The Evaluation and Maintenance of the Flexible Pavement on the Sampan-Ketapang Highway Using the Pavement Condition Index (PCI) Method and the Bina Marga Method

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ABSTRACT

Sampang Regency is one of the cities located on the island of Madura which has natural resources potential supporting to their survival and the growth of tourism. One of the most visited places is Ketapang with those many tourist attractions. The road damage will cause the difficulty to access that place as it is the main road. Furthermore, it is often passed by the large vehicles carrying any kind of materials such as wood, tobacco, rice and others for sale. In order to prevent the continuous road damage thus it is required to do its repair handling. In this study, the Pavement Condition Index (PCI) method and the Bina Marga method are used to determine the type and grade of road damage. Therefore, a direct survey was carried out where the 5 km long road was divided into 50 segments. The results of the study found that there were 5 types of damage. For the average PCI value of 75.94 it goes into a routine maintenance and for the Bina Marga method the priority order (UP) gets a score of 11 that belongs to the routine maintenance. The repair methods used for a routine road maintenance are P2 repair (asphalt), P4 repair (crack filling), P5 repair (patching hole), and P6 repair (levelling). Meanwhile, the budgetary costs of those repairs spend around IDR 97.000.000 (ninety seven million rupiah).

INTRODUCTION

Sampang Regency is one of the cities located on the island of Madura which has natural resources potential supporting to their survival and the growth of tourism. One of the most visited places is Ketapang with those many tourist attractions. The road damage will cause the difficulty to access that place as it's the main road to get there from Sampang. Furthermore, it is often passed by the large vehicles carrying any kind of materials such as wood, tobacco, rice and others for sale.

That damage is caused by light or large vehicles crossing the road in Sampang Regency to Ketapang and vice versa. The road plays an important role when the volume of the vehicles are increasing day by day specifically those large vehicles with the heavy loads dominate the road load repeatedly thus its load resistance is decreased. The handling and prevention are required in the form of evaluation or repair of the road in order to prevent the continuous road damage.

This research will discuss about the evaluation and maintenance of flexible pavement on the Sampang-Ketapang Highway. The standard method used are the Pavement Condition Index (PCI) and the Bina Marga method of handling road damage referring to PUPR Ministerial Regulation No. 13 of 2013 and according to the book (Ministry of Public Works, Directorate General of Bina Marga, 2011), No. 001-02 / M / BM / 2011 regarding the standard of road repairs for routine maintenance [1].

LITERATURE REVIEW

A. Flexible Pavement

Flexible Pavement is a pavement that uses the asphalt binder as their material and characteristically flexible when it is hot. The pavement layer carries the load and distributes the traffic load to the subgrade as shown in Figure 1.

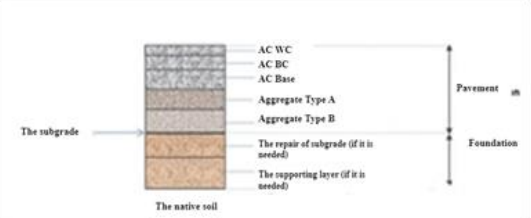

Figure 1. The Layering Order of the Flexible Pavement

B. Bina Marga Method

In the Bina Marga (BM) method, the type of road damage that should be considered during the visual

survey are surface hardness, holes, patches, cracks, furrows, and subsidence.

There are several stages to complete the calculation, including:

a. Calculating LHR Value
   The way of calculating the LHR value is by looking for the SMP value in order to detemine the traffic class
b. Calculating the parameters for each type of damage and conducting an assessment for each of them
c. Adding up each value for each type of damage, then determining the value of the road condition
d. The priority order is divided into several classifications as follows :
   1. The priority order of 0 – 3, indicating the road should be included in the improvement program
   2. The priority order of 4 – 6, indicating the road needs to be included in the periodic maintenance program
   3. The priority order more than 7, indicating the road is simply included in the routine maintenance program

C. Pavement Condition Index (PCI)

Pavement Condition Index (PCI) is one of the assessment systems for the condition of the road pavement according to the type and grade of damage that could occur as well as can be used as a reference for the maintenance efforts.

