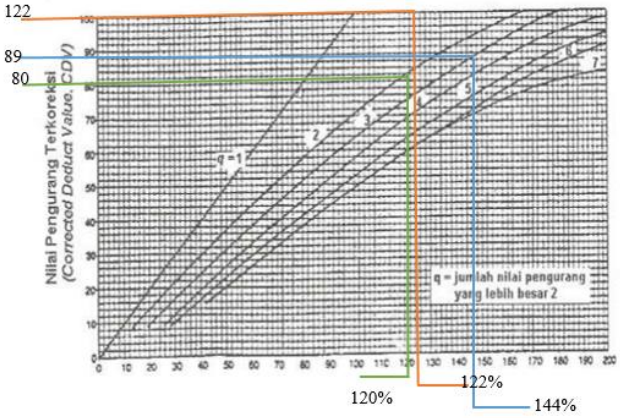
the deduct value is 3, the highest value is added with the rest i.e. 0.94 multiplied by the next subtraction value (0.94 x 28 = 26.32)

Tabel 3 Deduct Value

No	Deduct Value					TDV	Q	CDV
1.	68	28	22	0	26	144	3	89
2.	68	28	22	0	2	120	2	80
3.	68	28	22	2	2	122	1	122

TDV is the total amount of DV and the CDV value can be seen in the image above. If CDVmax (highest CDV) < HDV1 (highest DV) then HDV is used in PCIs calculations, and vice versa, if CDVmax > HDV1 then CDVmax is used.

4. Corrected Deduct Value



Gambar Corrected Deduct Value

Information :

= TDV for graphyc q1

= TDV for graphyc q2

= TDV for graphyc q3

For TDV = 149 that cuts the graph q = 1 obtained CDV > 100, then to find the CDV value is used to interpolate the value of TDV and

$$\text{CDV}: \frac{100}{120} = \frac{100}{100+x}$$

$100(100 + x) = 10200$

$X = \frac{12200}{100} - 100 = 22$

So CDV = 100 + 22 = 122

5. PCI Value

PCI Values Of Sta 0+000 to 0+100 can be obtained in the following ways :

Because CDVmax = 122 > 100, the CDV max used is 100.

PCI = 100 – CDVmax

PCI = 100 – 100

PCI = 0 (Failed)

6. CONCLUSSION

Based on research and analysis of data obtained several conclusions including :

1. The type of damage thaht occured on the Teuku Umar – Dr Wahidin Sudirohusodo with a damage area of 4823 m2 with a damage percentage of 12.53%. consists of several types of damage including cracks with a damage area of 2101 m2 (43.56%), Patholes with a damage area of 1.2 m2 (0.02%), Raveling with a damage area of 52595 m2 (10.9%), Patching with a damage area of 1893 m2 (39.25%), Polished Agregate with a damage area of 283.9 m2

(5.87%), Ruts with a damage area of 6.56 m2 (0.13%), Depression with a damage area of 7.62 m2 (0.15%), Bleeding with a damage area of 3.99 m2 (0.08%).

2. The condition on the Teuku Umar – Dr Wahidin Sudirohusodo Tuban National road is Very Poor with a PCI value of 38.31 with the segment that has the best condition in segment 33 with a PCI value of 100 in the Excellent category.
3. From the results of the analysis that has been carried out on the Teuku Umar – Dr Wahidin Sudirohusodo National Road. S as much as 3.5 kilometers divided into 35 segments obtained that from the 35 (thirty-five) segments above 18 (eighteen) segments of which are obtained repair techniques in the form of P3 (crack filling), it can be proposed that the right repair technique for the Teuku Umar – Dr Wahidin Sudirohusodo Tuban National road segment is the addition of a new pavement layer (Overlay).

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