Analysis of Damage Level of Flexible Pavement on the May Zen Road Section, Kalidoni District, Palembang

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Abstract. The road served as a ground transportation infrastructure to connect one place to another in order to facilitate economic, social, and cultural activities. Good road conditions make it easier for the population to move around for economic and social interactions. However, road damage not only hinders economic and social activities but can also have fatal consequences for the residents, such as accidents for road users. Therefore, roads need periodic evaluation to ensure their service level is maintained. The May Zen road section in the Kalidoni District of Palembang is categorized as a heavily trafficked road. A study was conducted on this road section using the Pavement Condition Index (PCI) method to assess the types and levels of damage found in the field. The observed types and levels of damage include Alligator Cracking at 0.101%, Edge Cracking at 0.128%, Longitudinal & Transverse Cracking at 0.307%, Potholes at 0.171%, and Raveling at 0.264%. The average PCI value for the May Zen road from STA 0+000 to 2+200 is 49.8, categorized as moderate (fair). A moderate category implies that the road condition on the May Zen section only requires structural improvement.

Keywords: Road Damage, Determination of Corrected Deduct Value (DCV), PCI (Pavement Condition Index).

1 Introduction

Concrete Roads are essential infrastructure in land transportation systems, crucial for connecting one place to another to facilitate economic, social, and cultural needs. Well-maintained roads enhance the mobility of the population in economic and other social activities. However, if roads are damaged, it not only hinders economic and social activities but can also pose serious risks to the population, leading to accidents for road users. Therefore, roads need to be periodically evaluated to ensure their service level is well-maintained. Road infrastructure is closely related to traffic volume. High and repetitive traffic volume can result in a decrease in the quality of road pavement. The deterioration of road pavement quality is marked by damage to the road layers , both

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structurally and functionally. If road damage is left unattended for a long time, it can worsen the condition of the road pavement layers, affecting safety, comfort, and smooth traffic flow. Thus, handling and maintenance on the road are necessary.

The May Zen Road in the Kalidoni District of Palembang, South Sumatra, is categorized as a heavily trafficked road. This is because the road serves as a main thoroughfare leading to the city of Palembang in South Sumatra. It has become one of the frequently traversed routes by various types of land transportation, ranging from light vehicles to heavy-duty ones. With the increasing traffic volume on this road over the years, it has resulted in a diminished capacity of the road to bear the load placed upon it. This is evident in various damages such as cracks, undulations, and ripples on the road. In order to ensure that this road segment provides a high-quality service that is smooth, safe, comfortable, and efficient, efforts are needed to address and repair the existing road damages.

With the increasing quantity of transportation for the community, it is necessary to implement a road handling and maintenance program to ensure a good role for the road network. In accordance with available data references, the author conducted research using the Pavement Condition Index (PCI) method with the title "Analysis of Level Damage of Flexible Pavement Roads on the May Zen Road Section in the Kalidoni District, South Sumatra, STA 0+000 – 2+200.

1.1. Literature Review

The previous research serves as one of the fundamental references for conducting research and can be a new source of inspiration for further studies. Previous research is valuable for expanding and deepening the theories and methods to be applied in conducting research. The final results of previous research can be used for comparison, allowing the identification of strengths and weaknesses that can be further developed

The research findings of Aulia Dewi Fatikasari (2021). From the results of the study, it was found that the Pavement Condition Index (PCI) of Cangkring Road was 18,4, indicating that there's a failure in the pavement condition. The applicable repair for handling this matter is by road reconstruction [2].

The research findings of Aleksander Suksestri Gemo (2019), with an average PCI value of 42.89 after being input into the parameters, indicate that the road condition is quite good. Therefore, it is recommended to include this road in a periodic maintenance program [1].

The research results of Giyatno from Muhammadiyah University Surakarta (2016) indicate that the regression analysis between the PCI values and the budget for road sections yielded a determination coefficient of 0.64 and a correlation coefficient of -0.80. This suggests a moderate relationship, and the form of the relationship is linear and negative [3].

1.2. The Type of Road Pavement

The road pavement serves to protect the subgrade and pavement-forming layers from experiencing excessive stress and strain due to traffic loads. The choice of road pavement type is related to the available construction funds, maintenance costs, and construction speed to minimize disruption to traffic during project implementation. Road pavements can be classified into three types: Flexible pavement, Rigid pavement, and Composite pavement.

