

Rigid Pavement Condition Assessment With Bina Marga Method and Pavement Condition Index (PCI) Method in Dumai - Duri City at STA 173+000 - 177+000

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Abstract

Appraisal the condition of the road on pavement surface is one step in the determination of maintenance management program to a road segments that need to be handled. This study pupose is to determine the road condition on the road section Dumai City - Duri precisely at STA 173 + 000-177 + 000 and also to determine the type of precise handling program in maintenance. Based on the results of the analysis, the greatest damage type, either use Bina Marga Method and PCI Method is type of slippery aggregate damage. But for the smallest percentage of damage, there is a difference between Bina Marga Method and PCI Method. This is due to a difference in the election unit examined samples. In the Bina Marga Method the smallest damage percentage is type of popouts damage while in PCI method obtained the smallest percentage value of the damage isa type of fracture damage on plate. Results of assesment rigid pavement road surface conditions at STA 173 + 000-177 + 000 in Dumai City Limits road - Duri by Bina Marga Methodobtained damage limitation percentage on 2.40% to the size of the surface layer of pavement surveyed road conditions were rated as " good (B) "the obtained result of determination program, namely road handling routine maintenance. While the results of the condition assessment of PCI method, PCI value obtained with a value on 65.25 road conditions as "Good " and the determination program of road maintenance is regular maintenance. It can be concluded that the results of assessment of the condition of Dumai City Limits road - Duri City at STA 173 + 000-177 + 000 using either a Bina Marga Methods and Pavement Condition Index (PCI) Methods in determining the assessment of road conditions and determining the program road plan maintenance obtained the same results.

Keywords: Rigid Pavement, Condition Assessment , Bina Marga Methods, Pavement Condition Index (PCI), Surface Layer of Pavement

1. Introduction

Dumai City Limits road - Duri is one of access link two important cities, it's Dumai City and Duri City (Bengkalis regency). Dumai as an international port city in the Riau and one of the Duri oil field in Riau province [1-5]. Thus the presence of heavy vehicles for export-import very much at all. Roads Limit Dumai - Duri

function as an arterial road and is a national road [6].

From these circumstances, it is necessary to assessing the conditions of the road surface, especially at kilometer 173 until kilometer 177 because at that point the damage can be seen visually [7]. In addition to damage to the surface very much and characteristics of damage at that point is also very varied, to allow when the

determination is done at that point would facilitate the maintenance management program will determine the results of the assessment of the obtained maintenance as to what would be applied on the surface of the roadway, routine maintenance, periodic, rehabilitation or improvement of the structure [8].

This study aims to:

- 1) Knowing the types of damage that occur on the surface of the rigid pavement road roads Dumai City Limits - Duri especially at kilometer 173 + 000-177 + 00
- 2) Knowing the condition of roads in the category of STA 173 + 000-177 + 000 in Dumai City Limits road - Duri rigid pavement surfaces are based on the method of Highways and Method of PCI.
- 3) Knowing the road maintenance management program for rigid pavement road surface in Dumai City Limits road - Duri STA 173 + 000-177 + 000 according to the road condition assessment based on the method of Bina Marga and Pavement Condition Index Method (Pavement Condition Index, PCI).

2. Material and Methods

A. Research Design

In conducting the assessment penelitian road conditions, all parts of the pavement surface surveyed need to be assessed in detail by collecting all the information needed.

B. Location and Time Research

The location (Figure 1) and time of the study can be described as follows:

- 1) On the road Dumai City Limits road - Duri precisely at STA 173 + 000 is the starting point of the survey area and STA 177 + 000 as the end point of the survey area.
- 2) The length of the surveyed locations along the 4 km that has only one lane and two-lane divided road with a width of 7 m.
- 3) Collection of field data is planned to be conducted approximately 1 week.

