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Comparison of Assessment and Recommendations for Handling Road Damage of the PISEW Program Using the Highway Method and *Pavement Condition Index* (PCI)

Muh. Husen[1], I Dewa Made Alit Karyawan[2], Muhajirah[3]
[1, 2, 3]Master of Civil Engineering Program, Faculty of Engineering, University of Mataram, Mataram, Indonesia
Email address: uchen.vie@gmail.com

Abstract — *Road construction projects involving community participation, such as the Regional Socio-Economic Infrastructure Development Program (in Indonesian: Pengembangan Infrastruktur dan Sosial Ekonomi Wilayah/ PISEW), typically rely on volunteer labor, basic tools and equipment, and locally available materials near the project site. Consequently, the quality of the roads constructed tends to be inconsistent and less durable, often resulting in premature damage. This study aims to analyze the types and causes of damage observed on three specific road sections: Mekar Bersatu-Beber Village (Section 1), Jenggik Village-Lando Village (Section 2), and Loyok Village-Gelora Village (Section 3). The assessment utilizes the Bina Marga Method and Pavement Condition Index (PCI). The Bina Marga Method is a commonly used approach in Indonesia to evaluate road conditions based on various parameters such as types of damage, severity levels, and distribution of damage along road sections. The results from this method can be utilized to prioritize road repairs and maintenance programs. In contrast, the PCI method evaluates pavement conditions on a scale from 0 to 100, detailing types and extents of damage but does not provide specific maintenance recommendations. Damage types identified across the three sections include crocodile cracks, potholes, collapses, and aggregate loss, with additional wave-type damage in Section 1 and longitudinal cracks in Section 2. A comparative analysis reveals that the Bina Marga Method offers a simpler and more user-friendly approach compared to PCI. It prioritizes maintenance actions based on assessment results, whereas PCI focuses solely on quantifying pavement condition without explicit maintenance directives. Additionally, the Bina Marga Method incorporates the Average Daily Traffic value, which is not utilized in the PCI Method.*

Keywords— *PISEW, road damage, Highway method, PCI method*.

I. INTRODUCTION

The development of road infrastructure in rural areas is one of the government's strategic efforts to improve connectivity and community welfare. The Regional Socio-Economic Infrastructure Development Program (PISEW) is a clear example of a community-based infrastructure development program that aims to strengthen connectivity in the area [1]. However, road construction by the community often faces various obstacles caused by limited resources.

Road construction work involving community participation typically relies on volunteer labor, simple tools and equipment, and local materials available around the project site. As a result, the quality of the road being built is often inconsistent and not durable, leading to premature damage [2].

This study examines three road sections that were built with a community participation mechanism, the three road sections were completed in 2018 and are currently damaged, as shown in Figure 1.

In addition to resource limitations, several other factors also affect the life of road pavements, including: increased traffic volume, waterlogging on the road surface and overload. These factors accelerate damage to road pavements, which in turn results in losses such as vehicle speed impediments, reduced comfort for road users, and increased risk of accidents [3]. Another disadvantage is the waste of road maintenance budgets, which requires immediate handling to avoid greater costs in the future [4].

a. Section 1 b. Section 2 c. Section 3

Figure 1. Road Surface Conditions Observed

The condition of road pavements will decrease as the service life and traffic load increase [5]. Therefore, periodic maintenance is very necessary so that the road remains at an optimal level of service. Evaluation of road surface conditions is usually carried out using the Highway Method, with the help of the Provincial and Regency Road Management System (PKRMS) application [6], [7].

There are various methods used for road damage evaluation, including: *Pavement Condition Index (PCI)* [8], *Surface Distress Index* (SDI) [9] and Bina Marga Method [10]. The selection of this evaluation method is important because each method has advantages and disadvantages. The results of the analysis of each method provide different recommendations, so the wrong decision can have a fatal impact. In this study, the Bina Marga method is used because

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it is easier and faster to use, while the PCI method is used as a comparison because it is more detailed in its use [10].

Road construction with community participation has many challenges, especially related to limited resources. Periodic evaluation of road conditions and the use of appropriate methods are essential to ensure the life of the pavement is in accordance with the plan and avoid greater losses in the future.

II. RESEARCH METHODS

A. Research Location

The location of the study is a road with a type of Lapen Asphalt pavement built through the PISEW Program in 2018, namely: The Mekar Bersatu Village Road-Beber Village, Batukliang District , Central Lombok Regency is 1451 meters long (Section 1). Loyok Village Road-Gelora Village, Sikur District (Section 2), East Lombok Regency along 1100 meters. The Jenggik Village-Lando Village Road, Terara District (Section 3), East Lombok Regency is 758 meters long.

Figure 2. Research Location

B. Types and Needs of Data

The type of data needed can be seen in the following Table 1.

TABLE 1. Types of Data Required for Analysis

No	Data Requirements	Type Data	Data Source	Method of collecting data
1	Road geometric.	Primary data	Location of the road being studied	Road site survey
2	Type, level and amount of road damage.	Primary data	Location of the road being studied	Road site survey
3	Type, weight and volume of passing vehicles	Primary data	Location of the road being studied	Road site survey
4	What factors cause damage	Primary data	Location of the road being studied	Road site survey
5	Road class/status	Secondary data	Public Works Department and Regency Settlement Service	Interviews and file collection
6	Location overview	Secondary data	• District office • Village government office • Central Bureau of Statistics Office • Internet Web	Copy and Download Files

C. Data Analysis

The data obtained was analyzed using 2 (two) methods, namely: Bina Marga Method and *Pavement Condition Index* (PCI).