The assessment of the pavement condition is required to determine the value of Pavement Condition Index (PCI), including:

a. Density (Level of Damage)

$$Destity = \frac{Ad}{As}\ x\ 100\% \quad (1)$$

$$Destity = \frac{Ld}{As}\ x\ 100\% \quad (2)$$

Notes :

a) Ad: The total area of the type of damage for each grade of damage (m²).
b) Ld: The total length of the type of damage for each grade of damage (m).
c) As: The total area of the segment unit (m²).

b. Deduct Value
   The Deduct Value is the deduction value for each type of damage obtained from the curve of the relationship between the density and the deduct value. It is also distinguished by the grade of damage for each of them.
c. Total Deduct Value (TDV)
   The Total Deduct Value (TDV) is the total value of the individual deduct value for each type of damage and the grade of damage that exists in a research unit.
d. The Deduction Total of Maximum Permit (m)
   To determine the deduction total of maximum permit (m) can use the following formula:

$$mi = 1 + \frac{9}{98}\ x\ (100\text{-}HDVi) \quad (3)$$

Notes:

- mi : The deduction total of permit including the fractions and the sample units
- Hdvi : The highest value of individual deduction for the sample or the segment

e. The Q Value
   The Q value is obtained based on the total of deduct value data in one sample unit whose value is greater than 2 (for asphalt pavement).
f. *Corrected Deduct Value* (CDV)
   Corrected Deduct Value (CDV) is obtained from the curve of the relationship between the TDV and CDV with the recovery of the bending curve according to the sum of the individual deduct values that are greater than two (2).
g. The Classification of Pavement Quality
   If the CDV is known, then the PCI value for each unit can be determined by the following formula:

$$PCI_{(S)} = 100 - CDV \quad (4)$$

Notes :

- $PCI_{(S)}$: Pavement Condition Index for each unit
- CDV : *Corrected Deduct Value* for each unit

For overall PCI Value:

$$Destity = \frac{\Sigma PCI\ (S)}{N} \quad (5)$$

Notes:

a) PCI : The total of pavement PCI value
b) $PCI_{(S)}$: *Pavement condition index* for each unit
c) N : The total of unit

h. The Grade of Pavement Condition

Furthermore, the value of the calculations have been obtained, thus determining the condition of the road pavement which is divided into seven parts.

METODOLOGY

The methodology can be seen in Figure 2.

A. The Problem Identification

The problem that will be discussed in this study is the evaluation for the grade of damage of the road pavement on the Sampang-Ketapang highway, where the current condition has damage caused by several factors and can disturb the safety and the convenience of road users.

B. Literature Study

The literature study or namely the theoretical basis used to find out the analysis of the calculation data.

C. Data Collection

The primary data of the study as follows:

1. The survey of the existing road condition.
2. The Type of Damage

The secondary data is a data that is obtained from the existing sources of the related institutions or other relevant surveys. Thus are the secondary data of this study as follows:

1. The traffic data
2. The HSPK of Sampang Regency

D. Data Analysis

The collected data can be processed and analyzed, thus the calculation results are obtained according to the theory and applicable provisions. The assessments of

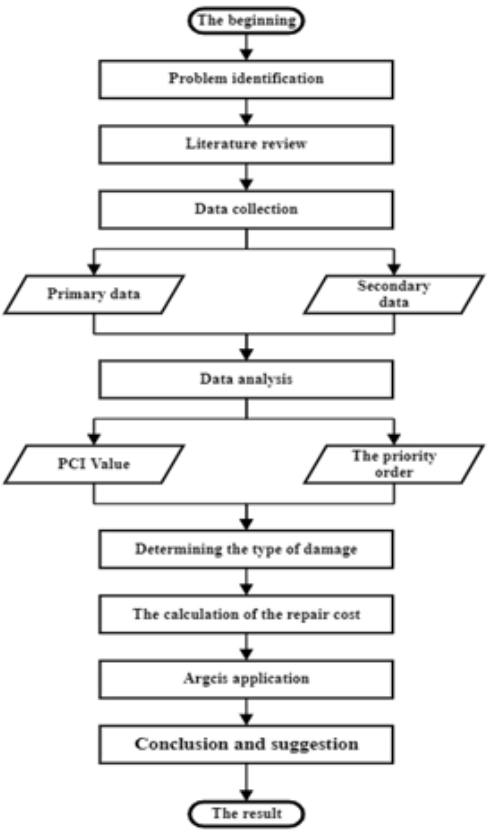

Figure 2. The Methodology of The Study

the road pavement conditions were obtained using the Pavement Condition Index (PCI) method and the Bina Marga method.

