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Road Damage Analysis on Inter-City Roads Using Pavement Condition Index (PCI) Approach in West Java Indonesia

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Abstract
Poor road infrastructure conditions have a significant impact on transportation efficiency, user safety, and logistics costs, especially in areas with tropical climates and heavy vehicle traffic such as in West Java. This study aims to evaluate the condition of road pavement on the Jangga–Cikamurang Road section in Indramayu Regency using the Pavement Condition Index (PCI) method. The survey was conducted visually along 1 kilometer of road, which was divided into 10 segments of 100 meters each. Observations included identification of the type of damage, severity, and extent of damage in each segment. The results of the study showed that the most dominant types of damage were alligator cracking (42.47%) and depression (33.63%) with high severity. The PCI values obtained varied between 6 and 78, with 60% of segments categorized as poor to failed, and only 10% in satisfactory condition. These findings indicate that most road sections are in unserviceable conditions and require structural handling. Based on the PCI value classification, reconstruction actions are recommended for segments with PCI < 55, overlay and structural maintenance for PCI 55–70, and preventive maintenance for PCI > 70. This study confirms the importance of implementing PCI as a technical decision-making tool in sustainable road maintenance planning.

Keywords: Pavement Condition Index, Road Damage, Road Maintenance, PCI, Intercity Road, West Java.

INTRODUCTION

Road infrastructure is a vital component of the national transportation system that supports inter-regional connectivity, economic growth, and logistics distribution. In developing countries, such as Indonesia, the quality of the road network plays a key role in accelerating regional development, reducing transportation costs, and increasing access to basic services and the job market (Shrivastava, Shrivastava, and Joshi 2024; Silva et al. 2024). Inter-city roads, in particular, function as the main link between districts and provinces, so they require serious attention in terms of maintenance and quality improvement.

Road damage is a common problem in various regions of Indonesia, including West Java, and impacts various aspects such as the economy, society, and safety. Damaged road surfaces—such as cracks, holes, deformation, and structural failures—not only reduce driving comfort and safety, but also increase fuel consumption, accelerate vehicle deterioration, and raise the risk of traffic accidents (Hashim, Badawy, and Heneash 2023; Silva et al. 2024). Studies have shown a potential reduction in average vehicle speed of up to 25% due to rough road surfaces, impacting delivery times and increasing the probability of accidents. Additionally, a 10cm increase in road surface roughness can lead to a 5% increase in rolling resistance and a 21% increase in unit transportation costs, ultimately burdening logistics and supply chain sectors (Hashim et al. 2023; Silva et al. 2024). Poor pavement quality correlates with decreased traffic capacity, leading to congestion and delays and contributing to greater economic losses. Prolonged traffic congestion disrupts passenger comfort and has long-term effects on businesses relying on timely delivery. Increased traffic volumes on substandard roads can decrease the efficiency of service delivery, negatively affecting customer satisfaction and business continuity (Hashim et al. 2023; Zhou et al. 2022). From an environmental perspective, greater surface damage can result in increased CO_2 emissions; research on highways has demonstrated that additional fuel is consumed when driving over *potholes* and rough surfaces, leading to heightened emissions (Chatti 2020; Piechowicz et al. 2024).

The characteristics of Indonesia's tropical climate, such as high rainfall and extreme humidity, also accelerate road degradation. Humidity-related damage—including *stripping*, *rutting*, *potholes*, and edge cracking—is a major concern on pavements in tropical zones (Aman et al. 2023; Nawir and Mansur 2022). Poor drainage systems result in stagnant water, which accelerates the weathering and peeling process of asphalt and increases the risk of severe structural damage (Lee and Le 2024; Ríos-Touma, Kondolf, and Walls 2020). Elevated temperatures commonly found in tropical climates interact with road materials, producing thermal stress that ultimately leads to cracking and surface deformation. Continuous sun exposure, combined with humidity, causes asphalt to deteriorate more rapidly than under temperate conditions, highlighting the need for research into advanced materials and construction techniques capable of withstanding these circumstances (Lee and Le 2024; Quinn et al. 2018). For example, adding filler materials such as crumb rubber has been studied to improve the moisture resistance of asphalt mixes, potentially increasing their durability in humid tropical climates (Aman et al. 2023).

To assess road pavement condition, several methods have been adopted, but one of the most widely used is the *Pavement Condition Index* (PCI). PCI is a road surface assessment system based on the type, severity, and extent of visible damage, with a score ranging from 0 (failed) to 100 (good) (Azam et al. 2023; Hidayat and Prasetyaningtiyas 2023). This method is popular among road and infrastructure management agencies for its simplicity, measurability, and cost-efficiency.