1. *Highway Method*

The procedure for data analysis with the Highway Method is as follows:

a. Specifies the type and class of the road.
b. Calculate the Average Daily Traffic/ ADT (in Indonesian Lalu Lintas Harian Rata-rata/ LHR) for the surveyed roads and determine the value of the road class using Table 2 [11].

TABLE 2. Table of LHR and Road Class Values

No	Average Daily Traffic (LHR) (passenger car units/day)	Road Class Value
1	< 20	0
2	20 – 50	1
3	50 – 200	2
4	200 – 500	3
5	500 – 2000	4
6	2000 – 5000	5
7	5000 – 20000	6
8	20000 – 50000	7
9	> 50000	8

c. Tables survey results and groups data according to the type of damage.
d. Calculate the parameters for each type of damage and make an assessment of each type of damage based on Table 3 [11].

TABLE 3. Table for Determining Condition Numbers Based on Damage Type

Cracking	
Type	**Number**
Alligator	5
Random	4
transverse	3
Longitudinal	1
None	1
Wide	**Number**
> 2 mm	3
1 – 2 mm	2
< 1 mm	1
None	0
Area of Damage	**Number**
> 30%	3
10% - 30%	2
< 10%	1
None	0
Rutting	
Depth	**Number**
> 20 mm	7
11 – 20 mm	5
6 – 10 mm	3
0 – 5 mm	1
None	0

Patching and Potholes	
Area	**Number**
> 30%	3
10% - 30%	2
< 10%	1
None	0
Surface Roughness	
Type	**Number**
Disintegration	4
Weathering/ Ravelling	3
Rough	2
Fatty	1
Close Texture	0
Depression	
	Number
> 5/100 m	4
2 – 5/100 m	2
0 – 2/100 m	1
None	0

e. Add up each number for all types of damage, and assign road condition values based on Table 4 [11].

TABLE 4. Determination of Road Condition Value (RCV) Based on Total Damage Rate

No	Total Damage Number	Road Condition Value
1	26 – 29	9
2	22 – 25	8
3	19 – 21	7
4	16 – 18	6
5	13 – 15	5
6	10 – 12	4
7	7 – 9	3
8	4 – 6	2
9	0 – 3	1

f. Calculate the priority value of road conditions using the equation:

Priority Score = 17–(LHR Class + RCV) (1)

g. Determine the actions taken to handle road damage based on Table 5 [11].

TABLE 5. Determination of Actions Taken Based On Priority Values

No	Priority Value	Actions Taken
1	0 – 3	Increase Program
2	4 – 6	Periodic Maintenance Program
3	> 7	Routine Maintenance Program

2. *Method of PCI*

The procedure for data analysis with the PCI Method is as follows:

a. Establish *a deduct value* by:
 1) Sums the total of each type of damage at each severity.
 2) Calculate the density value , which is the percentage of the area or total length of each type of damage to the total area or length of the road section measured (sample unit). Thus, the density of damage can be expressed by the equation [3], [8], [10]:

$$Density\ (\%) = \frac{Ad}{As} \times 100 \quad (2)$$

or

$$Density\ (\%) = \frac{Ld}{As} \times 100 \quad (3)$$

with:

Ad = Total area of one type of pavement for each severity of damage (m2)
As = Total area of sample units (m2)
Ld = Total length of one type of damage for each severity of the damage (m)

 3) Determine *the deduct value* for each type of damage and the combination of severity based on the *deduct value determination curve* [3], [8], [10].

b. Determine the permit value of *the deduct* (m) by:
 1) If airports have only one reduction value > 5 and roads > 2, then the full reduction value is used as the corrected reduction value, otherwise continue to the next steps,
 2) Sorting the deduct value from the largest value,
 3) Determine the value of m using the equation:

$$m = 1 + (9/98) \times (100 - HDV) \quad (4)$$

with:

m = Deduct permit value .
HDV = highest value of the *deduct.*

c. Determine the Maximum CDV *(Corrected Deduct Value)* by:
 1) Specifies the amount of *deduct* value greater than 2 (q).
 2) Determine the total value of *the deduct* by adding up each *deduct value*.
 3) Determine the CDV from the calculations 1) and 2) by using the deduct value correction curve [3], [8], [10] as presented in Figure 3 .