E. Determination of The Type of Repairs

The determination of the type of repair is according to the result of the grade of pavement conditions referring to (Goverment Regulation of PUPR No. 13/PRT/M/2011) that mention there are several ways of handling such as routine maintenance, periodic maintenance, and road improvement (reconstruction).

F. Calculation of Repair Cost

The repair cost can be calculated based on the result of the type of repair for each damage. It is useful for calculating in order to find out the volume of work and the price of work unit (HSP) including material, tool and labor.

G. Argcis Application

ArcGIS Desktop is a collection of software (suites), one of them is ArcMap. ArcMap is the most important software in ArcGIS Desktop because almost all stages of GIS such as input, analysis and output of spatial data can be done on ArcMap, as well as using other mapping software such as ArcView 3.x, QGIS, AutoCAD Land Desktop, and others. However, many GIS tasks cannot be performed using ArcMap, thus the users need to learn and use other ArcGIS Desktop software besides ArcMap.

NO.	Type of vehicle	Left	Right	Total
1	Motorcycle	1963	1966	3929
2	Light vehicle	606	625	1231
3	Heavy vehicle	328	342	670
4	Slow vehicle	87	106	193

NO.	Type of vehicle	Total	EMP	SMP
1	Motorcycle	3929	0,4	1571,6
2	Light vehicle	1231	1	1231
3	Heavy vehicle	670	1,3	871
4	Slow vehicle	193		0
			TOTAL	3671,6

Figure 3. The traffic Data of LHR on Sampang-Ketapang highway in 2021

DATA MANAGEMENT

A. General

The evaluation and maintenance of the flexible pavement on the Sampang-Ketapang Highway refers to the existing road conditions, where the data is obtained regarding to the direct survey results (primary data) as well as the data from the Public Works Office of Sampang Regency (secondary data). To evaluate and maintain the roads optimally, thus the following data that is needed in this study as follows:

1. Traffic Data (LHR)
2. The Data of HSPK

B. Traffic Data (LHR)

The traffic data (LHR) is required to determine the UP value (priority order) in the Bina Marga method. The summary of traffic data (LHR) was obtained from the Public Works Office of Sampang Regency as shown in Figure 3.

C. Data of HSPK

The HSPK data was obtained from the data of Sampang Regency. It is required to determine the budget plan (RAB) for the repair of the Sampang-Ketapang highway. It includes the unit prices for material, tool and labor. The following HSPK data used for the repair of the Sampang-Ketapang highway can be seen in Figure 4.

ANALYSIS AND DISCUSSION

A. The Calculation Based On Bina Marga Method

1. The Calculation of LHR Value

The LHR value is obtained by looking for the SMP value to determine the traffic class as shown in figure 5.

2. Calculating the parameters for each type of damage and assessing each type of damage as shown in Figure 6.
   a. Hole
      a) 0,55 x 0,24 = 0,132 m^2
         Hole
      b) 0,6 x 0,3 = 0,18 m^2
         Total of Hole = 0,318 m^2
   b. Cracked Alligator Skin
      1 x 0,8 = 0,8 m^2

