

Road Damage Analysis Using the Bina Marga Method (Case Study of the Parit 5 Tembilahan Hulu Road Section)

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Abstract: Jalan Raya Parit 5, located in Tembilahan Hulu District, serves as a vital transportation corridor that connects various regions and functions primarily as a distribution route for local agricultural products as well as an alternative access to the provincial road network. This road segment consists of a two-way single lane configuration but currently carries a high traffic volume, including heavy vehicles such as trucks transporting agricultural and plantation commodities. These conditions lead to excessive loading, ultimately contributing to both structural and functional deterioration of the pavement. Addressing these issues requires a comprehensive evaluative assessment of the existing roadway damage, employing a systematic technical approach such as the Bina Marga visual assessment method. This study applies a descriptive quantitative approach, which is suitable for evaluating the physical condition of the road, as it involves direct measurements of various types of pavement surface distresses followed by numerical analysis. The findings indicate that the types of pavement damage observed along the STA 0+000 to STA 0+800 segment of Parit 5 Road include settlement, potholes, ravelling, random cracking, alligator cracking, longitudinal cracking, and patching. The average damage index obtained is 2.04, while the road condition index averages at 2.40. Based on the calculation results, the priority index value for this road segment is 10.5. Referring to the recommended action associated with the priority index score, routine maintenance is necessary for this road segment. Further mitigation and preventive efforts may include immediate rehabilitation of severely damaged sections, prevention of progressive damage, drainage improvement, and periodic monitoring.

Keywords: Road Damage, Highway Method.

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Introduction

Jalan Parit 5, located in Tembilahan Hulu District, Indragiri Hilir Regency, serves as a vital roadway connecting inter-regional areas, particularly functioning as a distribution route for agricultural commodities and an alternative access to the provincial road network. This road segment has a one-lane two-way configuration; however, it accommodates a relatively high traffic volume, including heavy vehicles such as trucks transporting plantation and agricultural products. Such conditions impose excessive loads on the pavement structure, ultimately leading to a decline in both structural and functional performance.

Various forms of pavement distress have been identified along this segment, including alligator cracking, potholes, patching, and surface stripping. These types of damage not only reduce driving comfort but also pose a potential threat to traffic safety. The high severity level of the pavement distress indicates complex problems related to both pavement structure and subgrade conditions.

One of the major contributing factors to the accelerated pavement deterioration in this area is the local soil characteristics. Tembilahan Hulu is known for having very soft soil, characterized by low bearing capacity and poor stability. This condition challenges the pavement structure to retain durability under heavy traffic loads and extreme tropical weather cycles. Without appropriate technical evaluation and treatment, pavement degradation will continue to occur repeatedly, resulting in economic losses and disruption to community mobility.

Therefore, a comprehensive evaluative study of pavement damage conditions is required using systematic technical approaches such as the Bina Marga visual inspection method. The evaluation aims to identify the types and severity levels of damage, quantitatively assess pavement conditions, and provide recommendations for appropriate maintenance actions based on field conditions. The results of this assessment are expected to serve as a basis for more effective, efficient, and sustainable road maintenance planning.

This research refers to the study conducted by Aditya (2022), which aimed to assess pavement damage levels and propose maintenance measures using the Bina Marga method. The method combines Average Daily Traffic (ADT) survey results and visual inspection of pavement surface distress to determine pavement condition values. However, this research examines a different case study location, forming the novelty of the study. The objective is to determine the type and extent of damage and provide preventive and corrective measures for the pavement distress observed along the selected road segment.

Methodology

This study adopts a descriptive quantitative approach, which aims to systematically and objectively describe pavement distress conditions based on measurable numerical data. This approach is suitable for evaluating physical road conditions since it involves direct quantification of pavement damage followed by numerical analysis.

Severity assessment plays an essential role in this evaluation. Pavement damage is classified into three severity levels: minor (L), moderate (M), and severe (S), based on the level of disturbance to road users' comfort and safety, as well as potential structural deterioration. These severity levels influence the overall pavement condition score (Directorate General of Bina Marga, 1990).

The Bina Marga method is a rating system that evaluates pavement conditions based on the type, severity, and extent of pavement distress, serving as a reference for pavement maintenance planning. According to Bina Marga, pavement damage is associated with

structural deficiencies when one or more pavement components fail to withstand traffic-induced stress and strain.

The percentage of pavement damage is calculated using Equation (1):

$$\text{Damage Percentage (\%)} = \frac{\text{Damage Area (m}^2\text{)}}{\text{Observed Road Area (m}^2\text{)}} \times 100\% \quad (1)$$

Where:

Np = Percentage Value of Road Damage

Results and Discussion

The Parit 5 Road section is one of the main connecting roads in Tembilahan Hulu District, Indragiri Hilir Regency, Riau Province. This road has an important role in community mobility and distribution of agricultural and plantation products, especially coconut and areca nut which are the region's leading commodities. The length of the Jalan Parit 5 section that is the object of this study is 800 meters (0.80 km), which begins at the coordinates (0°23'14.57"N, 100°50'40.57"E) – as STA 0+000 and ends at the coordinate point (0°25'26.99"N, 100°48'50.82"E) – STA 0+800. Jalan Parit 5 is a road with 1 lane of 2 lanes as shown in Figure 5.1, where the road body consists of a layer of flexible pavement and concrete road shoulders, with a road body size of 4.00 meters and the left and right road shoulders of 1.00 meters each.