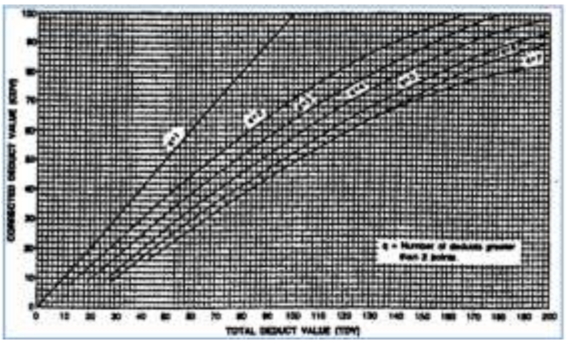

Figure 3. Relationship between TDV and CDV

 4) The smallest deduct value is subtracted by 2 then repeat steps a) to c) until the value q = 1.
 5) The maximum CDV is the largest CDV in the above iteration process.
 6) Calculate the PCI *(Pavement Condition Index)* with the equation [3], [8], [10]:

$$PCIs = 100 - CDVmaks \quad (5)$$

with:

PCIs = PCI for each sample unit or research unit,
CDVmax = Maximum CDV of each sample unit

Meanwhile, to calculate the overall PCI value in one road section, it can be calculated using the equation:

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$$PCI_r = \sum \frac{PCIs}{N} \quad (6)$$

with:

PCIr = average PCI score from all research areas
PCIs = PCI value for each sample unit
N = Number of sample units.

7) Once the PCI value is known, the pavement condition rating can then be determined from the sample unit reviewed using Table 5 [3], [8], [10].

TABLE 6. PCI Values and Pavement Conditions

No	PCI Value	Pavement Condition
1	0 – 10	Failed
2	11 – 25	Very Poor
3	26 – 40	Poor
4	41 -55	Fair
5	56 – 70	Good
6	71 – 85	Very Good
7	86 - 100	Excellent

III. RESULTS AND DISCUSSION

A. Location Overview

The three sections reviewed include the category of village roads as access connecting two or more villages built for the development of rural areas, especially to facilitate community access in carrying out social and economic activities. The village government as the manager of the road has never made repairs to damaged roads due to the limited budget they have. The Mekar Bersatu-Beber Village Road section has been proposed to change the status to a Regency road to make it easier to handle, but has not received approval from the Regency government.

1. Batukliang District

Batukliang District is located in Central Lombok Regency with an area of 5,037 ha consisting of 10 villages: Beber, Pagutan, Barabali, Bujak, Peresak, Mantang, Aik Darek, Selebung, Tampak Siring, and Mekar Bersatu. It is bordered to the North Batukliang District, to the east by Kopang District and East Lombok Regency, to the south by Praya District and to the west by Pringgarata District.

Figure 4. Location of Section 1 of Batukliang District

The users of the road connecting Mekar Bersatu Village with Beber Village are the people of the two villages and also from several surrounding villages which are used as access between villages, to agricultural land, to places of education, health and schools and other purposes. The population of Mekar Bersatu Village and Beber Village for each village is 3,142 and 11,202 people, while the area is 2.60 and 8.02 km2 with a population density of 1,208 and 1,397 people/km2.

2. Terara District

Terara District is located in East Lombok Regency with an area of 4,141 ha consisting of 16 villages: Jenggik, Rarang, Suradadi, Santong, Terara, Sukadana, South Rarang, Lando, Central Rarang, Leming, Selagik, Embung Raja, Kalianyar, Embung Kandong, Rarang Batas and Pandan Duri. It is bordered to the north by Montong Gading District, to the east by Sikur District, to the south by Sakra District and to the west by Central Lombok Regency. Jenggik Village and Lando Village are part of the Terara District area which is directly adjacent to the location of the two research objects, which is a connecting road between the two villages with a volume of 2,215 meters. The section is a road that is the authority of the village government in handling it. The Jenggik Village and Lando Village Governments also have a limited budget in their maintenance so that they cannot repair or increase the damage to the road, for this reason the village government really hopes for assistance from the Regency and provincial governments to handle the damage to the road.

Figure 5. Location of Section 2 of Terara District

3. Sikur District

Sikur District is located in East Lombok Regency with an area of 7,827 ha consisting of 13 villages: Sikur, Montong Baan, Loyok, Kotaraja, Tetebatu, Kembang Kuning, South Montong Baan, Gelora, South Tetebatu, Jeruk Manis, Darmasari, South Sikur, West Sikur and Semaya. It is bordered to the north by the State Forest, to the east by Masbagik District, to the south by Sakra District and to the west by Terara and Montong Gading Districts. The use of the road connecting Jenggik Village with Lando Village is the people of the two villages and also from several surrounding villages which are used as access between villages, access to agricultural land, access to education, health and schools and other purposes. The number of residents of Jenggik Village and Lando Village according to BPS data (Terara District in 2021 Figures) for each village is 6,465 and 6,486 people, while the area is 2.93 and 3.98 km^2 with a population density of 2,206 and 1,629 people/km^2.

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Figure 6. Location of Section 3 of Sikur District

B. Data Analysis

1. Highway Method

a. Road Geometric Data

Road geometry data was obtained by conducting a direct survey in the field. Received information about road geometry such as road level, road width, road edge and presence or absence of drainage channels. The results of measuring road geometry data in all sections are as shown in Table 7.