NO.	Component	Unit	Unit Cost (Rupiah)	Total Cost (Rupiah)
A. Worker				
1	Labor	OH	110000	110000
2	Overseer	OH	135000	135000
B. Materials				
1	Fine aggregate	MP	212200	212200
2	Asphalt emulsion	Kg	11872.01004	11872.01004
3	Asphalt	MP	10609	10609
4	Kerosene	Kg	11557	11557
5	Agregate type A	MP	312664,57	312664,57
6	Agregate Coarse Sand	MP	158950,43	158950,43
C. Equipment				
1	Concrete Mixer	Jam	111125	111125
2	Baby Roller	Jam	107628	107628
3	Dump Truck	Jam	266836	266836
4	Asphalt Sprayer	Jam	14895	14895
5	Air Compressor	Jam	173949	173949
6	Whell Loader	Jam	483044	483044
7	Jack Hammer	Jam	68754	68754
8	Water Tank Truck	Jam	367666	367666

Figure 4. The HPSK Data of Sampang-Ketapang Highway in 2021

The damage area can be determined by adding up the area of the existing cracks, then dividing it by the area of the segment and multiplying by 100%. Here is an example of the calculation:

a) Alligator Cracks

$$\left(\frac{0{,}8}{400}\right) x\ 100 = 0{,}2\%$$

b) Hole

$$\left(\frac{0{,}318}{400}\right) x\ 100 = 0{,}03975\%$$

In order to determine the score of the road condition, the damage data is categorized according to the range of the condition value in the determination table, these numbers are at STA 1+300 – 1+400, thus the data that should be entered is the value of pothole and alligator crack. Furthermore, adding up all of the condition value with the details of alligator cracks (5) + holes < 10% (1) = 6. Thus, for STA 1+300 – 1+400 have a Bina Marga value with a total of 6

3. Adding up each number for each type of damage and determining the road condition value

According to these results, the average value of the Bina Marga is 100 / 50 = 2. With this value, the total of the damage value belongs to number one as shown in figure 7

4. The priority order is divided into several classifications

According to the collected data of the road condition and the traffic class, the priority order can be determined with the following formula:

a) UP = 17 – (LHR Class + The Score of Road Condition)
b) UP = 17 – (5+1)
c) UP = 11

From these results, the Sampang-Ketapang highway starts from STA 0+000 – 5+000 is included in the routine maintenance program.

The Traffic Class	LHR
0	<20
1	20-50
2	50-200
3	200-500
4	500-2000
5	2000-5000
6	5000-20000
7	20000-50000
8	>50000

Figure 5. The Table of Traffic Class

NO	STA	Type of damage	P	L	A	Total
14	1+300-1+400	Hole	0,55	0,24	0,132	0,318
		Hole	0,62	0,3	0,186	
		The cracks like the alligator skin	1	0,8	0,8	0,8

Figure 6. The Table of The Damage Area

B. Calculation Based on Pavement Condition Index (PCI)

1. Type of Damage

There are the following data on the types of damage found on the Sampang-Ketapang Highway of STA 0+000 – STA 05+000:

1). Hole
2). Patch
3). Crack Like Alligator Skin
4). Fine Crack
5). Groove Crack

2. Calculating the Total of Damage Value

Furthermore, adding the area based on the formula (6) after the dimension value of the damage was obtained as follows:

$$A = P\ x\ L \qquad (6)$$

Adding up all the same types of damage in one segment thus the total value of area (Ad) is obtained, as an example of calculations at STA 1+300 – STA 1+400 can be seen in Figure 8.

3. Looking for The Damage Percentage (Density)

The following formula applied to figure out the percentage of damage such as for every 100 m gets the value of STA 1+300 – STA 1+400 as shown in Figure 8.

a. Hole Damage

$$Density = \frac{0{,}318}{400}\ \text{x } 100\ \% = 0{,}08\ \%$$

b. The Damage of Crack Like Alligator Skin

$$\text{Density} = \frac{0{,}8}{400}\ \text{x } 100\ \% = 0{,}2\ \%$$

4. Determining The Deduct Value (DV)

Furthermore, the density value has been obtained and inserting each type of damage onto a graph according to the grade of damage per segment. If the damage is different then the highest damage value is taken. There are the DV or deduct value for STA 1+300 to 1+400 as follows:

a. Hole Damage

The total of damage value	Number
26 – 29	9
22 – 25	8
19 – 21	7
16 – 18	6
13 – 15	5
10 – 12	4
7 – 9	3
4 – 6	2
0 - 3	1

Figure 7. The total of damage value

NO	STA	Type of damage	SIZE			$\sum A$
			P	L	A	
			(M)	(M)	$(M)^2$	$(M)^2$
14	1+300-1+400	Hole	0,55	0,24	0,132	0,3
		Hole	0,62	0,3	0,186	
		The cracks like the alligator skin	1	0,8	0,8	0,8

Figure 8. The value of total damage

According to the graph, the DV for the hole damage is 3 as can be seen in Figure 9.

b. The Damage of Alligator Skin

According to the graph, the DV for the hole damage is 10 as can be seen in Figure 10.