C. Data Collection

Data were obtained by observation and examination directly on field by visually, survey was conducted on roads Limit Dumai - Duri city along 4 km which is divided into several units of samples in one sample unit to the concrete slab

of the rigid pavement is about 20 plates are based form conditions survey used in Bina Marga and PCI method. Fill out a form condition survey includes :

- a. Specifies the types of damage on rigid pavement.
- b. Identification of damage, these observations purpose to differentiate between the types of damage on specifically
- c. Determine the level of damage, fill out the form according to severity level of the damage like severity of damage level "low" (L), severity level of damage "medium" (M) and severity level of "High" (H) and also extensive damage of surface.



Figure 1. Map Location Research

D. Method of Calculation

Deduct Value is a value of deduction for any kind of damage that obtained from the curve density (density) and severity (severity level) defect.

Density is the percentage of area or total length for one type of damage to area or total length of road sections is measured, can be in sq.ft or m², or in feet or meters. There Fore, the density of the sample unit damage with concrete pavement can be expressed by the equation [9-13]:

$$\text{density (\%)} = \frac{A_d}{A_s} \times 100 \text{ or } \frac{L_d}{A_s} \times 100 \quad (1)$$

Witch is,

A_d = The number of combinations of damage type and the severity level of the same damage that occurs on the plate.

A_s = The total number of plates in one sample unit

L_d = The total length of the type of damage for each of severity level of the damage.

Total Deduct Value, (TDV) is the sum total of the value deduction of each sample unit.

Corrected Deduct Value (CDV) was obtained from the curve of the relationship between Total Deduction Value (TDV) and Deduction Value

(DV) by selecting the appropriate curve. If the value *CDV* obtained is less than *Highest Deduct Value* (HDV), then the *CDV* that used is the highest value individual deduction.

PCI Values, after *CDV* obtained, then *PCI* for each unit calculated by using the equation [10]:

$$PCI_s = 100 - CDV \tag{2}$$

With the $PCI_s = PCI$ for each sample unit or research units, and *CDV* is *CDV* from each sample unit.

PCI_f value pavement overall on the road for rigid pavement is [11]:

$$PCI_f = \frac{\text{Total value of } PCI_s}{N} \tag{3}$$

Witch is,

PCI_f = Value *PCI* average of the entire area of research

PCI_s = Value *PCI* for each unit of sample

N = Number of sample units

PCI_f value obtained will be used for the assessment of the pavement condition. Distribution pavement value that suggested by FAA (1982) and Shahin (1994), shown in Table 1. For example, obtained $PCI_f = 60$, then the value of pavement condition is "good" [11].

Table 1. PCI and road condition value (FAA, 1982, [11])

PCI Value	Condition
0-10	Failed
11-25	very poor
26-40	poor
41-55	fair
56-70	good
71-85	very good
86-100	excellent

Source: Maintenance of the highway [9]

Unit sample

Unit sample is part or section from a pavement is defined only for the assessment purposes. The way of Distribution Unit sample according to Shahin (1994), for highway pavement from concrete (rigid pavement) and for the airport with a connection plate is $\leq 7,62$ m (25 ft), the size of sample unit recommended is 20 ± 8 slab of concrete [9].

Assessment of surveyed Unit Sample according to Shahin [11] degree of required sampling depends on the level of utilizing of the survey whether the survey conducted on the network level or on th project level. Project-level

data management requires of accurate data for preparation project planning and contract. Therefore, compare with network-level management, there is more sample unit required on the project level [10].

Table 2. Sample for criteria collected sample units on network level from several institutions department [11].

The number of sample units in the section (N)	Number of units examined (n)
1-5	1
6-10	2
11-15	3
16-	4
40>40	10% (rounded up to the next whole sample unit)

Source: Maintenance of the highway [9]

Based on Table 2, described example of taking a sample unit for the number of sample units in the section (N) more than > 40 (n) then multiplied by 10% for the number of sample units to be examined (n). At STA 173 + 000-177 + 000, is the road condition on study in Limits road Dumai - Duri city have result number N is 80, the result from divide length road on studied (4000 meters) with a length of one sample unit it is 50 meters. So for a number of units examined (n) is $80 \times 10\%$ so, $n = 8$ units samples examined. To choose 8 units of samples examined from 80 samples of existing units, Shahin [11] suggessted to used two ways in choosing the samples examined unit, it is one of them choosing by randomly (*random start*). On the highways and parking lots, generally it's very difficult to obtain a high degree sample, except on project-level evaluation has been conducted. To the degree of the sample 10% until 25% as shown in Table 3, usually is sufficient for the network level [9] [11].

