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Evaluation of Road Damage Using The Pavement Condition Index (PCI) Method on Jalan Raya Waringin, Palasah District, Majalengka Regency

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ABSTRACT

Evaluation of road damage is an important process in monitoring and maintaining existing road infrastructure. The Pavement Condition Index (PCI) method is an approach that is commonly used to measure road conditions and identify the level of existing damage. Evaluation will be focused on the Jalan Raya Waringin section, to be precise in Palasah District, Majalengka Regency. This section will be selected based on its relevance, accessibility, and representation of overall road conditions in the area. The evaluation aims to assess road damage on Jalan Raya Waringin using the PCI method to get an overview of the condition of the road infrastructure. The assessment will help identify the extent and type of existing road damage Jalan Raya Waringin is a one-way road, with a width of 3.8 meters. From the results of the research data collection, it was obtained several types of damage occurred on the 250 m long section of Jalan Raya Waringin. Starting from the front of the Riyadul Huda Foundation to the front of the Adila motorbike (workshop), there is several damage such as Alligator Cracking, Potholes with a moderate level of damage (medium), and others. The results of the research on the condition of the Jalan Raya Waringin section, Palasah District, Majalengka Regency using the PCI method obtained an overall 47.8%. PCI Fair, meaning that the condition of the road pavement is quite significant and requires periodic maintenance. The types of damage that can be found in Jalan Raya Waringin, Palasah District, Majalengka Regency include Holes, Weathering and Loose Grain, Crocodile Skin Cracks, Longitudinal and Transverse Cracks, and Subsidence. Damages that occur as a result of subgrade soil conditions or unfavorable foundations. Weathering and Lose Grain, Crocodile Skin Cracks, Longitudinal and Transverse Cracks, and Collapse. Damages that occur as a result of subgrade soil conditions or unfavorable foundations.

1. Introduction

Evaluation of road damage is an important aspect of road infrastructure management worldwide. One widely adopted method for assessing road conditions is the Pavement Condition Index (PCI). The PCI method provides a quantitative measure of the overall condition of a road section, taking into account various defects such as cracks, potholes, and surface damage. On an international scale, road infrastructure plays an important role in economic development, trade, and global connectivity.

Countries around the world are facing challenges related to aging road networks, increasing traffic volumes, and limited resources for maintenance and rehabilitation. International journals published within a specified time frame highlight the importance of using standardized methods such as PCI to accurately evaluate road conditions. Researchers emphasize the need for consistent evaluation techniques to assess road damage globally and promote best practices in managing road infrastructure [1]

At the national level, Indonesia faces challenges related to road maintenance due to factors such as increasing population, urbanization, and growth in vehicle ownership. These challenges require the adoption of standard methods for accurately evaluating road conditions and prioritizing maintenance interventions. National journals published over some time highlight the importance of using reliable techniques such as the PCI method to comprehensively assess road damage. Researchers emphasize the need for an accurate evaluation approach to prioritize maintenance activities and allocate resources effectively [2]

In the Majalengka region, the Waringin highway section in Palasah District serves as a vital transportation link, facilitating regional connectivity and economic activity. The condition of these road sections is critical to ensuring an efficient and safe journey. Regional journals published within a set time frame highlight the importance of using reliable evaluation methods such as the PCI method to accurately assess road conditions. Researchers emphasize the need for a local evaluation approach that takes into account the unique characteristics and challenges of regional road networks [3]

The Jalan Raya Waringin section in Palasah District, Majalengka Regency is the main transportation route for the local community, connecting residential areas, commercial centers, and public facilities. The condition of these roads directly impacts the quality of transportation and the welfare of the local population as a whole. Local journals published within the specified timeframe highlight the importance of using accurate evaluation methods such as the PCI method to assess road conditions effectively. Researchers emphasize the need for a local evaluation approach that takes into account the unique characteristics and challenges of the local road network [4]

The main objective of this study is to evaluate road damage in the Jalan Raya Waringin section using the PCI method. This study aims to assess the extent and type of road damage, identify the underlying causes, and propose effective maintenance and rehabilitation strategies. By achieving these goals, this research seeks to contribute to existing knowledge on road maintenance and provide valuable insights for local governments and transportation agencies in managing and maintaining road infrastructure effectively in the Jalan Raya Waringin section in Palasah District.