5. Adding up the Total Deduct Value (TDV)

The total of the TDV or the total of reduction value is obtained for one segment by adding up all the DV in that segment. As in STA 1+300 to 1+400, its TDV is 40 as can be seen in Figure 11.

6. Looking for The *Corrected Deduct Value* (CDV)

The CDV is obtained by entering the TDV into the CDV table. The Q value is the total of Deduct value which is more than 2. According to the graph shown in Figure 9, the CDV of this segment is 28.

7. Determining the PCI Value

The following formula of determining the PCI value after the CDV was obtained as follows:

PCI = 100 – CDV
= 100 – 28
= 72

8. The Recap of PCI Value

Based on these results, the overall PCI value from STA 0+000 – 5+000 is

PCI Value = Σ PCI / N PCIF
= 4145 / 50 = 82,9 (Excellent)

Where N is the total of segments

According to those results, the Sampang-Ketapang highway is included in the routine maintenance program.

C. The Handling of Damage of The Road Pavement

1. Paving (P2)

The types of damage that is repaired with local asphalt bitumen is an alligator cracks, square cracks, longitudinal and transverse cracks with a width of less than 2 mm, and reveling. Thus the following way in order to repair its damage as follows:

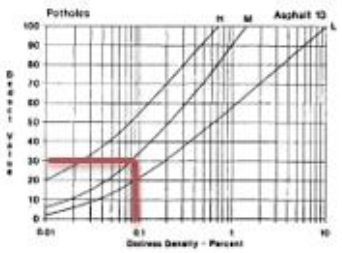

Figure 9. The deduct value graphic of hole

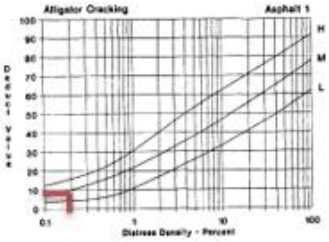

Figure 10. The graphic of deduct value of the cracks

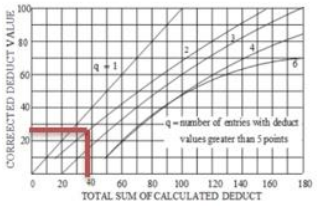

Figure 11. The graphic of a corrected deduct value

a. Cleaning the part to be repaired becuase the road surface must be clean and dry
b. Making a square mark on the area to be repaired by using a dye spray paint
c. Spraying the emulsion asphal about 1.5 kg/m² evenly on the marked area
d. Spreading the sand/fine aggregate evenly over the entire area to be repaired in order to cover them
e. Compacting them with a light compactor

2. Filling the Cracks (P4)

The type of damage repaired by filling the cracks is longitudinal and transverse crack damage with a crack width of more than 2 mm. Thus the following way in order to repair its damage as follows:

a. Cleaning the area because the road surface must be clean and dry
b. Filling the cracks with the heat oil asphalt
c. Covering the cracks that have been filled with asphalt by the coarse sand

3. Patching (P5)

The type of damage repaired by this kind of method are box cracks, alligator cracks with a crack width of more than 2 mm and subsidence, as well as the holes with a depth of more than 50 mm. Thus the following way in order to repair its damage as follows:

a. Making a square mark over the area to be repaired by using a dye spray paint covered a good part of the road.
b. Digging the road layer over the marked area until reaches the deep layer.
c. The edges of the excavation must be upright and its bottom should be equal and horizontal.
d. Tamping the bottom of the excavation.