TABLE 7. Road Geometric Conditions

No	Section Name	Road Class	Road Length (m)	Road Width (m)	Road Shoulder (m)	Drainage
1	Section 1	Village Road	1,451	3	0.6 – 1.2	Exist
2	Section 2	Village Road	1,100	3	0.8 – 1.1	Exist
3	Section 3	Village Road	758	3	0.6 – 1.2	Exist

b. Traffic Volume

Traffic volume data collection in each section is carried out for 3 (three) days with consideration because weekdays and school entry days, namely Monday, Wednesday and Thursday for 6 (six) hours, namely morning at 06.00-08.00, afternoon at 12.00-14.00 and afternoon at 16.00-18.00. The vehicles observed are grouped into 8 groups (Gol. 1, 2, 3, 4, 5a, 5b, 6a, 6b, 7a, 7b, 7c and 8) (Department of Settlements and Regional Infrastructure, 2004), then the data is summed based on 3 (three) groups, namely:

- Motorcycles (MC), consisting of: group 1.
- Light vehicles (LV), consisting of: groups 2, 3 and 4.
- Heavy vehicles (HV), consisting of: groups 5a, 5b, 6a, 6b, 7a, 7b, 7c.

Table 8 is the result of observing the number of vehicles per hour.

TABLE 8. Number of Vehicles, Section 1

Day/ Date	Time	MC (V)	LV (V)	HV (V)	Total (V/H)
Monday, March 18, 2024	06.00 – 07.00	83	5	0	88
	07.00 – 08.00	130	4	3	137
	12.00 – 13.00	134	3	2	139
	13.00 – 14.00	140	5	2	147
	16.00 – 17.00	145	13	1	159
	17.00 – 18.00	139	12	2	153
	Averages	**129**	**7**	**2**	**137**
Wednesday, 20 March 2024	06.00 – 07.00	57	1	0	58
	07.00 – 08.00	110	0	0	110
	12.00 – 13.00	122	9	2	133
	13.00 – 14.00	143	12	0	155
	16.00 – 17.00	155	13	5	173
	17.00 – 18.00	152	14	0	166
	Averages	**123**	**8**	**1**	**133**
Thursday, 21 March 2024	06.00 – 07.00	52	0	0	52
	07.00 – 08.00	190	4	0	194
	12.00 – 13.00	75	12	0	87
	13.00 – 14.00	75	8	0	83
	16.00 – 17.00	166	8	1	175
	17.00 – 18.00	203	17	0	220
	Averages	**127**	**8**	**0**	**135**

TABLE 9. Number of Vehicles, Section 2

Day/ Date	Time	MC (V)	LV (V)	HV (V)	Total (V/H)
Monday, March 18, 2024	06.00 – 07.00	156	4	0	160
	07.00 – 08.00	122	11	2	135
	12.00 – 13.00	115	5	0	120
	13.00 – 14.00	106	1	4	111
	16.00 – 17.00	97	5	5	107
	17.00 – 18.00	184	12	1	197
	Averages	**130**	**6**	**2**	**138**
Wednesday, 20 March 2024	06.00 – 07.00	120	7	0	127
	07.00 – 08.00	124	7	3	134
	12.00 – 13.00	120	7	0	127
	13.00 – 14.00	110	10	6	126
	16.00 – 17.00	170	9	2	181
	17.00 – 18.00	185	9	7	201
	Averages	**138**	**8**	**3**	**149**
Thursday, 21 March 2024	06.00 – 07.00	95	5	0	100
	07.00 – 08.00	78	9	3	90
	12.00 – 13.00	89	7	1	97
	13.00 – 14.00	110	8	6	124
	16.00 – 17.00	174	8	3	185
	17.00 – 18.00	162	8	5	175
	Averages	**118**	**8**	**3**	**129**

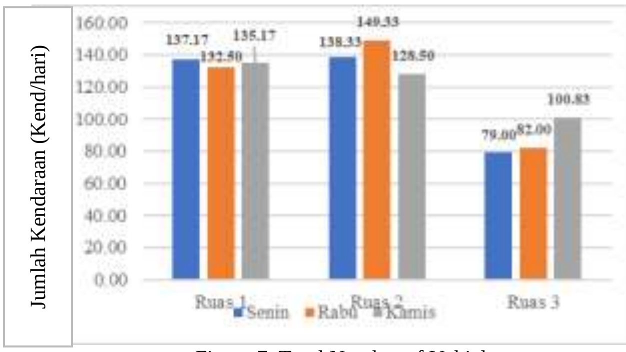

Figure 7. Total Number of Vehicles

After obtaining the data on the number of vehicles in the table above, then the LHR value is calculated as in Table 9.

TABLE 10. Number of Vehicles, Section 3

Day/ Date	Time	MC (v)	LV (v)	HV (v)	Total (V/H)
Monday, March 18, 2024	06.00 – 07.00	77	3	0	80
	07.00 – 08.00	68	9	3	80
	12.00 – 13.00	41	3	3	47
	13.00 – 14.00	80	6	3	89
	16.00 – 17.00	58	4	3	65
	17.00 – 18.00	100	11	2	113

	Averages	71	6	2	79
Wednesday, 20 March 2024	06.00 – 07.00	64	2	0	66
	07.00 – 08.00	100	5	2	107
	12.00 – 13.00	60	6	1	67
	13.00 – 14.00	89	3	5	97
	16.00 – 17.00	58	3	4	65
	17.00 – 18.00	80	6	4	90
	Averages	**75**	**4**	**3**	**8**
Thursday, 21 March 2024	06.00 – 07.00	41	0	0	41
	07.00 – 08.00	90	13	5	108
	12.00 – 13.00	95	8	6	109
	13.00 – 14.00	80	3	3	86
	16.00 – 17.00	125	11	4	140
	17.00 – 18.00	116	3	2	121
	Averages	**91**	**6**	**3**	**101**