3. Results And Discussion

A. Data Analysis

On May 16 to June 20, 2016 or during the 4 day survey of pavement surface condition Dumai City limits road - Duri STA 173 + 000-177 + 000 that begins at 7:30 Am and finished at 5:30 Pm visual survey of the condition on the surface of the rigid pavement made for 4000 meters and a width of 7 meters meaningful way the surveyed area is 28000 m². Types surveyed pavement cement concrete continued without reinforcement with concrete slab dimensions of the unit has a length of 5 meters and a width of 3.5 meters.

B. Analysis Bina Marga Method

From damage data obtained by the kind of damage that occurred in the streets Bts. Kota Dumai - Duri are cracks crosswise, crack length, crack angle, aggregate slippery, scaling, warping crack, cracked diagonal, cracks winding, fillings large, spalling, Outskirts down (lane), seal the joint, popouts, pumping and pothole. It can be seen in Table 4 Recapitulation data destruction and data percentage of total damage according to the method of Bina Marga.

Table 3. Percentage of total road damage against damage to limit roads Dumai City Limits road - Duri Analysis Bina Marga Method

No	Damage Type	Damage Size (m2)	Percentage of Damage (%)
1	Transverse Cracks	63.1 6	9.38
2	CracksAft	70.0 0	10.39
3	CracksAngle	22.7 2	3.47
4	Aggrerat Slick	200. 75	29.81
5	Hair Crack	9.95	1.48
6	Fracture	17.5 0	2.60
7	Cracked Diagonal	12.9 5	1.92
8	Cracks winding	1.37	0.20
9	Large fillings	93.8 0	13 , 93
10	angle chipped	2.77	0.41
11	chipped Connection	5.80	0.86
11	Joint Seal	57.7 8	8.58
12	Lane	111. 700	16.59
13	Popouts	0,04	0,01
14	Pumping	2,73	0, 41
15	Hole	0.40	0.06
	Size Total Damage	673. 41	100.00

Source: Analysis of Data

From Table 3 above obtained total damage is 673,41m² while the surface area of the pavement being simulated is 28000 m² (4000 × 7 m) can be obtained percentage limit damage to the STA 173 + 000-177 + 000 in Dumai City limits road - Duri is 2.40%. For more details, the percentage of damage limitation is obtained by means of the

following:

$$\begin{aligned} \text{Size Total damage:} \\ &= 673.41 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{Spacious surface surveyed:} \\ &= 28000 \text{ m}^2 (4000 \times 7 \text{ m}) \end{aligned}$$

$$\begin{aligned} \text{Total number of damage:} \\ &= \frac{\text{Total SizeDamage}}{\text{The surface area surveyed}} \times 100\% \\ &= \frac{673,41 \text{ m}^2}{28000 \text{ m}^2} \times 100\% = 2.40\% \text{ "good" (B)} \end{aligned}$$

Referring to Table 1 on the determination of the road maintenance management program asphalt / cement concrete obtained by percentage limit damage on section STA 173 + 000 -177 + 000 s Dumai City Limits road - Duri is 2.40% of the surface area surveyed pavement layer of the obtained condition "B" (Good) and the treatment is routine maintenance program.