NO	Type of damage	Grade	Type of repair
1	The cracks like the alligator skin	L	P2
		M	P2
		H	P2
2	Obesity	L	P1
		M	P1
		H	P1
3	Bumpy and Basin	L	P5
		M	P5
		H	P5
4	Longitudinal and transverse cracks	L	P4
		M	P4
		H	P4
5	Patch	L	P5
		M	P5
		H	P5
6	Hole	L	P5
		M	P5
		H	P5
7	Edge Crack	L	P2
		M	P2
		H	P2
8	Shovel	L	P5
		M	P5
		H	P5
Note:			
(P1) Spreading the sand		(P4) Filling the crack	
(P2) Local paving		(P5) Patching the hole	
(P3) Covering the crack		(P5) Patching the hole	

Figure 12. The damage repair of the road pavement

e. Filling the excavation hole with the replacement material, namely aggregate foundation layer material or asphalt mixture.
f. Tamping layer by layer, and increasing the thickness of its material in the last layer in order to get the compact and equal road surface

For handling the damage of road pavement can be seen in Figure 12.

D. The Calculation of Work Cost

1. The Volume of Work

The data of damage classifications that has been determined according to the book of the Ministry of Public Works Directorate General of Bina Marga, 2011), No 001-02/M/BM/2011 regarding the standard repairs for the road maintenance, there are the following formula in order to calculate the volume of the damage repair as follows:

a. The Calculation of Damage Volume P2

(P2) Paving

The usage of 1.5 liters of asphalt emulsion is required for 1 m2, thus the following calculation for the total usage of asphalt emulsion as follows:

a) Asphalt Emulsion
Volume = Damage Area x Asphalt Volume per m²
= 30,50 m² x 1,5 liter/m²
= 45,75 liters

b) Aggregate Sand Cashier (5 mm)
Volume = 30,50 m² x 0,015 m
= 0,46 m³

b. The Calculation of Damage Volume P4

(P4) Filling of Cracks

NO.	Component	Unit	Total Cost (Rupiah)
a	b	c	f= d x e
A	**P2 Method: The Asphalting**		
1	The Material Of Emulsion Asphalt	Liter	Rp1,347,686
2	Agregate Sand Cashier	$(M)^3$	Rp210,435
	Total of cost work P2		**Rp1,558,121**
B	**Method P4: Filling the crack**		
1	The Material Of Emulsion Asphalt	Liter	Rp1,933,156
2	Agregate Sand Cashier	$(M)^3$	Rp297,802
	Total of cost work P4		**Rp2,230,958**
C	**Method P5: Patching hole**		
1	The excavation of road pavement Without Cold Milling Machine		Rp3,867,276
2	The excavation of grained pavement	$(M)^3$	Rp20,053,523
3	The layer foundation of aggregate grade A	$(M)^3$	Rp7,128,089
4	The binder permeated layer	Liter	Rp18,949,733
5	The cold asphalt mixture	$(M)^3$	Rp35,072,441
	Total of cost work P5		**Rp85,071,062**
	(A) Total of cost work		**Rp87,951,141**
	(B) The value added tax (VAT) = 10% x A		**Rp8,795,114**
	(C) The total of the work cost = A + B		**Rp96,746,255**
	(D) Rounding cost		**Rp97,000,000**
The cost around			
Ninety Seven Thousand Rupiah			

Figure 13 The cost recapitulation of the road repairs

The usage of 1.5 liters of asphalt emulsion is required for 1 m2, thus the following calculation for the total usage of asphalt emulsion as follows:

a) Asphalt Emulsion
Volume =Damage Area x Asphalt Volume per m²
= 43,75m² x 1,5 liter/m²
= 65,63 liter

b) Aggregate Coarse Sand (5 mm)
Volume = 43,75 m² x 0,01 m
= 0,66 m³

c. The Calculation of Damage Volume P5

(P5) Patching of Hole

a) The excavation of asphalt pavement without Cold Milling Machine, the layer thickness of its surface that is ecavated similar to 6c
Volume = Damage Area x Asphalt Volume per m²
=137,5 m² x 0,06 m
= 8,25 m³