TABLE 11. LHR Value, Section 1

Day	**MC**	**LV**	**HV**	**Volume (pcu/day)**
	0,50	1,00	1,30	
	(v/d)	(v/d)	(v/d)	
Monday	129	7	2	74
Wednesday	123	8	1	71
Thursday	127	8	0	72
Total	**379**	**23**	**3**	**217**

TABLE 12. LHR Value, Section 2

Hari	**MC**	**LV**	**HV**	**Volume (pcu/day)**
	0,50	1,00	1,30	
	(v/d)	(v/d)	(v/d)	
Monday	130	6	2	74
Wednesday	138	8	3	81
Thursday	118	8	3	71
Total	**386**	**22**	**8**	**226**

TABLE 13. LHR Value, Section 3

Hari	**MC**	**LV**	**HV**	**Volume (pcu/day)**
	0,50	1,00	1,30	
	(v/d)	(v/d)	(v/d)	
Monday	71	6	2	44
Wednesday	75	4	3	45
Thursday	91	6	3	55
Total	237	17	8	**144**

From the table above, it can be seen that the highest average daily traffic for Sector 1 is 74 junior high schools/day, 81 junior high schools/day for Sector 2 and 55 junior high schools/day for Sector 3. With the LHR data, based on Table 2, it shows that Section 1, Section 2 and Section 3 are included in the road category with a VLHR between 50 - 200 junior high schools/day, so that all three are included in class 2.

c. Damage Condition

Data on road conditions were obtained through surveys in each research location (section) by measuring the area, length, and width according to the type of damage that occurred. Each section is divided into several segments with a length of 100 meters each and another size for certain conditions. The recapitulation of road damage on the three sections can be seen in Table 14.

d. Damage Figures and Road Conditions

The road condition value based on the type of damage is calculated based on Table 3 with the damage numbers for the surface roughness group (crushed, coarse granular, rough and fatty) based on the type of damage only, while for potholes and patched damage it is calculated based on the type of damage only. based on the percentage of damage area to the total area of the road section being reviewed. . For the type of crack damage, the damage number is seen from the type of crack, crack width, and percentage of damage area, where the crack group value used is the largest number of the three components above. . For grooves, the damage figure is based on the depth of the groove that occurs, while for collapses, the damage figure is based on the length of the collapse per 100 m. Furthermore, based on the damage figures (using Table 4), the road conditions are obtained as in Table 15.

TABLE 14. Road Damage Recapitulation

Types of Damage		**Section 1**	**Section 2**	**Section 3**
Weathering	m^2	392,17	210,80	554,40
	%	9,01%	6,39%	24,38%
Fatty	m^2	15,6	-	-
	%	0,36%	-	-
Potholes	m^2	58,23	49,85	40,86
	%	1,34%	1,51%	1,80%
Alligator crack	m^2	20,19	52,55	270,27
	%	0,46%	1,59%	11,89%
	Average widht (mm)	1,92	2,44	2,47
Longitudinal crack	m^2	-	1,51	-
	%	-	0,05%	-
	Average widht (mm)	-	3,00	-
Depression	m^2	13,93	11,00	16,86
	%	0,32%	0,33%	0,74%
	Long (m)	3,38	3,43	3,50
Total	**m^2**	**500,12**	**325,71**	**882,39**
	%	**11,49%**	**3,87%**	**38,80%**

TABLE 15. Recapitulation of Road Damage Numbers

Types of Damage	**Parameter**	**Damage Numbers**		
		Section 1	**Section 2**	**Section 3**
Weathering	Type	3	3	3
Fatty	Type	3	0	0
Potholes	Area	1	1	1
Alligator crack	Type	5	5	5
	Widht	2	3	3
	Area	1	1	2
Longitudinal crack	Type	0	1	0
	Widht	0	3	0
	Area	0	1	0
Depression	Long	2	2	2
Total Damage Numbers		**17**	**20**	**16**
Road Condition		**6**	**7**	**6**

e. Priority Values

Based on the results of determining the LHR class and the value of road conditions, the priority value can be calculated using equation 1. Here's an example calculation for Section 1:

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

With a Priority Value of 9, based on Table 5, the value is included in the Priority Value group >7. In this group, the road section is included in the Routine Maintenance program. In the same way, handling actions are obtained for Sector 2 and 3 (see Table 16).

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TABLE 16. Recapitulation of Determining the Type of Road Maintenance

No	Section Name	LHR Class	Road Condition Value	Priority Value	Actions Taken (Program)
1	Section 1	2	6	9	Routine Maintenance
2	Section 2	2	7	8	Routine Maintenance
3	Section 3	2	6	9	Routine Maintenance

2. *Method of PCI*

a. *Deduct Value*

The deduct value is determined based on the condition of road damage that has previously been shown in the analysis of the Highway Method. However, in this method, severity data is needed for each type of damage.

From the damage area data, the density value of each segment is known to be 3 m wide using equation 2 as an example of calculation for Section 1 (STA 0+000 – 0+100), the type of hole damage with a severity of L is as follows:

$$Density\ (\%) = \frac{Ad}{As}\ X\ 100$$

$$Density\ (\%) = \frac{0{,}08}{(100x3)}\ X\ 100$$

$$0{,}03\%$$

From the curve, a *deduct value* of 8 is obtained (see Figure 8).