2. Literature Review

2.1 Introduction to Pavement Condition Index (PCI)

The Pavement Condition Index (PCI) is a widely adopted method for evaluating road damage and assessing pavement conditions. PCI provides a quantitative measure of the overall condition of a road section, taking into account various defects such as cracks, potholes, and surface damage. According to research, PCI is an effective tool for prioritizing road maintenance activities and allocating resources based on the level of damage. The method involves visual inspection, data collection, and analysis to determine the PCI rating, which ranges from 0 to 100, with higher values indicating better road conditions [3]

PCI is a numerical rating system that measures the condition of road pavement based on various types of disturbances, such as cracks, rutting, and potholes. Based on a research study PCI provides a

comprehensive definition and description, highlighting its purpose as a tool for monitoring and managing road infrastructure [5]

Based on the results of research that discusses the components and data collection processes involved in evaluating PCI. These studies outline the importance of visual surveys, identification of pavement disturbances, and use of special equipment for data collection [6]. They emphasize the need for a standardized protocol to ensure consistency and reliability in PCI assessments [7]

These studies present detailed formulas and guidelines for calculating PCI scores by type, severity, and level of difficulty [8]. They also provide an interpretation scale for rating pavement conditions and prioritizing maintenance activities. Calculation methods and interpretation criteria for PCI are discussed in studies [9]

2.2 Road Damage Evaluation Using PCI

Research studies have highlighted the application of the PCI method in evaluating road damage and identifying specific types of damage [10]. In a study by the authors used PCI to assess the condition of rural roads in a certain area. These findings demonstrate the effectiveness of PCI in identifying common types of disorders, such as fatigue cracking and rutting, which helps inform maintenance and rehabilitation strategies. Similarly, it uses the PCI method to evaluate road conditions in urban areas and identify significant types of disturbance, including alligator potholes and cracks. This study emphasizes the importance of regular PCI evaluations to ensure timely maintenance interventions [11].

The Pavement Condition Index (PCI) is a standard method that provides a quantitative measure of road conditions, allowing accurate assessment and comparison of pavement damage [12]. Studies that highlight the importance of the PCI method in evaluating road damage emphasize its role in identifying the type of disturbance, prioritizing maintenance activities, and allocating resources effectively [13]. Researchers have made advances in PCI methodology to improve its accuracy and applicability. Studies that address the integration of advanced technologies such as LiDAR and machine learning techniques in the PCI evaluation process [14] [15] [16] [17] [18]. These advances increase the efficiency of data collection and analysis, enabling more precise and reliable assessments of road conditions.

2.3 Application of the PCI Method

Research conducted to provide relevant insights. A study that focuses on assessing road conditions using the PCI method in neighboring districts. The research highlights the importance of accurate data collection and analysis for effective decision-making in road maintenance. These findings emphasize the need to apply PCI evaluation in the local context of Jalan Raya Waringin to identify common types of disturbances and prioritize maintenance efforts accordingly [4]. The use of PCI in maintenance planning has been studied extensively. Such research emphasizes the benefits of using PCI to guide maintenance strategies [19] [20] [21] [22] [23] [24]. By accurately assessing road conditions, PCI allows the identification of critical areas that require immediate attention and helps to optimize the allocation of limited resources, resulting in cost-effective and sustainable maintenance practicesand [25]

Despite its advantages, the PCI method also faces certain challenges and limitations. A study that addresses issues such as data collection challenges, subjective interpretation of hazard ratings, and the need for ongoing monitoring [26]. This study highlights the importance of overcoming this challenge to improve the accuracy and reliability of PCI evaluations. In summary, the Pavement Condition Index (PCI) method has been widely recognized as an effective approach for evaluating road damage and prioritizing maintenance activities. Highlighting the importance of routine PCI evaluation and accurate

data analysis [27] [28] [29] [30] [31]. The findings emphasize the need to apply the PCI method in the local context to assess the extent of road damage, identify common types of damage, and inform appropriate maintenance and rehabilitation strategies.