b) The excavation of grained pavement which the layer thickness of base A (Aggregate Type A) is 10 cm
Volume = Damage Area x Layer Thickness
= 137,5 m² x 0,1 m
= 13,75 m³

c) The layer thickness of the base A (Aggregate Type A) is 10 cm
Volume = Damage Area x Layer Thickness
= 137,5 m² x 0,1 m
= 13,75 m³

d) The usage of binder permeated layer (Prime Coat) is about 0.8 liters/ m²
Volume = Damage Area x Layer Thickness
= 137,5 m² x 0,8 liter/m²
=110 liter

e) The cold asphalt mixture which its thickness of surface layer is 6 cm

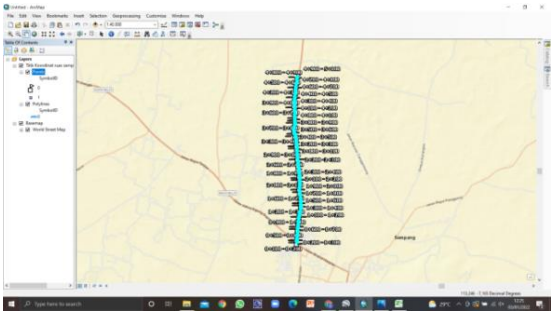

Figure 14. The Final Appearance of The Argcis Application

Volume = Damage Areax Layer Thickness
= 66,24 m² x 0,06 m²
= 8,25 m³

2. The Analysis of Calculating the Price of Work Unit

According to the calculated volume, it is required to determine the analysis of calculating the price of work unit in order to find out the estimated cost that will be used for the repairs. It consists of a worker wages, materials and tools that is required for its repairs.

Asphalt (P2)

The working of Asphalt (P2)

1) Asphalt Emulsion
   a. The Worker Wages
      a) Worker (OH)
         = Estimated Quantity x Unit Price
         = 0,0104 x IDR 110.000
         = IDR 15040,00
      b) Overseer (OH)
         = Estimated Quantity x Unit Price
         = 0,0003 x IDR 135.000
         = IDR 40,50
         Total = IDR 1580,50
   b. Materials
      a) Asphalt
         = Estimated Quantity x Unit Price
         = 1,0424 x IDR 10.609
         = IDR 11.058,40
      b) Kerosone
         = Estimated Quantity x Unit Price
         = 0,0704 x IDR 11.557
         = IDR 813,61
         Total = IDR 11.872,01
   c. Equipments
      a) Compresesor
         = Estimated Quantity x Unit Price
         = 0,0207 x IDR 173.949
         = IDR 3593,99
      b) *Dump Truck*
         = Estimated Quantity x Unit Price
         = 0,0207 x IDR 266836
         = IDR 5513,14
      c) *Asphalt Sprayer*
         = Estimated Quantity x Unit Price
         = 0,0207 x IDR 173.949
         = IDR 3055,68
         Total = IDR 12162,81
   d. The Total Cost of Labor, Material and Equipment
      = Labor + Material + Equipment
      = IDR 25615,32
   e. Overhead & Profit
      = 15 % x Total Cost of Labor, Material and Equipment
      = 15 % x IDR 25615,32
      = IDR 3842,30
   f. The Unit Price of Labor
      = Total Cost of labor, material and equipment x Overhead & Profit
      = IDR 29457,62
2) Spreading The Coarse Sand
   a. Worker Wages
      a) Labor (OH)
         = Estimated Quantity x Unit Price
         = 0,0532 x IDR 110.000
         = IDR 5852,00
      b) Overseer (OH)
         = Estimated Quantity x Unit Price
         = 0,0023 x IDR 135.000
         = IDR 307,53
         Total = IDR 6159,53
   b. Materials
      a) Coarse Sand
         = Estimated Quantity x Unit Price
         = 1,2154 x IDR 312664,57
         = IDR 379.998,24
         Total = IDR 379.998,24
   c. Equipments
      a) *Dump Truck*
         = Estimated Quantity x Unit Price
         = 0,0115 x IDR 266.836
         = IDR 3076,31
      b) *Whell Loader*
         = Estimated Quantity x Unit Price
         = 0,0106 x IDR 483.044
         = IDR 5135,12
      c) *Asphalt Sprayer*
         = Estimated Quantity x Unit Price
         = 0,002 x IDR 107.628
         = IDR 233,64
         Total = IDR 8445,07
   d. Total Cost of Labor, Material and Equipment
      = Labor +Material + Equipment
      = IDR 394.602,84
   e. Overhead & Profit
      = 15 % x Total Cost of Labor, Material and Equipment
      = 15 % x IDR 394.602,84
      = IDR 59.190,43
   f. Unit Price of Labor
      = Total Cost of Labor, Material and Equipment x Overhead & Profit