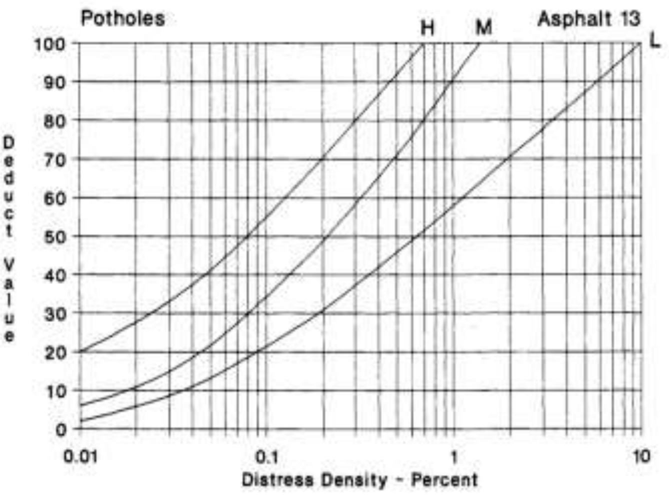

Figure 8. *Deduct Value* for Hole Damage Types

The results of determining the deduct value of each segment can be seen in tables 17.

TABLE 17. Results of Deduct Value Section 1 Determination

STA	Types of Damage	Seve-rity	Area (m^2)	Density (%)	Deduct Value
0+000 - 0+100	Potholes	L	0.08	0.03	8
		M	0.06	0.02	11
		H	6.60	2.20	68
	Depression	M	2.98	0.99	9
	Alligator crack	L	0.18	0.06	0
		M	6.55	2.18	30
0+100 - 0+200	Potholes	L	0.48	0.16	26
		M	0.26	0.09	32
		H	7.63	2.54	71
	Depression	L	0.18	0.06	0
		M	6.88	2.29	12
	Alligator crack	M	2.17	0.72	19
0+200 - 0+300	Potholes	L	0.89	0.30	38
		M	0.50	0.17	45
	Depression	M	0.49	0.16	8
	Alligator crack	H	1.39	0.46	22
	Weathering	H	40.20	13.40	47
0+300 - 0+400	Potholes	L	0.38	0.13	25
		M	1.62	0.54	73
		H	2.88	0.96	51
0+400 - 0+500	Potholes	L	0.44	0.15	27
		M	1.03	0.34	62
		H	2.71	0.90	50
0+500 - 0+600	Potholes	L	0.26	0.09	20
		M	0.14	0.05	22
	Depression	M	3.40	1.13	9
0+600 - 0+700	Potholes	M	0.18	0.06	25
		H	0.84	0.28	78
	Weathering	M	24.00	8.00	17
0+700 - 0+780	Potholes	L	0.25	0.10	22
		M	0.36	0.15	71
		H	11.80	4.92	88
	Corrugation	M	15.60	6.50	34
+780 - 1+244	-	-	-		
1+244 - 1+300	Potholes	M	0.39	0.23	51
1+300 - 1+400	Potholes	H	5.32	1.77	62
	Weathering	M	186.00	62.00	37
1+400 - 1+500	Potholes	M	0.30	0.10	35
		H	0.36	0.12	58
	Weathering	M	24.90	8.30	17
1+500 - 1+600	Potholes	H	11.97	3.99	82
1+600 - 1+700	Alligator crack	M	9.90	3.30	34
1+700 - 1+800	Potholes	M	0.30	0.10	35
		H	0.21	0.07	48
1+800 - 1+915	Weathering	M	117.07	33.93	62
Total			500.12		

TABLE 18. Results of Deduct Value Section 2 Determination

STA	Types of Damage	Seve-rity	Area (m^2)	Density (%)	Deduct Value
0+000 - 0+100	Potholes	H	8.94	2.98	75
	Depression	L	6.76	2.25	6
	Alligator crack	M	33.60	11.20	57
	Weathering	H	9.00	3.00	24
0+100 - 0+200	Weathering	H	84.80	0.40	66
	Depression	M	2.44	1.53	60
0+200 - 0+300	Potholes	M	1.20	1.33	22
		H	4.60	39.00	65
	Alligator crack	M	4.00	0.40	66
	Weathering	H	117.00	1.53	60
0+300 - 0+400	-	-	-		

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STA	Types of Damage	Seve-rity	Area (m^2)	Density (%)	Deduct Value
0+400 - 0+500	Potholes	H	6.75	2.25	69
	Longitudinal crack	M	1.51	0.50	4
0+500 - 0+600	-	-	-		
0+600 - 0+700	-	-	-		
0+700 - 0+800	Potholes	M	3.31	1.10	32
		H	5.40	1.80	64
0+800 - 0+900	Potholes	M	0.25	0.08	30
		H	0.50	0.17	67
0+900 - 1+000	Potholes	H	9.90	3.30	78
	Alligator crack	L	2.08	0.69	8
		M	12.87	4.29	37
1+000 - 1+100	Depression	M	1.80	0.60	9
	Potholes	H	9.00	3.00	77
Total			325.71		

