

Application of Pavement Condition Index (PCI) on the Assessment of the Kalumata Highway of the City of South Ternate

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Abstract. In general, roads are built as infrastructure to facilitate mobility and accessibility of socio-economic activities in society. The existence of the highway is very necessary to support the growth rate of the economy, agriculture and other sectors. Considering the benefits that are so important, therefore, matters related to the development and maintenance of roads are a priority to be researched and developed in planning, implementing and maintaining them. One of the research targets is the one km Kalumata highway in the city of South Ternate which suffered significant damage, both minor damage, moderate damage and severe damage to some of these roads. The purpose of this study was to determine the type and extent of damage to the road surface, and provide measures to repair road damage based on the level and type of damage that occurred. The application of the PCI is carried out by visual survey stages at the research location, determining the type and level of damage and measuring the damage dimensions which include length, width and depth, calculating the area of damage, analyzing the damage condition. Based on the results of the analysis, the surface of the Kalumata- road in Ternate is classified as a severity level with a PCI value of 0.00. an alternative improvement that is appropriate is routine.

Keywords: Road Section, Level of Damage, Pavement Conditions Index Method.

1. Introduction

Lately in the city of South Ternate, we often see many vehicles passing by on the highway. The number of these vehicles sometimes makes the road become more crowded from day to day. The trigger of road density in addition to the number of vehicles is due to driving knowledge and damaged road conditions. In general, road damage such as cracking, corrugation, and damage to grooves extending along the road around the vehicle wheel rutting are also in the form of asphalt pavements on the bleeding surface, and there are also holes (pothole). This damage can occur on the road surface using asphalt concrete as the surface layer. Road damage like this is usually caused by a variety of factors, for example, due to heavy vehicle wheel loads (repeated), high groundwater conditions, the consequences of wrong execution time, and also due to planning errors. [1,2]

The history of the development of the highway along with the level of importance of the movement of people, goods from one place to another as well as the findings of its building materials and material technology related to the highway (including road pavement).

Road pavement is a pavement layer that is located between layers of subgrade and wheel of the vehicle that serves to provide services to the means of transportation where it is expected that during the service period there will be no significant damage. Therefore it is our duty to know from the cause of the damage and how to maintain the road. In order to create a safe and comfortable way and provide significant benefits for the sustainability and survival of the wider community and become one of the factors making it an improvement in people's lives from several aspects of life. [3,4].

Theoretical and empirical studies show that all road users certainly want the road used is safe, comfortable, clean etc. Therefore the damage that occurs on the road must be addressed and repaired seriously.

The Kalumata section road is far from the ideal word, the number of holes and waves on the road, or the former excavation project makes the road not conducive anymore. (a lot of damage to the body of the road). For that research is needed on the types of damage, grouping the types of damage that occurred on the pavement on the road, so that it can be known what should be done to overcome the damage problems that occur in the road as a matter of concern for the surrounding environment, especially the road, so that things don't happen that we don't want, such as accidents that can take lives.

The method used in this study is the pavement condition index to provide input to the road organizer about appropriate handling strategies to be implemented on the road.

2. Literatur review

2.1. Definition of Road

Roads are land transportation which includes all parts of the road, including complementary buildings and equipment that are destined for traffic, which is at ground level, above ground level, below ground level and / or water, and above the water surface, except railroad fire, lorry roads and cable roads [5].

According to Law No. 38 of 2004 concerning roads, in accordance with their designation, the road is distinguished by special roads and public roads, both of which are the lifeblood of people's lives in an effort to develop national and state life [6].

2.2. Pavement Condition Index (PCI)

Pavement condition index (PCI) is a system for assessing road pavement conditions by type, the level of damage that occurs and can be used as a reference in the maintenance business [7,8,13, 15]. The PCI method provides information on pavement conditions only at the time of the survey, but cannot provide a predictive picture in the future. However, by periodically conducting condition surveys, information on pavement conditions can be useful for predicting future performance, as well as being able to be used as a more detailed measurement input [9].

2.3. Severity Level

The severity level is severity level to each type severity leve. The severity level used in calculating PCI is low severity level (L), medium severity level (M) and high severity level (H) [9,16,18].

2.4. Terms in PCI Count [10, 15]

2.4.1. Density

Density is the percentage of the total area or length of one type severity to the area or total length of the part of the road measured. The equation for calculating density values is as follows:

Density = Distress amount in m² / sample unit area in m² x 100.

2.4.2. Deduct Value (DV)

The deduct values are determined from the deduct value curves for each distress type and severity.

2.4.3. Total Deduct Value (TDV)

A total deduct value (TDV) is computed by summing all individual deduct values.

2.4.4. Corrected Deduct Value (CDV)

The corrected deduct value (CDV) can be determined from the correction curves. When determining the CDV, if any individual deduct value is higher than the CDV, the CDV is set equal to the highest individual deduct value. Figure 1 shows corrected deduct values for flexible pavements.