PCI is especially relevant for developing countries because it can be integrated with local labor-based maintenance strategies, creating job opportunities while enhancing infrastructure quality (Grum et al. 2023). Using PCI also facilitates decision-making on road damage prioritization through standardized, quantitative data that is comparable across locations and periods (Chamorro and Tighe 2019; Vu, Huu, and Tran 2021). Numerous studies have demonstrated PCI's effectiveness in managing roads in urban, suburban, and rural settings (Jadaan et al. 2018; Rivera et al. 2015).

However, implementing PCI in Indonesia still comes with challenges, such as limited human resources, gaps in technical training, and a lack of modern inspection tools. To address these issues, innovative technologies have been introduced, including drones (*UAVs*), laser scanning, smartphone applications, and Geographic Information System (*GIS*)-based mapping systems (AbdelRaheem et al. 2023; Arianto, Suprapto, and Syafi'i 2018; Waga, Malinen, and Tokola 2021; Zang et al. 2018). Combining PCI with spatial approaches enables real-time and precise visualization of road conditions to support agile and efficient policymaking.

Recent research indicates that integrating PCI with the *International Roughness Index* (IRI) can provide a comprehensive evaluation of road performance, covering both structural conditions and user comfort (Isradi et al. 2023; Piryonesi and El-Diraby 2021). While PCI focuses primarily on visible and structural issues, IRI reflects the actual driving experience.

Merging these two metrics has been shown to improve the accuracy of maintenance planning and budgeting.

Indonesia's inter-city roads face systemic challenges, including heavy traffic loads that surpass design capacity (Al-Janabi and Obaid 2024; Hatoum et al. 2022), confined maintenance budgets leading to reactive repairs (Hasibuan and Surbakti 2019), and dependence on subjective or infrequent manual inspections. Thus, a standardized, data-driven approach like PCI is needed to ensure the effectiveness of road maintenance programs.

West Java Province is highly relevant as a case study area for this research. It has Indonesia's densest road network, connecting industrial zones, logistics centers, and agricultural regions. One strategic corridor is *Jalan Jangga–Cikamurang* in Indramayu Regency, vital for connecting districts and urban areas, providing main access to the West Java International Airport (*Bandara Internasional Jawa Barat*, BIJB) Kertajati, and linking directly to the *Cikedung* Toll Gate and the *Cikopo–Palimanan* (*Cipali*) Toll Road.

The condition of infrastructure along this corridor directly influences mobility, goods distribution, and connectivity to new economic growth centers such as airport and toll road hubs. Therefore, monitoring and evaluating road conditions in the *Jangga-Cikamurang* section is essential for supporting regional development sustainability and efficient regional transport. The lack of studies evaluating road condition in this corridor using the PCI method reveals a significant information gap.

This study aims to analyze the degree of damage on inter-city roads in West Java Province, focusing on the *Jangga–Cikamurang* corridor, using the *Pavement Condition Index* (PCI) approach and offering maintenance recommendations based on PCI evaluation results to guide infrastructure repair prioritization. The study is expected to make a significant contribution to the development of measurable and practical road assessment methods and to support evidence-based, efficient, and sustainable road maintenance policies. Moreover, the results may serve as a methodological reference for similar studies in other tropical regions with comparable traffic and climate characteristics.

RESEARCH METHOD

Research Flow

This study carried out a series of stages as described in Figure 1. It began with a literature review and identification of strategic locations based on aspects of connectivity and the urgency of road infrastructure maintenance. Furthermore, a preliminary survey was conducted to assess the general condition of the *Jangga-Cikamurang* Road section. Based on the observations, it was decided to analyze 1 km of the total road length because this segment was considered representative, with relatively uniform pavement conditions. The next stage involved a visual field survey aimed at identifying the types of road surface damage, assessing their severity, and measuring the extent of damage. Data obtained from each segment were used to calculate the PCI value quantitatively using a standard formula. The PCI calculation results were then analyzed descriptively to determine the actual condition of each segment. The entire series of activities concluded with the formulation of maintenance recommendations based on the obtained PCI values.