Figure 1. Road Column

At the time of taking field survey data, it showed that there were various types of road damage, such as crocodile cracks, holes, patches, grain releases, elongated cracks, random cracks and sinks. Based on initial observations, many road segments suffered moderate to severe damage. These conditions can endanger the safety of road users and reduce comfort in road use.

A survey of road conditions was carried out to identify the type and extent of damage on the Parit 5 Road section in Tembilahan Hulu District, Indragiri Hilir Regency. The method used in this observation refers to the Manual Guidelines for Road and Bridge Condition Systems (SKJP) published by the Directorate General of Highways (1990). The

survey was carried out visually by dividing the road section into several observation segments. Each segment was observed directly to record the type of surface damage, severity, and dimensions of damage such as length, width, and area.

The data from this observation became the basis for calculating the Road Condition Value (NKJ), which was then used to evaluate the classification of the physical condition of the road, ranging from good condition to severely damaged. In addition, field documentation such as photos and technical notes is also used to strengthen the interpretation of existing road conditions. The discussion in this subchapter will describe the results of the survey based on three main aspects, namely the division of road segments, the type of damage found, and the severity and extent of damage that occurred in each segment.

To facilitate the implementation of visual surveys and analysis of road conditions, the Jalan Parit 5 section in Tembilahan Hulu District is divided into several segments. This division is carried out based on the guidelines of the Highway Method (SKJP, 1990) which recommends the length of the segment between 100 to 200 meters, depending on the condition and total length of the road. In this study, the ±800-meter road section is divided into 8 segments each 100 meters long, starting from STA 0+000 to STA 0+800. Table 1 shows the segment of road division observed in the field survey.

Table 1 Road Condition Observation Segment

Segmen	Early STA	Final STA
1	0 + 000	0 + 100
2	0 + 100	0 + 200
3	0 + 200	0 + 300
4	0 + 300	0 + 400
5	0 + 400	0 + 500
6	0 + 500	0 + 600
7	0 + 600	0 + 700
8	0 + 700	0 + 800

This division is intended so that road damage recording can be carried out systematically and measurably in each part of the road. Each segment is assigned an identification code that makes it easier to record the type of damage, dimension measurements, and visual documentation in the field.

After the segments were divided, the field survey continued with the identification of the types of damage found in each segment of Jalan Parit 5 Tembilahan Hulu. This identification is carried out visually by referring to the classification of road surface damage according to the Bina Marga Method (Bina Marga, 1990), which includes various forms of damage such as crocodile cracks, longitudinal/transverse cracks, potholes, patches, and the release of aggregate grains (ravelling). Each type of damage is recorded based on its shape,

pattern, and spread, then measured to determine its extent and severity. This process aims to find out the actual condition of the road as a whole, so that the value of damage in each segment can be calculated. This data is the basis for further analysis for the assessment of the Total Value of Road Conditions and determining the appropriate handling strategy. Table 2 shows the types of road damage found in each segment observed in this study.

Table 2. Types of Road Damage Found in Field Surveys

Segmen	IS	Types of Damage	Area (m2)
1	0+000 – 0+100	Pelepasan Butir	1,08
		Tambalan	13,08
		Lubang	0,20
		Elongated Crack	1,08
		Crocodile crack	1,40
2	0+100 – 0+200	Lubang	1,77
		Elongated Crack	8,04
3	0+200 – 0+300	Tambalan	5,88
		Elongated Crack	0,68
4	0+300 – 0+400	Amblas	80,00
		Crocodile crack	4,76
		Tambalan	6,09
5	0+400 – 0+500	Lubang	0,50
		Random Cracks	3,78
		Elongated Crack	4,80
		Crocodile crack	1,53
6	0+500 – 0+600	Lubang	0,20
		Crocodile crack	0,50
		Elongated Crack	8,96
7	0+600 – 0+700	Tambalan	7,28
		Crocodile crack	8,40
8	0+700 – 0+800	Elongated Crack	4,32
		Random Cracks	1,80
		Crocodile crack	6,16

Table 2 shows the types of damage encountered in each segment. There are several types of damage found along the road section that are the object of observation in this study, such as Grain Release, Patches, Holes, Crocodile Cracks, Elongated Cracks, Random Cracks and Sinkings.

Assessment of the condition of the pavement is important in the management of the pavement system, the results of the assessment can be used to find out whether the pavement is still feasible or not, and also to determine when repairs are made to the pavement layer. In this Bina Marga method, the types of damage that need to be considered when conducting a visual survey are surface roughness, holes, patches, cracks, grooves, and sinks. The determination of the value of road conditions is carried out by adding each number and value for each type of damage.