TABLE 19. Results of Deduct Value Section 3 Determination

STA	Types of Damage	Seve-rity	Area (m^2)	Density (%)	Deduct Value
0+000 - 0+100	Potholes	L	0.69	0.23	34
		H	20.16	6.72	95
	Alligator crack	H	40.52	13.51	66
0+100 - 0+200	Depression	L	0.96	0.32	4
	Potholes	H	7.68	2.56	72
	Alligator crack	H	58.50	19.50	70
	Weathering	H	40.80	13.60	45
0+200 - 0+300	Potholes	H	2.76	0.92	50
	Alligator crack	L	4.40	1.47	14
		M	48.75	16.25	54
		H	26.26	8.75	60
	Weathering	H	15.00	5.00	30
0+300 - 0+400	Potholes	M	4.44	1.48	38
		H	2.94	0.98	9
	Weathering	H	69.60	23.20	57
0+400 - 0+500	Potholes	H	5.13	1.71	62
	Alligator crack	L	9.42	3.14	22
		M	47.50	15.83	52
		H	30.60	10.20	61
0+500 - 0+600	Alligator crack	M	4.32	1.44	25
	Weathering	H	78.00	26.00	60
	Depression	M	12.96	4.32	18
0+600 - 0+700	Weathering	H	267.00	89.00	77
0+700 - 0+758	Weathering	H	84.00	48.28	68
Total			882.39		

b. The Value of m

The value of m is calculated by equation 4. For example, for the calculation of the condition value of Section 1 (STA 0+000 – 0+100), *the highest deduct value* (HDV) is 68, so the value m = 1 + (9/98) x (100 – 68) = 3.94. This step is also used to calculate the value of m in other segments and the results can be seen in Table 20-22.

TABLE 20. Recapitulation of Calculation of m-Value in Section 1

No	STA	HDV	m
1	0+000 – 0+100	68	3.94
2	0+100 – 0+200	71	3.66
3	0+200 – 0+300	47	5.87
4	0+300 – 0+400	73	3.48
5	0+400 – 0+500	62	4.49
6	0+500 – 0+600	22	8.16
7	0+600 – 0+700	78	3.02
8	0+700 – 0+780	88	2.10
9	1+244 – 1+300	51	5.50
10	1+300 – 1+400	62	4.49
11	1+400 – 1+500	58	4.86
12	1+500 – 1+600	82	2.65
13	1+600 – 1+700	34	7.06
14	1+700 – 1+800	48	5.78
15	1+800 – 1+915	62	4.49

TABLE 21. Recapitulation of Calculation of m-Value in Section 2

No	STA	HDV	m
1	0+000 – 0+100	75	3.30
2	0+100 – 0+200	60	4.67
3	0+200 – 0+300	66	4.12
4	0+300 – 0+400	-	-
5	0+400 – 0+500	69	3.85
6	0+500 – 0+600	-	-
7	0+600 – 0+700	-	-
8	0+700 – 0+800	64	4.31
9	0+800 – 0+900	67	4.03
10	0+900 – 1+000	78	3.02
11	1+000 – 1+100	77	3.11

TABLE 22. Recapitulation of Calculation of m-Value in Section 3

No	STA	HDV	m
1	0+000 – 0+100	95	1.46
2	0+100 – 0+200	72	3.57
3	0+200 – 0+300	60	4.67
4	0+300 – 0+400	57	4.95
5	0+400 – 0+500	62	4.49
6	0+500 – 0+600	60	4.67
7	0+600 – 0+700	77	3.11
8	0+700 – 0+758	68	3.94

c. CDV Maksimum (Corrected Deduct Value)

1) Determine the *total deduct value (TDV) for each road section by adding up all deduct values.* For Sector 1 (STA 0+000 – 0+100) TDV = 109 and so on for other segments and segments.
2) Determining CDV is based on q and TDV values using the CDV curve.
3) *The deduct value* that is close to the value of 2, is made equal to 2 so that the value of q will be reduced and then steps a) to c) are repeated until the value of q = 1 is obtained. An example of the results of the CDV iteration can be seen in Table 23.

TABLE 23. Example of Iteration Results

STA	m	Iteration				TDV	q	CDV
0+000 – 0+100	3.94	#1	68	30	11	109	3	69
		#2	68	30	2	100	2	71
		#3	68	2	2	72	1	72

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Referring to Table 23, with the value of m = 3.94 indicates the maximum number of iteration rows of 3, then the result of each iteration is summed (TDV). The TDV value is inserted into the curve to get the CDV value based on the q value as shown in Figure 8.

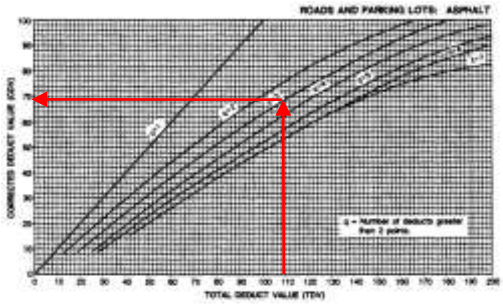

Figure 8. CDV value

Based on the CDV value of each segment, the maximum CDV value is then determined. For the example in Figure 8, the maximum CDV value is 72.

d. PCI Values

The calculation of the PCI value uses equation 5, namely PCI = 100 – maximum CDV, the maximum CDV value for Sector 1 (STA 0+000 – 0+100) is 72, then the PCI value = 100 – 72 = 28 and the average PCI value is obtained by dividing the number of PCI values by the number of segments (equation 6). The results of the calculation of the PCI Value for each road section can be seen in Table 24-26.