1.3. Pavement Description Method

Damage to the pavement is generally undesirable as it affects the quality of vehicle comfort, structural support, and appearance. To describe the damage, a method is needed to assess the quantity of each type of damage and provide uniform nomenclature. Therefore, a catalog of common types of damage occurring in a specific pavement type is required. With this catalog, individuals can recognize types of damage and simultaneously understand the causes of the damage.

1.4. Identification of Pavement Damage Types

The names of pavement damages will describe the appearance of the damage. Damages may not necessarily correspond to any predefined type. Therefore, the recorded types of damage can be simplified into a combined damage system; for example, one damaged area may be a combination of cracks, ruts, and depressions. Naming pavement damages aims to facilitate reference. For example: groove with alligator cracking, groove with longitudinal cracking, and etc.

1.5. Types and Causes of Road Damage

The types of road damage that can be identified include rutting, alligator cracking, block cracking, humps and sags, corrugation, depression, edge cracking, joint reflection cracking, lane/shoulder drop, longitudinal and transverse cracking, patches, aggregate abrasion, potholes, rutting, slippage cracking, expansion, aggregate loss, and weathering.

To ascertain the causes of damage with certainty, a more in-depth investigation is needed beyond visual assessment, such as creating test holes, physical tests, and so on. Simple forms of damage are generally easier to identify in terms of their causes. Damage to road pavement construction can be classified as: traffic (such as increased traffic and repetitive loads), water (such as rainfall, poor drainage systems, and water rise due to capillarity) and pavement construction materials (in this case, can be caused by the inherent characteristics of the materials or may also be due to inadequate management systems).

1.6. Maintenance of Flexible Pavement

Various types of maintenance for repairing asphalt pavement damage include works such as crack sealing, surface maintenance, and the addition of surface and additional layers /overlay.

2 Methodology

2.1 The Scope of Research

The area chosen as the research location was one section of the road that had experienced various damages, namely May Zen Road in the Kalidoni District, South Sumatra, from STA 0+000 to 2+200.

2.2 Data Collection

The data collection method was conducted by dividing the data into primary and secondary data. Primary data was obtained through field testing, specifically the Pavement Condition Index (PCI) road damage form, visual documentation, road length, and damage dimensions. Secondary data was obtained from the Public Works Agency, Transportation Agency, and relevant agencies in Palembang City, which were used as supporting data for the primary data, including location maps and traffic data (LHR).

2.3 Data Analysis

The method used to analyze road damage calculations was the PCI (Pavement Condition Index) method, which involved observing points of road damage and recording them in an observation data form. The data were then processed to obtain road damage values.

3 Result and Discussion

3.1 Determination of Samples

Based on Road Length = 2.2 km = 2200 m Road Width = 15.00 m = 7.50 m (per lane). The total sample units are 2200/100 (STA) = 22 units x 2 lanes = 44 (samples for the left and right lanes). Sample Unit Area = 7.50 m x 100 (STA) = 750 square meters (area per segment box). The number of samples to be surveyed is based on the guidelines of the Ministry of Public Works and Public Housing regarding the Pavement Condition Index [3], equal to $n = \frac{Nd^2}{\frac{e^2}{4}(N-1)+d^2} = \frac{44(10^2)}{\frac{5^2}{4}(44-1)+10^2} = 11{,}9 \approx 12$ samples, with distance intervals, equal to $I = N/n = 44/12 = 3{,}6 \approx 4$.

3.2 Road Damage Level Analysis

Entering Area of Damage Values. The results of the road damage condition survey, in terms of length and area of road damage, were recorded on the survey form.

Calculating Deduct Value. From the survey data, the Deduct Value was obtained as follows:

Deduct Value in Section 16 (STA0+000 – 2+200). The following were the results of the analysis of deduct values, Edge Cracks (Moderate) = 1.16 m², Potholes (Low) = 4.54 m², Potholes (High) = 15.03 m², Longitudinal & Transverse Cracks (Low) = 4.06 m², Longitudinal & Transverse Cracks (High) = 7.34 m², Alligator Cracks (High) = 9.18 m², Aggregate Spalling/Release (High) = 23.81 m²

Calculating density (%). To calculate the density value, you measure the area or length of road damage and divide it by the road pavement area. Then, multiply the result by 100 percent. Here were the density values of the damages at STA 0+000 to 2+200 with a road width of 7.50 m and a length of 100 m. The following were the results of the density value calculation, Edge Cracks (Moderate) = 1.54%, Potholes (Low) = 0.60%, Potholes (High) = 2.00%, Longitudinal & Transverse Cracks (Low) = 0.54%, Longitudinal & Transverse Cracks (High) = 0.97%, Alligator Cracks (High) = 1.22%, Aggregate Spalling/Release (High) = 3.17%

Finding Deduct Value (DV). Finding Deduct Value could be done using a graph of types of damages [5].