C. Data Analysis Pavement Condition Index (PCI) Methods

PCI Calculation

For the entire sample calculation unit has obtained the maximum CDV value with steps are and how that has been described in the journal entry no. 2 The literature review (Section Count PCI sample unit for rigid pavement) can be seen in the example of Table 3 (unit sample 1 STA 173 + 000) and the results of calculation of number of total units of the sample (8 units of samples) have been combined in the calculation of the total PCI value and yield an average value of PCI (PCI_f) can be seen in Table 4 below:

Table 4. Average Count PCI for continuous rigid pavement (the number of sample units: 8) (FAA, 1982)

No.Unit sample	Number plates	Plates Size (m)	PCI
1	20	5 × 3,5	62.00
2	20	5 × 3,5	63.64
3	20	5 × 3,5	71.00
4	20	5 × 3,5	68.00
5	20	5 × 3,5	69.90
6	20	5 × 3,5	64.00
7	20	5 × 3,5	63.50
8	20	5 × 3,5	60.00
Total Value PCI			522.04
Average Value(PCI _f) = (Total value of PCI/ 8)			65.25
Value Condition: Good (Table 3)			

Source: Data Analysis

Type of damage that existed at the STA STA 173 + 000 to 177 + 000 in Dumai City Limits road - Duri among others aggregate damage slick, linear cracks (crack lengthwise, crosswise, diagonal and winding), the edge of the falls, fractures, damage to the charger connection, corner cracks, hairline cracks, chipped

connection, chipped corners, and large patches. Where of all the damage The damage to percentage according to of Bina Marga Method and PCI Method is a slippery aggregate damage for more details can be seen in Figures 2 and Figure 3 below:

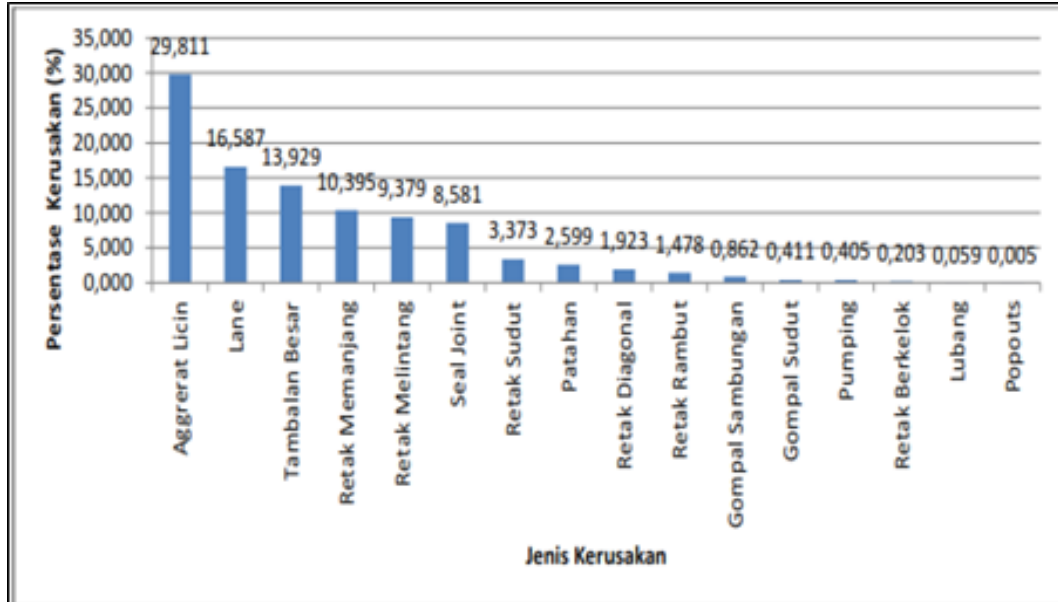


Figure 2. Diagram of the percentage of damage on the surface of the rigid pavement STA 173 + 000-177 + 000 in Dumai City Limits road - Duri on Highways assessment methods.