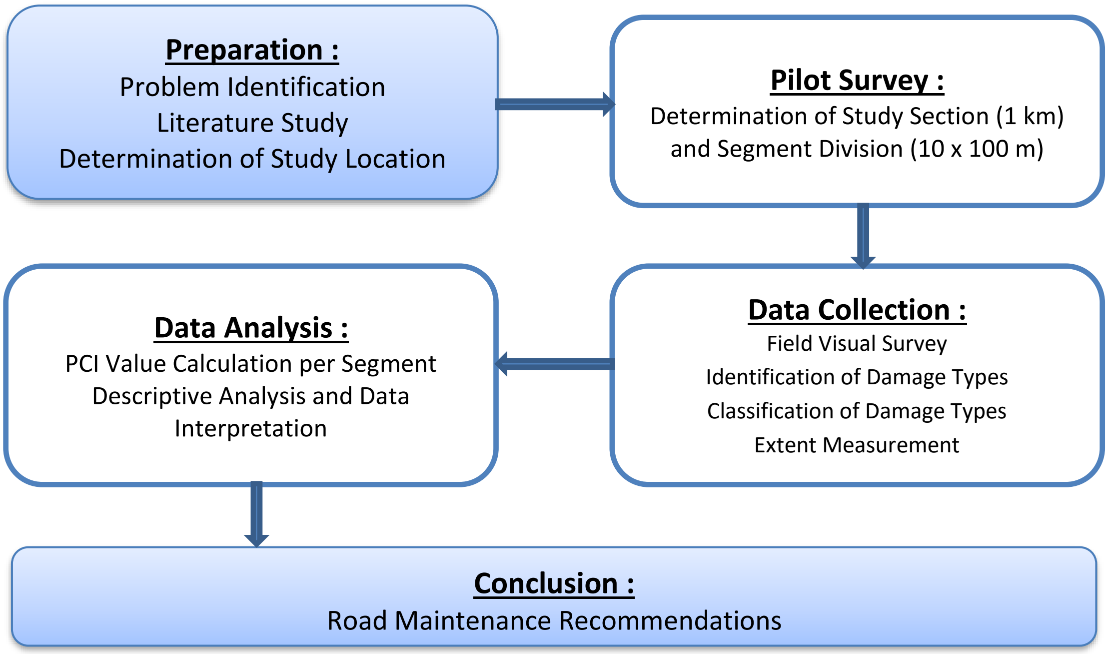

Figure 1. Research Flow

Studi Area

The *Jangga–Cikamurang* road section in Indramayu Regency was chosen as the research location because of its strategic value in supporting the regional transportation system in West Java. Its geographical location is close to access points such as the West Java International Airport (*Bandara Internasional Jawa Barat*, BIJB) Kertajati and the *Cikedung* Toll Gate, as well as its direct connection to the *Cikopo–Palimanan* (*Cipali*) Toll Road, making this section important for facilitating the flow of vehicles, including logistics and goods distribution vehicles. The routine passage of heavy vehicles along this route has the potential to exert excessive pressure on the road pavement structure.

The existing conditions along this section show a tendency toward relatively homogeneous damage patterns; therefore, a 1-kilometer segment was chosen as a representative sample for technical evaluation. This segment was then divided into 10 sections of 100 meters each to allow focused, efficient, and comparative observations between segments. This approach is expected to provide an accurate picture of the functional condition of the road and support efforts to establish data-based maintenance priorities.