Calculating Total Deduct Value. The Total Deduct Value (TDV) was obtained by adding up all individual deduction values.

Finding the Value of q. The value of q was the sum of Deduct Values (DV) that exceeded 2 (for roads with asphalt surface and parking areas).

Calculating Corrected Deduct Value (CDV). To obtain the value of CDV, the TDV was entered into the correction value on the CDV graph by drawing a vertical line at the CDV value until it intersected the q line, then drawing a horizontal line.

Calculating Pavement Condition Index Value. The PCI value could be calculated by subtracting the maximum CDV from 100. From the test results and PCI calculations, the determination of the appropriate handling alternative was made through the indicator of the PCI value, as follows:

Table 1. Utilizing PCI Values to Determine Treatment Types

No	Stationing	Section	PCI Value	Rating	Treatment Types
1	0+100 - 0+200	43	28	Poor	Reconstruction/recycling
2	0+300 - 0+400	20	31	Poor	Reconstruction/recycling
3	0+600 - 0+700	39	9	Failed	Reconstruction/recycling
4	0+700 - 0+800	16	66	Good	Structural Improvements
5	0+900 - 1+000	35	72	very good	Periodic Maintenance
6	1+100 - 1+000	12	79	very good	Periodic Maintenance
7	1+200 - 1+300	32	88	Excellent	Routine Maintenance
8	1+400 - 1+500	8	48	Fair	Reconstruction/recycling

9	1+400 - 1+600	29	48	Fair	Reconstruction/recycling
10	1+900 - 1+800	4	11	Very poor	Reconstruction/recycling
11	1+900 - 1+800	26	36	Poor	Reconstruction/recycling
12	2+200 - 2+100	23	82	very good	Periodic Maintenance

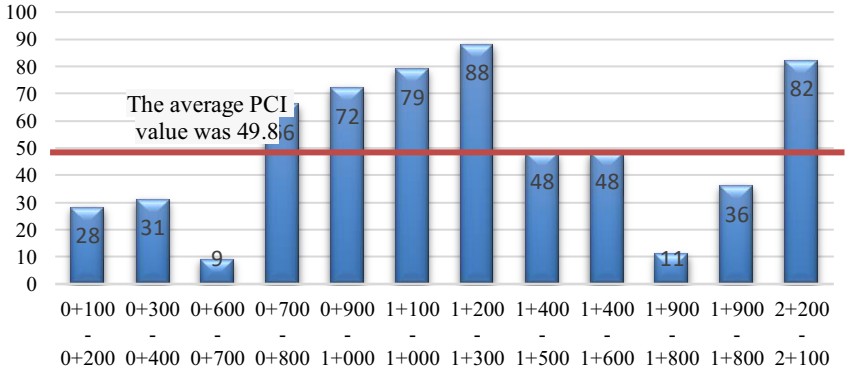

Fig. 1. The Average PCI (Pavement Condition Index) value

After determining the type of treatment for each road damage level based on the PCI value, it was found that 6 sections needed Reconstruction/Recycling, 1 section required Routine Maintenance, 1 section needed structural maintenance, and 3 sections needed periodic maintenance. The average PCI value for the May Zen road from STA 0+000 to 2+200 is 49.8, categorized as moderate (fair).

4 Conclusion

Based on the research conducted in the field, as well as the analysis and discussion of the research results, several conclusions can be drawn as follows: The types and levels of damage found in the field are Alligator Cracks 0.101%, Edge Cracks 0.128%, Longitudinal & Transverse Cracks 0.307%, Potholes 0.171%, and Aggregate Spalling/Release 0.264%. The average PCI value for the May Zen road from STA 0+000 to 2+200 is 49.8, categorized as moderate (fair). A moderate category implies that the road condition on the May Zen section only requires structural improvement.

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