TABLE 24. Results of PCI Value Calculation and Road Conditions for Section 1

No	STA	CDV Max.	PCI Value	Condition
1	0+000 – 0+100	72	28	Poor
2	0+100 – 0+200	79	21	Very Poor
3	0+200 – 0+300	85	15	Very Poor
4	0+300 – 0+400	88	12	Very Poor
5	0+400 – 0+500	83	13	Very Poor
6	0+500 – 0+600	33	67	Good
7	0+600 – 0+700	82	18	Very Poor
8	0+700 – 0+780	98	2	Failed
9	1+244 – 1+300	51	49	Fair
10	1+300 – 1+400	70	30	Poor
11	1+400 – 1+500	69	31	Poor
12	1+500 – 1+600	82	18	Very Poor
13	1+600 – 1+700	34	66	Good
14	1+700 – 1+800	60	40	Poor
15	1+800 – 1+915	62	38	Poor
	Total		452	
	Averages		**30.13**	**Poor**

TABLE 25. Results of PCI Value and Road Condition Calculation for Section 2

No	STA	CDV Max.	PCI Value	Condition
1	0+000 – 0+100	91	9	Failed
2	0+100 – 0+200	62	38	Poor
3	0+200 – 0+300	88	12	Very Poor
4	0+300 – 0+400	0	100	Excellent
5	0+400 – 0+500	70	30	Poor
6	0+500 – 0+600	0	100	Excellent
7	0+600 – 0+700	0	100	Excellent
8	0+700 – 0+800	68	32	Poor
9	0+800 – 0+900	69	31	Poor
10	0+900 – 1+000	82	18	Very Poor
11	1+000 – 1+100	79	21	Very Poor
	Total		**491**	
	Averages		**44.64**	**Fair**

TABLE 26. Results of PCI Value and Road Condition Calculation for Section 3

No	STA	CDV Max.	PCI Value	Condition
1	0+000 – 0+100	95	5	Failed
2	0+100 – 0+200	92	8	Failed
3	0+200 – 0+300	97	3	Failed
4	0+300 – 0+400	69	31	Poor
5	0+400 – 0+500	99	1	Failed
6	0+500 – 0+600	65	35	Poor
7	0+600 – 0+700	77	23	Very Poor
8	0+700 – 0+758	68	32	Poor
	Total		**138**	
	Averages		**17.25**	**Very Poor**

3. *Comparison of Highway and PCI Method Results*

A comparison of the results of road condition assessment between the Bina Marga method and *the Pavement Condition Index* (PCI) can be seen in Table 27.

TABLE 27. Comparison of the Results of the Analysis of the Bina Marga and PCI Methods

Name of Section	Method of Bina Marga		Method of PCI	
	UP Value	Information	PCI Value	Information
Section 1	13	Routine Maintenance	30.13	Poor
Section 2	13	Routine Maintenance	44.64	Fair
Section 3	11	Routine Maintenance	17.25	Very Poor

IV. CONCLUSIONS AND SUGGESTIONS

1. *Conclusion*

Conclusions based on the results of the analysis and discussion are as follows:

a. The types of damage obtained on the Mekar Bersatu Village Road - Beber Village (Section 1) include: grain release (9.01%), potholes (1.34%), crocodile cracks (0.46%), waves (0.36%) and collapse (0.32%) with the results of the analysis of bad road conditions (PCI) and recommended handling in the form of routine maintenance (Bina Marga method). For the Jenggik Village – Lando Village Road (Section 2), among others: grain release (6.39%), crocodile cracks (1.59%), potholes (1.51%), collapse (0.33%) and longitudinal cracks (0.05%) with the results of the analysis of moderate road conditions (PCI) with routine maintenance handling (Bina Marga). As for the Loyok Village Road – Gelora Village (Section 3), among others: grain release (24.38%), crocodile cracks (11.89%), holes (1.80%) and sinkholes (0.74%) with the results of analysis of very poor road conditions (PCI) with routine maintenance handling (Bina Marga).

b. Comparison of road damage assessment between the Highway Method and the PCI Method, namely in the

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Highway Method, the procedure is simpler and easier to understand compared to the PCI Method so that it is more appropriate to assess village road sections whose maintenance is the responsibility of the village government, then the results of the road condition assessment using the Highway Method are in the form of a priority order and are given recommendations for actions that can be taken. The PCI method is only in the form of a value of road pavement conditions.

2. Suggestion

Based on the results of the study, several things can be suggested as follows:

a. The village government makes regulations that limit the types of vehicles passing and empower village officials to monitor the use of village roads.
b. The village government seeks to repair road damage using village funds or propose to the local government as an environmental road repair. If possible, it is proposed to transfer the status to a district road so that the handling is faster.
c. The village government can encourage the Utilization and Maintenance Group (KPP) that has been formed to invite the surrounding community to work together to normalize the channel and clean the road shoulder as expected by the PISEW Program.

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