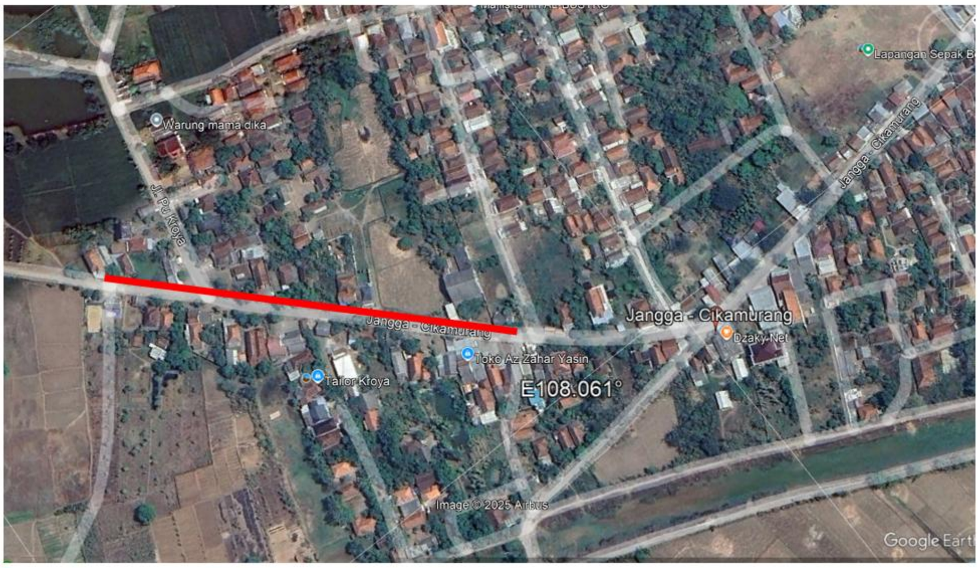

Figure 2. Study Area

Road Condition Assessment Method

The method used in this study is the Pavement Condition Index (PCI) Bina Marga which refers to the international standard ASTM D6433-09. PCI is a quantitative approach to assessing road surface conditions based on visual observation of the type, severity, and extent of damage. PCI values range from 0 (failed) to 100 (good).

Data Collection Procedure

Data collection was conducted through direct visual surveys in the field by a research team that had been given basic training on the classification of types and severity of pavement damage. Observation procedures include:

1. Identification of damage types, such as longitudinal cracks, alligator cracks, potholes, rutting, stripping, and raveling.
2. Classification of severity (low, medium, high) based on PCI guidelines.
3. Measurement of the extent of damage for each type of damage.
4. Recording and visual documentation using a field camera.

After all data is collected, the PCI value for each segment is calculated using a standardized formula in the PCI method, namely:

$$\mathbf{PCI = 100 - \sum (Deduct\ Value)}$$

Where the deductible value is determined based on a combination of the type, severity, and relative extent of damage to the total area of the segment.

Tools and Material

The tools used in this study include:

1. PCI inspection form (damage data sheet),
2. Measuring instruments (meter, long ruler),
3. Digital camera/smartphone for visual documentation,
4. GPS for recording the coordinates of each segment,
5. Data processing software (spreadsheets and visual plotting devices).

Data Analysis

The survey data is processed to produce PCI values for each segment. The PCI values are then analyzed descriptively to:

1. Identify segments with the worst conditions,
2. Determine condition classifications (Very Good, Good, Fair, Poor, Very Poor, Failed),
3. Prepare maintenance priority recommendations.

In addition, the PCI assessment results are also mapped spatially for damage distribution visualization, which aims to support maintenance decision making based on location.

RESULT AND DISCUSSION

General Description of Location and Road Characteristics

The Jangga – Cikamurang Road Section is part of the district road network located in the administrative area of Indramayu Regency, West Java Province. This road plays an important role in supporting connectivity between rural areas and the national road network. The Jangga – Cikamurang Road functions as one of the main accesses to the West Java International Airport (BIJB) Kertajati, as well as a connection to the Cikedung Toll Gate and the Cikopo–Palimanan (Cipali) Toll Road. The existence of this section is important in facilitating the flow of goods and services, especially from the eastern and central areas of Indramayu Regency to new centers of economic growth.

The road section observed in this study has a width of 5 meters, with a road structure in the form of flexible pavement using asphalt as a surface. The characteristics of this road are in accordance with the function of class III roads, namely connecting roads between local areas with two narrow lanes without a median. The analysis is focused on a 1 kilometer stretch, precisely STA 80+900 to STA 81+900, which is divided into 10 segments with a length of 100 m each as follows:

Segment 1 is STA 80+900 – STA 81+000
Segment 2 is STA 81+000 – STA 81+100
Segment 3 is STA 81+100 – STA 81+200
Segment 4 is STA 81+200 – STA 81+300
Segment 5 is STA 81+300 – STA 81+400
Segment 6 is STA 81+400 – STA 81+500
Segment 7 is STA 81+500 – STA 81+600
Segment 8 is STA 81+600 – STA 81+700
Segment 9 is STA 81+700 – STA 81+800
Segment 10 is STA 81+800 – STA 81+900

Visual observation results show that the road surface has experienced several types of damage with varying degrees of severity. The types of damage identified include alligator cracks, longitudinal/transverse cracks, potholes, bumps and humps, lane/shoulder drop off, and depressions at certain points. Depression damage is characterized by a fairly striking decrease in the elevation of the road surface, which is generally caused by weak subgrade structures or disturbances in the drainage system. In addition, the condition of the unpaved roadside and the drainage system that is not functioning optimally accelerate the damage process, especially during the rainy season.