NO	The PCI Method	Bina Marga Method
1	Doing the survey of LHR (The Average of Daily Traffic)	Do not doing the survey of LHR (The Average of Daily Traffic)
2	In analyzing the data used the table of the condition value as well as the LHR value	In analayzing the data used the graphic based on the type of damage
3	The final result is the priority order with its repairs in Bina Marga Method	The final result is the grade of the road condition in The Pavement Condition Index (PCI)

Figure 15. The Comparison between the PCI and the Bina Marga Method

= IDR 453.793,27

3. The Calculating of The Cost of The Work

After calculating the volume of work and the price of work unit, it is required to calculate the cost of the work. The following is an example of calculating of P2 (Asphalt) work:

b. The working of asphalt emulsion

Work Cost = Work Volume x HSP
= 45,75 x 29457,62
= IDR 1.347.686,02

c. The working of spreading the coarse sand

Work Cost = Work Volume x HSP
= 45,75 x 453793,27
= IDR 210.435,06

The cost recapitulation of repairing the road damage can be seen in Figure 13.

E. The Application of ArcGis

ArcGis as the Road Management Information System consists of road data, road maps, road conditions, is a database structure design program which is upgraded into the software. Furthermore, in order to determine the coordinates of the road that will be entered into the ArcGis application, there are the following steps of using its application:

1. Determining the coordinates of the survey location using the Locus Map Pro application via a handphone
2. Furthermore, saving the file and changing its format from the gpx to the kml format by using a Google Earth Application
3. The result of its change can be entered into the ArcGis application
4. Afterwards, the display appears as follows
5. The fifth, creating the data about the information of the road condition with MS. Excel in order to be entered into the ArcGis application
6. If the steps above have been completed, the final appearance can be seen in Figure 11.

CONCLUSION AND SUGGESTION

A. Conclusion

According to the results of the analysis and discussion about the conditions of the road pavement on the Sampang-Ketapang Highway, thus the following conclusion of its analysis as follows:

1. The types of damage that occur on the Sampang-Ketapang Highway with STA 0+000 to STA 5+000 consist of 5 types of damage, namely Holes, Patches, Alligator Skin Cracks, Fine Cracks and Grooved Cracks
2. According to the Bina Marga Method on the Sampang Ketapang Highway, the calculation of priority order is 11 where the road is included in the category of routine maintenance program.
3. According to the Pavement Condition Index (PCI) method on the Sampang Ketapang Highway, the calculation of the pavement condition grade reaches number 75.94 (Excellent)
4. Based on these results, the comparison between the two methods can be seen in Figure 15.
5. According to the type of damage pavement reviewed, there are the following repair methods used as follows:
   a. Asphalt (P2) The types of damage repaired with a local asphalt bitumen is the alligator cracks,
   b. Filling The Cracks (P4) the type of damage that is repaired by this method is damage to longitudinal cracks, transverse cracks, grooved cracks and fine cracks.
   c. Patching The Hole (P5) The type of damage belongs to this method is a hole
6. According to the type of damage, the estimated cost of handling those damage are about IDR 96.746.254,84

B. Suggestion

Based on the result of the analysis it can be suggested that the damage condition in that highway should be immediately repaired in order to prevent the worse damage that can endanger the road users.

REFERENCES

[1] Direktorat Jenderal Bina Marga, “Manual Pemeliharaan Rutin Untuk Jalan Nasional dan Jalan Provinsi Jilid II,” 2011.