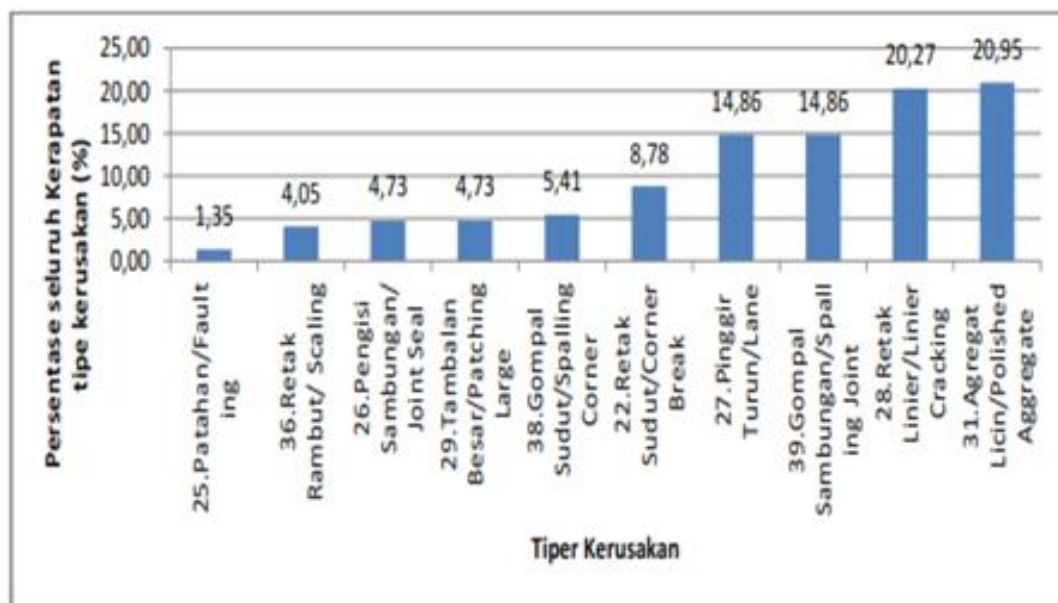


Figure 3. Diagram percentage density (density) age to the entire unit samples on rigid pavement surface STA 173 + 000-177 + 000 in Dumai City Limits road - Duri on assessment methods PCI

4. Conclusions

Based on the analysis of data and discussion is done then there are several things can be concluded as follows:

1. For each type of damage to the area as well as percentage of total area kerusakanya against damage can be described among other things, a slippery aggregate damage caused

by 200.75 m² (29.81%), verges or shoulders down (lane) damage caused amounted to 111.70 m² (16.59%), patches of the damage amounted to 93.80 m² (13.93%), longitudinal cracks damage caused amounted to 70.00 m² (10.39%), transverse cracks damage done by 63.16 m² (9.38), filler connection (sealjoint) damage caused amounted to 57.78 m²

(8.58%), cracked corner of the damage amounted to 22.72 m² (3.47%), fracture damage occurred at 17.50 m² (2.60%), cracked digonal 12.95 m² (1.92%), hairline cracks damage caused amounted to 9.95 m² (1.48%), connection chipped damage occurred amounted to 5.80 m² (0.86%), chipped corner damage that occurred was 2.77 m² (0.41%), pumping 2.73 m² (0.41%), winding crack damage occurred 1.37 m² (0.20%), hole damage caused 0.40 m² (0.06%).

2. The assessment results Limit road conditions Dumai - Duri at STA 173 + 000 - 177 + 000 with the road surface rigid pavement (rigid pavement) using the method of Highways and PCI method (Pavement Condition Index). For the method of Highways road condition assessment results are "Good" (B) with a percentage of 2.40% limit damage to total destruction 673.41 m² divided by the surface layer of pavement surveyed is 28,000 m². For PCI method produces an average value of PCI (PCI_f) 65.2 of the total value of 8 units of samples obtained condition assessment results are "Good".
3. Determining the treatment plan for road maintenance based on the assessment of the condition of Dumai City Limits road - Duri at STA 173 + 000-177 + 000 with the road surface rigid pavement using the method of Highways and methods of PCI (Pavement Condition Index), both methods equally propose a program of routine maintenance road handling.

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