Figure 3. Jangga – Cikamurang Road Condition

Type and Severity of Damage

The results of the visual field survey showed that the damage to the pavement surface on the Jangga-Cikamurang Road section consisted of various types, dominated by alligator cracking (42.47%) and depression (33.63%). Other types of damage identified were lane/shoulder drop off (15%), longitudinal and transversal cracks (6.97%), potholes (1.58%), and bumps and sags (0.35%), as shown in **Figure 4**. Alligator cracking damage indicates structural fatigue in the pavement layer due to repeated heavy traffic loads, while depression damage reflects the subsidence of the road surface layer due to weak subgrade bearing capacity and poor drainage system. These two types of damage contributed more than 75% of the total damage observed, indicating significant structural degradation in most road sections. Lane/shoulder drop off damage, which covered 15% of the total damage, indicated a difference in elevation between the shoulder and the main traffic lane, which could cause safety problems. Meanwhile, longitudinal & transversal cracks indicate cracks due to thermal expansion or structural movement, although in a smaller proportion. Although the proportion of potholes and bumps and sags damage is relatively small, their presence is still significant because they can develop into more serious damage if not handled immediately. Overall, these results show that the pavement on the Jangga-Cikamurang Road section experiences complex structural stress and requires appropriate maintenance actions according to the type of damage. Large amounts of depressed damage also have an impact on driving comfort and have the potential to cause waterlogging during the rainy season, which further accelerates the rate of road damage. This phenomenon is in line with the findings of (Hasibuan & Surbakti, 2019) and (Aman et al., 2023) that surface depreciation in tropical climates is often caused by water immersion and weak bearing capacity of the subgrade. Overall, the dominance of depressive damage and high severity at several points indicate that the structural condition of the road has experienced serious degradation. These results are an important basis for the next stage, namely calculating the PCI value and preparing technical recommendations for maintenance.

Table 1. Number of Damages on the Jangga - Cikamurang Road

Seg	Damage Type	Damage Level	Quantity (m^2)												Total Quantity
1	Potholes	Low	0,04	0,15											0,19
	Depression	Med	10,00												10,00
2	Long/trans Cracks	High	5,20												5,20
	Potholes	Med	0,28	0,25	0,09	0,14									0,76
3	Depression	Med	13,00	7,50	11,40	12,75	11,25	10,00	19,50						85,40
	Potholes	Med	0,25	0,25	0,12	0,20	0,12	0,09	0,25	0,09	0,20	0,25			3,36
		Med	0,09	0,12	0,25	0,25	0,20	0,12	0,16	0,20	0,09	0,06			
4	Potholes	Med	0,25	0,35	0,20	0,25	0,16	0,20	0,30	0,25	0,16	0,12	0,25	0,16	2,65
	Depression	Med	2,00	3,00	5,60	21,40	30,00								62,00
5	Aligator Cracking	High	2,30	3,96	2,52	2,52	4,29	9,03							24,62
	Lane Drop Off	Med	60,50	43,00											103,50
6	Long/trans Cracks	High	14,20												14,20
	Potholes	Med	0,25	0,25	0,35	0,20	0,16	0,24	0,24						1,69
7	Aligator Cracking	Med	11,00	5,55	7,50										24,05
8	Aligator Cracking	High	7,74	2,21	1,90	2,53	100,00								114,38
9	Long/trans Cracks	High	10,90	13,90											24,80
10	Potholes	Med	0,07	1,31											1,37
	Depression	High	12,60	29,40	9,00	5,40	1,89	7,20	9,18						74,67