In assessing the level of road damage, this study uses the road condition evaluation method based on the Highway guidelines (SKJP 1990). This method is designed to quantitatively evaluate the condition of the road surface through direct visual observation of the type and severity of the damage that occurs. The main parameters used in this method include the type of damage, the severity (lightweight, medium, severe), and the extent of the damage. Each type of damage has a specific weight that indicates its impact on structural function and driving comfort.

Table 3. Recapitulation of Road Condition Values

IS	Types of Damage	Damage Area (m ²)	Damage (%)	Damage Figures	Condition Value
0+000 – 0+100	Pelepasan Butir	1,08	0,18	3	3
	Tambalan	13,08	2,18	0	
	Lubang	0,20	0,03	0	
	Elongated Crack	1,08	0,18	1	
	Crocodile crack	1,40	0,23	5	
0+100 – 0+200	Lubang	1,77	0,30	0	1
	Elongated Crack	8,04	1,34	1	
0+200 – 0+300	Tambalan	5,88	0,98	0	1
	Elongated Crack	0,68	0,11	1	
0+300 – 0+400	Amblas	80,00	13,33	2	2
	Crocodile crack	4,76	0,79	5	
	Tambalan	6,09	1,02	0	
0+400 – 0+500	Lubang	0,50	0,08	0	4
	Random Cracks	3,78	0,63	4	
	Elongated Crack	4,80	0,80	1	
	Crocodile crack	1,53	0,26	5	
0+500 – 0+600	Lubang	0,20	0,03	0	2
	Crocodile crack	0,50	0,08	5	
0+600 – 0+700	Elongated Crack	8,96	1,49	1	2
	Tambalan	7,28	1,21	0	
0+700 – 0+800	Crocodile crack	8,40	1,40	5	2
	Elongated Crack	4,32	0,72	1	

Random Cracks	1,80	0,30	4
Crocodile crack	6,16	1,03	5

Based on Table 5.3, the average damage rate was 2.04 and the average road condition value was 2.40. So that for the analysis of the priority order assessment, it can be calculated as follows:

$$\begin{aligned} \text{UP} &= 17 - \text{Class LHR} + \text{Road Condition Value} \\ &= 17 - (4+2.40) \\ &= 10.60 \end{aligned}$$

Therefore, the priority order value in this study can be obtained as 10.5. By referring to the actions taken based on the results of the priority order value, namely a routine maintenance program. Routine Maintenance is the handling of surface layers that are designed to improve riding quality, without increasing structural strength and are carried out throughout the year.

Based on the results of the recapitulation of road damage using the Bina Marga method, it is known that the road condition on the STA 0+000 – 0+800 section is in quite varied condition, with an average condition value of 2.40 and an average damage rate of 2.04. Some segments, such as STA 0+100 – 0+200 and STA 0+200 – 0+300, have low condition values (1), which indicates the level of poor to severe damage, while other segments are still in moderate to good condition.

Seeing these conditions, it is necessary to make appropriate prevention and countermeasures based on the type and level of damage that occurs:

1. Further Damage Prevention

Prevention efforts aim to maintain road segments that are still in good condition (condition values 3–4), so as not to experience further degradation. Some suggested actions include:

- Routine maintenance, such as drainage channel cleaning, early crack closure, and road shoulder maintenance so that water does not seep into the pavement layer.
- Installation of signs and other road equipment to control vehicle speed, especially on segments with narrow road geometry or sharp curves.
- Vehicle load regulation, for example by limiting tonnage so that overload does not occur which accelerates cracking and deformation.

2. Current diversion during the construction maintenance period.

3. Improved Drainage

Most of the damage such as crocodile cracks, elongated cracks, and holes are greatly affected by the ingress of water into the pavement layer. Therefore, the repair and maintenance of drainage systems is an important aspect, especially in segments that are often flooded or located in concave topography.

4. Periodic Monitoring and Data Collection

To avoid damage that is not detected early, it is necessary to:

- Periodic inspections by relevant agencies use a road condition assessment form according to Highway standards.
- The use of GIS or drone technology for visual mapping and recording of the progress of road damage more accurately and efficiently.

With a combination of preventive measures in the segment that is still good and immediate action on the heavily damaged section, it is hoped that the road service life can be extended, and the maintenance budget can be used more effectively. These recommendations are important to consider in planning routine, periodic and total rehabilitation maintenance activities.

Conclusion

Based on the results of the research, it was found that the types of damage on Jalan Parit 5 Tembilahan Hulu, Indragiri Hilir Regency were sinks, holes, grain releases, random cracks, crocodile cracks, elongated cracks and patches scattered on the road sections observed at STA 0+000 to 0+800. The results were obtained with an average damage rate of 2.04 and an average road condition value of 2.40. Based on the calculations, the priority order value in this study was 10.5. By referring to the actions taken based on the results of the priority order value, namely a routine maintenance program. Efforts to counter and prevent road damage can be carried out by diverting the flow during the construction maintenance period and limiting tonnage loading.

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