3. Method

3.1 Location Study

The evaluation will focus on the Jalan Raya Waringin section, to be precise in Palasah District, Majalengka Regency. This section will be selected based on its relevance, accessibility, and representation of overall road conditions in the area. The selection will also consider factors such as traffic volume, road geometry, and previous maintenance history to ensure a comprehensive evaluation.

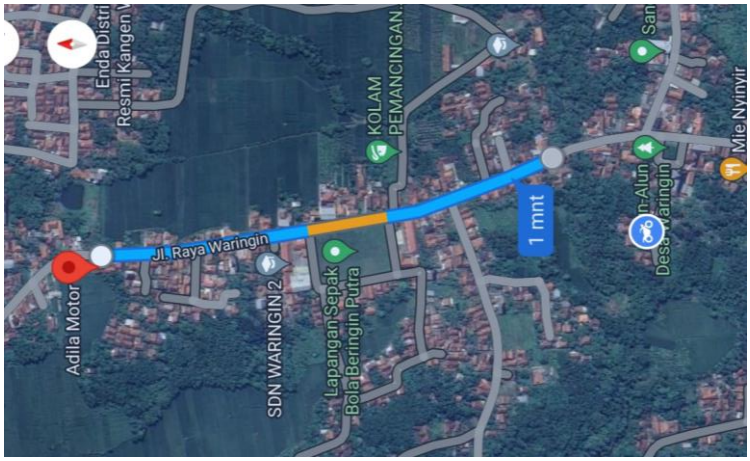

Figure 1 Research location map

Evaluation of road damage using the Pavement Condition Index (PCI) method on Jalan Raya Waringin, Palasah District, Majalengka Regency will be carried out within a certain period. The exact timeframe will be determined based on resource availability, data collection requirements, and weather conditions that may affect the assessment process.

The evaluation aims to assess road damage on Jalan Raya Waringin using the PCI method to get an overview of the condition of the road infrastructure. The assessment will help identify the extent and type of existing road damage, which is important for prioritizing maintenance efforts and allocating resources effectively. The evaluation will also contribute to the development of a sustainable road maintenance strategy in the Palasah District.

3.2 Data processing

The evaluation will involve applying the Pavement Condition Index (PCI) method, which includes visual inspection and data collection. A visual inspection will be carried out by trained personnel who will assess road conditions and identify various types of hazards, such as cracks, potholes, and surface defects. Data collection will involve recording the location, severity, and severity identified.

Table.1 PCI Value and Pavement Conditions

PCI value	Pavement Conditions

0-10	Failed
10-25	Very Poor
25-40	Ugly (Poor)
40-55	Enough (Fair)
55-70	good
70-85	Very Good
85-100	Perfect

Source: FAA, 1982: Shanin, 1994

The PCI method will be carried out following the established guidelines and standards. Data collection will involve using appropriate tools, such as cameras, gauges, and inspection forms, to document the difficulties observed. The collected data will be analyzed to calculate the PCI value for each road segment which represents the overall pavement condition. The analysis may involve data processing and statistical calculations to determine the severity and distribution of types of distress. These findings will then be interpreted and reported to provide an overview of road damage on the Waringin highway section in the Palasah District. PCI levels are written in levels 0-100.

The formula determines the pavement condition index (PCI). After completing the survey, the data obtained is calculated for the area and percentage of damage according to the level and type of damage. Following are the steps to get a PCI value, calculate the percentage of damage (density), determine the deduct value for each type of damage, calculate the allowable maximum deduct value (m), calculate the total deduct value, determine the Corrected Deduct Value (CDV).