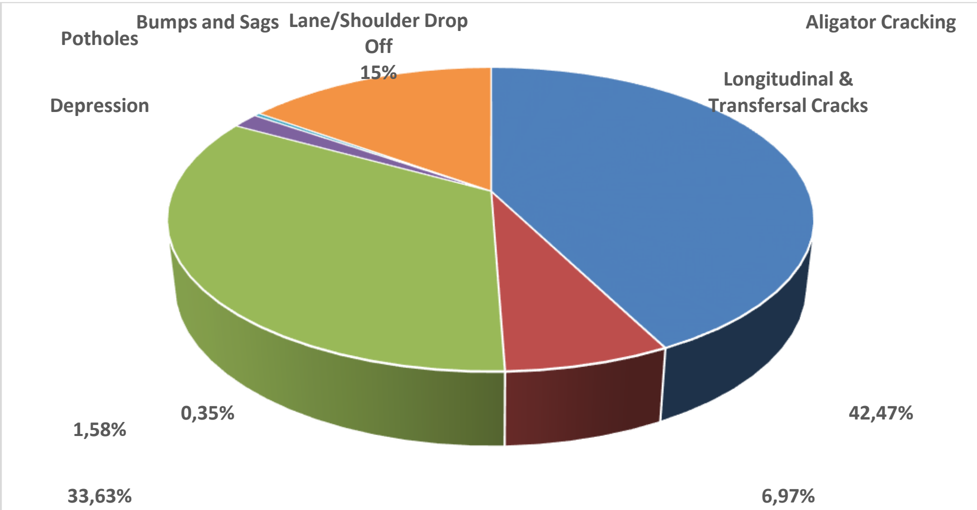

Figure 4. Damage Type of Jangga – Cikamurang Road

PCI Value per Segment

Evaluation of pavement conditions on each segment of the Jangga–Cikamurang Road section was carried out using the Pavement Condition Index (PCI) approach. The PCI value was calculated based on the results of a visual survey of the type of damage, severity, and extent of damage observed on each 100-meter segment. The results of the PCI calculation are shown in **Table 2**, while the distribution graph of PCI values between segments is presented in **Figure 5**. The results of the analysis show that the PCI values on 10 road segments vary from 6 to 78, reflecting variations in the level of damage between locations. Based on the PCI standard classification (ASTM D6433), the road conditions in these segments can be categorized as follows:

1. Satisfactory: 1 segment (Segment 1, PCI = 78)
2. Fair: 3 segment (Segment 2, 9 and 10, PCI = 56, 60 and 62)
3. Poor: 1 segment (Segment 5, PCI = 50)
4. Very Poor: 1 segment (Segment 6, PCI = 28)
5. Serious: 3 segment (Segment 3, 4 and 8, PCI = 18, 24 and 18)
6. Failed: 1 segment (segment 7, PCI = 6)

Figure 5 illustrates the PCI value per segment in the form of a bar chart, which makes it clear that Segment 7 is segments with the worst pavement conditions. This is in line with previous findings that these segments have a significant area of depressive damage, with a high level of severity.

Table 2. PCI Value and Damage Condition of Jangga – Cikamurang Road

Seg	Distress Density (%)	Deduct Value (Chart)	HDVi	Mi	TDV			Total TDV	q	CDV	PCI	Condition
1	0,04	20	20	8,35	20	10		30	2	22	78	Satisfactory
	2,00	10			20	2		22	1	22		
2	1,04	20	40	6,51	40	20		60	2	44	56	Fair
	0,15	40			40	2		42	1	44		
3	17,08	40	80	2,84	80	40		120	2	82	18	Serious
	0,67	80			80	2		82	1	82		
4	0,53	72	72	3,57	72	35		107	2	76	24	Serious
	12,40	35			72	2		74	1	74		
5	4,92	34	34	7,06	34	30	15	79	3	50	50	Poor
	20,70	15			34	30	2	66	2	50		
	2,84	30			34	2	2	38	1	40		
6	0,34	62	62	4,49	62	38		100	2	72	28	Very Poor
	4,81	38			62	2		64	1	66		
7	22,88	72	72	3,57	72	56	42	170	3	94	6	Failed
	4,96	42			72	56	2	130	2	86		
	0,27	56			72	2	2	76	1	76		
8	14,93	50	72	3,57	72	50		122	2	82	18	Serious
	26,00	72			72	2		74	1	74		
9	0,48	24	30	7,43	30	24		54	2	40	60	Fair
	0,08	30			30	2		32	1	32		
10	0,78	18	32	7,24	32	18		50	2	38	62	Fair
	0,10	32			32	2		34	1	34		

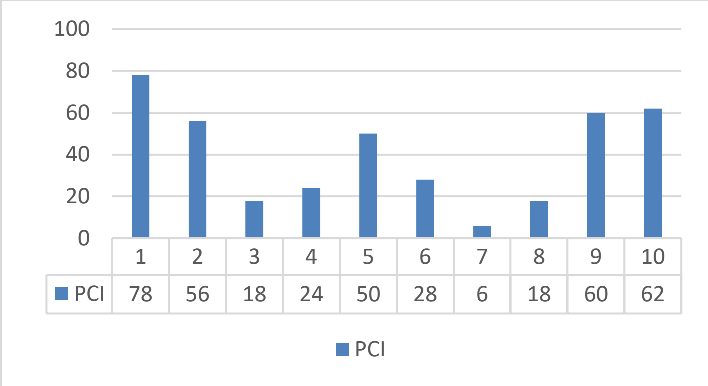

Figure 5. PCI Value on Jangga – Cikamurang Road

Next, **Figure 6** presents the percentage distribution of pavement condition classification based on PCI value. From the graph, it can be seen that 10% of segments are in failed condition, 10% of segments are categorized in Poor condition, 10% in Very Poor condition, 30% in Serious condition, 30% in Fair condition, and only 10% in Satisfactory condition. The dominance of the classifications "failed", "Poor", "Very Poor", and "Serious" indicates that most road segments experience structural and functional damage that requires immediate maintenance action. In general, the relatively low PCI values in most segments indicate that the quality of the road pavement in this section is in an inadequate condition for long-term service. These results can be the basis for determining maintenance priorities and allocating resources more precisely.