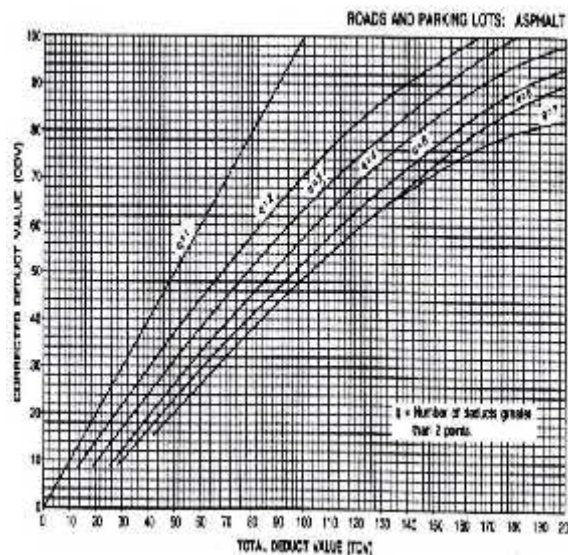


Figure 1. corrected deduct values for flexible pavements, source Shahin 1994 [11]

2.4.5. Value PCI

After the deduction value is corrected, the Pavement Condition Index value for each sample unit is calculated using Equations 2 and 3 as follows:

$$PCI(s) = 100 - CDV \tag{2}$$

Where:

PCI(s) = Pavement Condition Index of pavement section;

CDV = Corrected Deduct Value of pavement section.

For PCI values as a whole on certain road segments shown by the following equation:

$$PCI = PCI(s) / N \tag{3}$$

Where:

PCI = overall pavement PCI value.

PCI(s) = Pavement Condition Index of pavement section

N = Number of units

PCI values obtained are used to assess pavement conditions. the value of the pavement conditions suggested by [11,17] is shown in the table below.

Table 1. Value PCI and Rating

Nilai PCI	Rating	Treatments
0 – 10	<i>(failed)</i>	Reconstruction
11 – 25	<i>(very poor)</i>	Reconstruction
26 – 40	<i>(poor)</i>	
41 – 55	<i>(fair)</i>	Periodic
56 – 70	<i>(good)</i>	Routine
71 – 85	<i>(very good)</i>	Routine
86 – 100	<i>(excellent)</i>	Routine

2.5. Flexible Pavement Distresses

The district road maintenance guide series on flexible pavement maintenance techniques explains the types of flexible pavement distesses, generally can be classified as follows [13,19,20]:

- Deformation/distorsion: rutting, corrugation, shoving, depression and upheavel
- Cracking: longitudinal, transverse, diagonal, reflective, block, alligator crack, crescen/slipage cracks.
- Surface defect: ravelling, bleeding, polishing, peeling and stripping
- Potholes, patches, crossing of railroad tracks.
- Edge defect: edge break and edge drop.

3. Research Methods

3.1. Description study area

The research area was carried out on the Kalumata City section of South Ternate.

3.2. Data Processing

Data processing can be done anywhere for sure to identify the type of damage and its range based on the level of damage obtained from the road condition survey. Likewise the stage is always the same everywhere. The steps for conducting condition surveys and determining PCI ratings are carried out according to the literature [14]:

- Inspect sample unit, determine distress type and severity level and then measure the densit;
- The deduct values are determined from the deduct value curves for each distress type and severity.;
- A total deduct value (TDV) is computed by summing all individual deduct values.;
- Once the TDV is computed, the corrected deduct value (CDV) can be determined from the correction curves. When determining the CDV, if any individual deduct value is higher than the CDV, the CDV is set equal to the highest individual deduct value;
- The PCI is computed using the relation $PCI = 100 - CDV$.

4. Results and Discussion

The results and discussion describe the results of the research. The results and discussion are divided into:

4.1. Identification of Damage Types

The type of damage that occurs on the Kalumata road segment is dominated by crack type damage. The following is explained by the extent and percentage of damage according to the level and type of damage that occurs.

Joint reflection cracking was 0,002 % of the total damage that occurred with an area of 9,758 m², the subsequent damage to the edge crack was 0.001% of the total damage that occurred with an area of 2,890 m². Next the potholes was 0,001 % of the total damage, which is 2,690 m². Furthermore, alligator cracking was 0,002 % of the total damage, with an area of 11,51 m². Next shrinkage cracks expands by 0.001 % from the total damage, which is 4,200 m². Finally the damage to the depression is 0.001 % of the total damage, which is with an area of 6,659 m²

4.2. Density

The density value is obtained by dividing the total area of damage for each level of damage with the area of the sample unit.

The value of Joint reflection cracking density is 0,003 %, edge crack is 0.002 %, potholes is 0,002 %, alligator cracking is 0,004 %, shrinkage cracks is 0.001%, depression is 0.001% .

4.3. Deduct Value

The deduction value is obtained by adjusting the density value obtained into each damage graph according to the level of damage.

Type Joint reflection cracking density 0,003 % with damage all level is 0, edge crack density 0.002 % with damage all level is 0. For potholes density 0,002 % with damage all level is 0. For alligator cracking 0,004 % with damage all level is 0. For shrinkage cracks density 0.001% with damage all level is 0. Depression is density 0.001% with damage all level is 0..

4.4. Total Deduct Value

The total reduction value is the sum of all deduction values that have been obtained, which in this study is 0.

4.5. Corrected Deduct Value

With the number $q = 3$ and then plotted into the graph the corrected deduction value is obtained value 96.

4.6. Value Pavement Condition Index

Recapitulation of PCI values on the Kalumata road segment is $(100 - 0,00) / 1$ ie 0,00

4.7. Type of Handling

Based on the PCI value obtained, it can be stated that the assessment of excellent pavement requires routine.

5. Conclusion

The distresses that occurs on the Kalumata road segment is the Joint reflection cracking, edge crack, potholes, alligator cracking, shrinkage cracks, and depression Evaluation on the Kalumata road segment results in a PCI value of 100 with excellent conditions. The type of handling needed on the Kalumata road is routine.

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