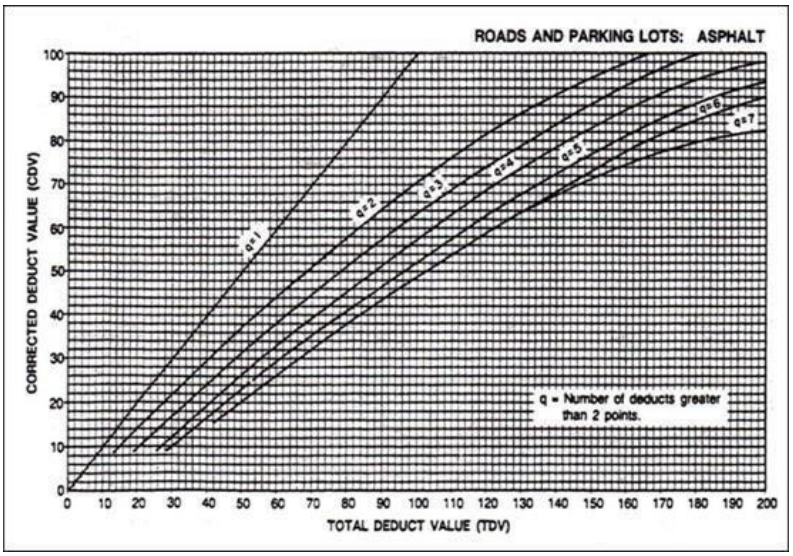

Figure 2 Relationship Between Total Deduct Value, TDV, and Corrected Deduct Value, CDV (Shanin, 1994)

after the CDV value is known, the PCI value can be determined using the following formula:

$$PCI = 100 - CDV$$

After the PCI value is known, then the rating of the sample unit under review can be determined by plotting the graph. As for calculating the overall PCI value in one road section, it can be calculated using the following formula:

$$\sum PCIf = \frac{\sum PCIs}{N}$$

PCIf = Average PCI value of all research areas

PCIs = PCI values for each sample unit

N = Number of sample units

Table 2 Determination of asphalt/cement road maintenance management program

Road Conditions	% Damage limit (% of Surface Pavement Area)	Handling Program
Good (B)	<6%	Routine Maintenance
Medium (S)	6-<11%	Routine / Periodic Maintenance
Minor Damage (RR)	11- <15%	Rehabilitation Maintenance
Heavily Damaged	>15%	Structural Enhancement Reconstruction

Evaluation of road damage using the PCI method on the Waringin highway, Palasah District, Majalengka Regency will be carried out within a certain period. The evaluation will focus on this particular section to assess road conditions and identify the extent and type of damage present. The PCI method will be implemented through visual inspection and data collection, followed by data analysis to calculate the PCI rating. These findings will contribute to effective decision-making and the development of a road maintenance strategy in the Palasah District.

4. Result and Discussion

Jalan Raya Waringin is a one-way street, with a width of 3.8 meters. From the results of the research data collection, it was obtained several types of damage occurred on the 250 m long section of Jalan Raya Waringin. Starting from the front of the Riyadul Huda Foundation to the front of the Adila motorbike (workshop), there is some damage such as Alligator Cracking, Potholes with a moderate level of damage (medium), and others.

Calculating Density = The number of segments that experience certain damage divided by the amount of damage in one sample unit multiplied by 100%. For example, the sample unit STA 0 + 100 to 0 + 150 which has damaged holes with a total = 8.89, with a sample area = 190 m. So the hole damage density value on the unit up to STA 0 + 100 to 0 + 150 is 4.68%. All calculations of Density values on the Jalan Raya Waringin Section from STA 0 +000 to STA 0 + 250 can be seen in the following table:

Table 3 Calculation of Density values

Damage Type	Quantity (Area)								Total	density
Reflection Cracking	2.66	-	-	-	-	-	-	-	2.66	1.40
Long and Trass Cracking	0.38	-	-	-	-	-	-	-	0.38	0.20
Long and Trass Cracking	1.02	1.38	-		-	-	-	-	2.4	1.26
Alligator Cracking	10.21	22.76	-	-	-	-	-	-	32.97	17.35
Weathering/Ravelling	0.3	0.06	0.11	0.06	-	-	-	-	0.53	0.28
Potholes	1.56	3.6	1.1	1.5	1.04	-	-	-	8.8	4.63
Potholes	13.3	10.64	11.02	-	-	-	-	-	34.96	18.40
Potholes	10:75	14.74	-	-	-	-	-	-	37.49	19.73
depression	0.75	-	-	-	-	-	-	-	0.75	0.39
Long and Trass Cracking	0.24	0.38	1.08	0.28	-	-	-	-	1.98	1.04
Alligator Cracking	14.9	-	-	-	-	-	-	-	14.9	7.84
Weathering/Ravelling	0.72	0.35	0.18	1.04	0.12	1.33	0.41	1.45	5.6	2.95
Potholes	0.8	4.84	3.06	1.43	1.08	1.21	1.17	3.24	16.83	8.86
Potholes	13.68	6.08	6.6	14.04	-	-	-	-	40.4	21.26
Long and Trass Cracking	1.9	2.47	3.74	0.57	1.76	1.3	-	-	11.74	6.18

Weathering/Ravelling	0.96	1.62	0.075	0.385	0.14	0.15	0.36	1.19	4.88	2.57
Potholes	1.8	1.2	3.61	1.68	0.6	-	-	-	8.89	4.68
Potholes	13.3	-	-	-	-	-	-	-	13.3	7.00
Damage Type	**Quantity (Area)**								**Total**	**density**
Long and Trass Cracking	0.1	0.72	1.9	1.52	1.52	-	-	-	5.76	3.03
Weathering/Ravelling	0.09	0.08	0.06	0.04	0.36	0.16	0.35	0.42	1.56	0.82
Potholes	4.62	13.3	-	-	-	-	-	-	17.92	9.43
Long and Trass Cracking	1.52	0.5	0.32	4.28	6.51	6.71	-	-	19.84	10.44
Weathering/Ravelling	0.36	0.175	0.06	0.04	0.36	0.16	0.35	0.42	1925	1.01
Potholes	0.72	1.14	-	-	-	-	-	-	1.86	0.98

From the table above it can be seen the Density values of all types of damage along Jalan Raya Waringin from STA 0 + 000 to STA 0 + 250. After obtaining the density values, then enter them into the Density and Deduct Value relationship graphs to get the Deduct Value values for each type of damage to the sample unit.

After obtaining the value (DV) for each type of damage in one sample unit, then adding it up to get the Total Deduct Value (TDV). After obtaining the total Deduct Value (TDV) then enter it into the graph of the relationship between Total Deduct Value and Correct Deduct Value (CDV) to get the PCI value for each sample unit.

The calculation of the PCI value with the PCI = 100 – CDVmax formula can be seen in the following table:

Table 4 PCI Calculation Results

No	stationing	HDV	CDV	PCI	Pavement Conditions
1	0+ 000 to 0 + 050	100	52	48	Fair
2	0+ 050 to 0 + 100	100	52	48	Fair
3	0+ 100 to 0 + 150	78	82	18	Very Poor
4	0+ 150 to 0 + 200	54	58	42	Fair
5	0+ 200 to 0 + 250	13	17	83	Very Good

From the table above it can be calculated that the total PCI value is = 239, so the average PCI for the Jalan Raya Waringin section, Palasah District, Majalengka Regency can be obtained as follows:

$$\text{PCI} = \frac{\textit{Total Nilai PCI}}{\textit{Jumlah Segmen Jalan}}$$

$$\text{PCI} = \frac{\mathbf{239}}{\mathbf{5}}$$

$$\text{PCI} = 47{,}8$$

From the data above, it can be concluded that the area of damage on the Jalan Raya Waringin section, Palasah District, Majalengka Regency, was obtained at 72.89, which in this number the road conditions can be categorized in a fair rating using the PCI method.

5. Conclusion

The results of the research on the condition of Jalan Raya Waringin, Palasah District, Majalengka Regency using the PCI method obtained as a whole is 47.8%. PCI = Fair, meaning that the condition of the road pavement is quite significant and requires periodic maintenance. The types of damage that can be found in Jalan Raya Waringin, Palasah District, Majalengka Regency include Holes, Weathering and

Loose Grain, Crocodile Skin Cracks, Longitudinal and Transverse Cracks, and Subsidence. Damages that occur as a result of subgrade soil conditions or unfavorable foundations.

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