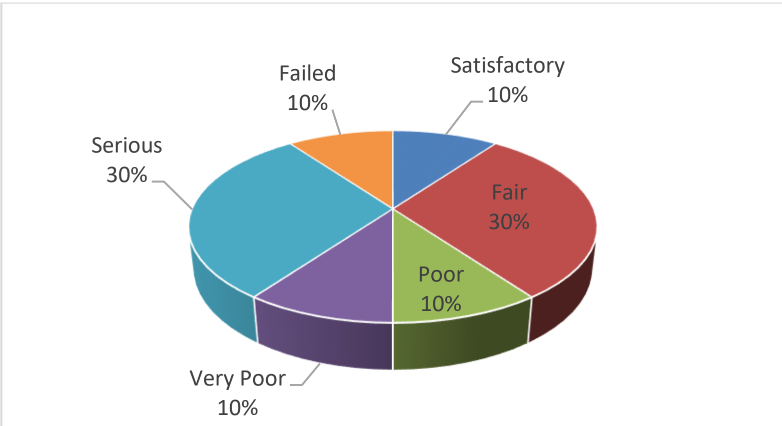

Figure 6. Damage Condition on Jangga – Cikamurang Road

Damage Pattern Analysis

Analysis of the Pavement Condition Index (PCI) values on the Jangga–Cikamurang Road section shows that in general, the pavement conditions on the studied road segments are of varying quality, with the majority tending to be in the poor category. Of the 10 segments studied, only one segment was categorized as being in satisfactory condition (PCI = 78), while the rest were spread across the fair, poor, very poor, serious and failed categories, as shown in **Figure 6**.

The distribution of PCI values shows that the worst damage occurred in Segments 7, with PCI values of 6, respectively, which are classified as failed. The damage in these segments is dominated by alligator cracking that extends almost the entire surface. The alternating crack pattern is a strong indication of structural damage due to material fatigue, which usually occurs due to the accumulation of heavy traffic loads exceeding the design capacity. In addition, this damage is likely exacerbated by ineffective drainage conditions, which cause water to seep into the pavement layer and weaken the subgrade. The combination of repeated traffic loads and water infiltration results in a decrease in the bearing capacity of the structure, accelerating the process of cracking and permanent deformation. This condition indicates that the road structure in the segment is no longer serviceable and requires comprehensive reconstruction. This finding is in line with the results of research (Chen et al., 2020) and (Piryonesi & El-Diraby, 2021) which state that alligator cracking is a common form of structural damage to flexible pavement roads due to fatigue or material fatigue, which is exacerbated by repeated heavy vehicle loads and weak subgrade conditions.

In addition, segment 5 is in the poor category, with a PCI value of 50. Meanwhile, segment 6 is classified as very poor (PCI = 28). Segments 3, 4 and 8 are in serious condition with PCI values between 18 - 24 and segment 7 is in failed condition with a PCI value of 6 indicating the need for partial reconstruction or more comprehensive structural rehabilitation.. When compared to PCI studies on other district roads in Indonesia, such as those conducted by (Suharso & Andaryati, 2024) on the Muliama-Makki section in Papua, the average PCI value on the Jangga-Cikamurang section was below the serviceability standard, with a more severe concentration of structural damage. In the study, the average PCI value was still in the range of 60–75, dominated by surface cracking and light stripping damage. In contrast, the results of a study by (Rivera et al., 2015) showed that on secondary roads with limited maintenance conditions, the PCI value was often below 50, especially on sections with open and non-optimally functioning drainage systems—conditions also found at this study location. This strengthens the conclusion that environmental factors such as drainage and heavy traffic are crucial factors in the damage of flexible pavement roads.

In general, the damage patterns found in this study also strengthen the recommendations of (Chamorro & Tighe, 2019) and (Piryonesi & El-Diraby, 2021) that the use of the PCI method needs to be carried out periodically and based on location, so that the maintenance strategy is not uniform, but is adjusted to the actual conditions of each segment.

Handling Recommendation

Based on the evaluation results of the Pavement Condition Index (PCI) values on 10 segments of the Jangga–Cikamurang Road, technical recommendations for handling road damage can be prepared that are adjusted to the level of pavement condition. This approach is important to ensure the effectiveness of maintenance, efficiency of budget allocation, and the sustainability of road service functions in the long term.

Table 3. Handling Recommendation of Jangga – Cikamurang Road

Seg	Stationing			PCI Value	Road Condition Handling
1	80+900	-	81+00	78	Preventive Maintenance
2	81+00	-	81+100	56	Structural Improvement

3	81+100	-	81+200	18	Reconstruction
4	81+200	-	81+300	24	Reconstruction
5	81+300	-	81+400	50	Reconstruction
6	81+400	-	81+500	28	Reconstruction
7	81+500	-	81+600	6	Reconstruction
8	81+600	-	81+700	18	Reconstruction
9	81+700	-	81+800	60	Structural Improvement
10	81+800	-	81+900	62	Structural Improvement

1. Segment PCI < 55

   Segments with PCI values below 55, which include the Poor, Very Poor, Serious and Failed categories, reflect road conditions that have experienced extensive and severe structural damage. In this segment, damage types such as large-scale depressions, sinkholes, and widespread potholes with high severity levels are found. This condition can no longer be overcome with light maintenance or surface patching.

   For these segments, the following actions are recommended:
   - Partial or complete reconstruction, including dismantling of the existing pavement layer,
   - Stabilization of the subgrade with granular material or chemical stabilization techniques,
   - Repair and improvement of the drainage system, especially in areas with indications of puddles or damage due to water,
   - Use of pavement materials that are suitable for tropical climate conditions, such as asphalt mixtures with anti-striping additives or geotextiles.

   These steps are needed to restore the structural strength of the road while extending the service life of the road in the future.
2. Segment with PCI between 55–70

   Fair category segments show a decrease in surface quality and early signs of structural degradation even though they have not experienced major structural failure. Common damages found include longitudinal cracks, minor deformation, and surface peeling (raveling).

   Recommended treatments include:
   - Light structural reinforcement such as overlay (recoating with hotmix),
   - Crack sealing to prevent water infiltration,
   - Local repairs (spot patching) at the initial points of damage.

   With timely treatment, these segments can be restored to good condition without the need for major demolition and at a more efficient cost.
3. Segment with PCI > 70

   The segment in the Satisfactory category is still in a functional condition and has not shown any significant signs of damage. At this location, the maintenance approach is focused on prevention and conservation of road service functions.

Handling recommendations include:

- Routine periodic maintenance, such as sweeping the road surface, cleaning drainage channels, and trimming roadside vegetation,
- Periodic monitoring of the development of micro damage so that it can be handled immediately before it develops into structural damage.
- Implementation of the Preventive Maintenance program in this segment is very important to maintain high PCI values and delay the need for major repairs in the future.

CONCLUSION

The results of the study showed that the dominant types of damage in this section are alligator cracking, contributing 42.47% to the total damage, and depression, contributing 33.63%, while other types of damage such as potholes, longitudinal/transversal cracks, bumps and *sugs*, and lane drop-offs account for only 23.90%. The high frequency and severity of depressions indicate serious structural weaknesses, possibly caused by poor drainage systems and heavy vehicle pressure. The PCI values obtained from the 10 segments showed significant variation, ranging from 6 to 78, with the following condition classifications: Satisfactory: 1 segment; Fair: 3 segments; Poor: 1 segment; Very Poor: 1 segment; Serious: 3 segments; Failed: 1 segment. Most segments are in a condition that is not suitable for service, as indicated by a PCI value below 55, signaling the need for rehabilitation or structural reconstruction. Comparison with previous studies confirms that severe damage to flexible pavements in tropical climates is strongly correlated with environmental factors such as waterlogging, high humidity, and irregular road maintenance. Technical recommendations based on PCI values include: full reconstruction for segments with PCI < 55; overlay and light structural reinforcement for segments with PCI 55–70; routine preventive maintenance for segments with PCI > 70. This study confirms that the PCI method can be used effectively as a technical evaluation and decision-making tool in road maintenance planning. This data-based approach enables local governments to implement more targeted, efficient, and sustainable *maintenance* programs. Periodic application of this method is recommended to monitor the development of road conditions over time.

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