Road Handling Needs Analysis Based on the Pavement Condition Index (PCI) Method

(Case Study: Jl. Tegal Binangun)

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Abstract. Roads are infrastructure access that is intended to move people/goods from their place of origin to their destination. Good roads will provide smooth infrastructure access and provide a high access rating. Assessment of access and smoothness of a road will affect the assessment of its structural and functional conditions.

Assessment of road conditions based on functionality is a condition where the road can provide services to road users in this case the community in the area of the road section. The assessment of conditions based on functionality can be carried out using several assessment methods, in this study the method used was the Pavement Condition Index (PCI). Based on the PCI value obtained in each segment, it will be continued by determining effective handling for road maintenance based on the Bina Marga preservation handling regulations.

This study is intended to provide effective and efficient road handling options in order to reduce the road maintenance budget which has been high and has not been on target. In addition, this study also provides a draft budget based on the 2018 Bina Marga General Specifications Revision 3 in accordance with the handling division needed for effective handling.

Keywords: Pavement Condition Index, Functional Condition, Specification Preservation Maintenance.

1 Introduction

1.1 Background

Road infrastructure maintenance in particular will be a job that greatly affects the budget that will be spent. If the maintenance is not carried out routinely and situationally, then the budget spent will be ineffective and inefficient because the volume of maintenance handling becomes large. Conversely, if maintenance handling is carried out routinely and scheduled, it will reduce the maintenance costs of certain

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road sections. Coupled with over dimension over load (ODOL) vehicles that provide a large damage effect.

In addition to reconstruction, major and minor rehabilitation also require large handling costs. Usually, handling that does not require large costs is routine handling, routine conditions, holding, and preventive. These handlings also depend on the assessment of damage that occurs in the field. Damage assessment consists of two parts, namely structural damage assessment, and functional damage. Each of these damages also greatly affects the road condition rating.

Functional damage assessments that are often carried out are using the Pavement Condition Index (PCI), Surface Distress Index (SDI), International Roughness Index (IRI), Road Condition Surface (RCS), Road Condition Index (RCI) methods and many more. For structural damage assessments, the method used is the Deflection Method, and Remaining Surface Life (RSL). In this study, the methods used to determine the damage assessment are the PCI and SDI methods. This study shows how the functional damage assessment method will get the same damage handling or not so that the handling volume will be calculated along with the budget plan based on the 2018 General Specifications Revision 3 for the section to be reviewed.

Based on the background above, the section that will be reviewed in this study is the Tegal Binangun Street section which is considered to be able to represent the condition of Over Dimension Over Load vehicles in Palembang City, South Sumatra Province.

2 RESEARCH METHODOLOGYS

2.1 Scope of Research

The location of this research is Jalan Tegal Binangun Kabupaten Banyuasin Province South Sumatera. The Basic unit price use is the unit price at South Sumatera Province in order to reduce the price margin like a mobility materials and tools. The Length of Jalan Tegal Binangun is 4.6 km from start section at the Simpang Tegal Binangun until Simpang Plaju. The Location can be seen in the image below :

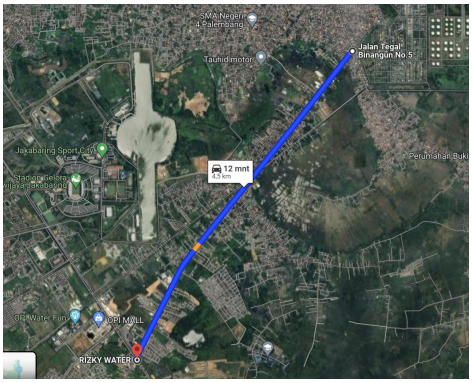

Fig. 1. Research Location Jalan Tegal Binangun.

2.2 Data Collection

Data collection is carried out to obtain primary data through direct surveys in the field. Data obtained directly in the field is road damage data using the survey method with the Pavement Condition Index (PCI) form. Furthermore, the data is processed and analyzed to obtain the value of damage that occurs in the field with up to date.

2.3 Data Analysis

The analysis method used is to measure road damage using the pavement condition index method. This method is assessed according to the location and stationing of the damage that occurs. so that the value of the PCI will show the actual condition of the damage. Furthermore, effective handling will be determined to improve the condition of the road.

For example, if the condition of the road requires reconstruction, then the price and costs required for reconstruction will be calculated according to the handling required up to the layer that requires handling. as well as other treatments that may be slightly cheaper. The following is a flow chart of the research carried out which can be seen in the image below.

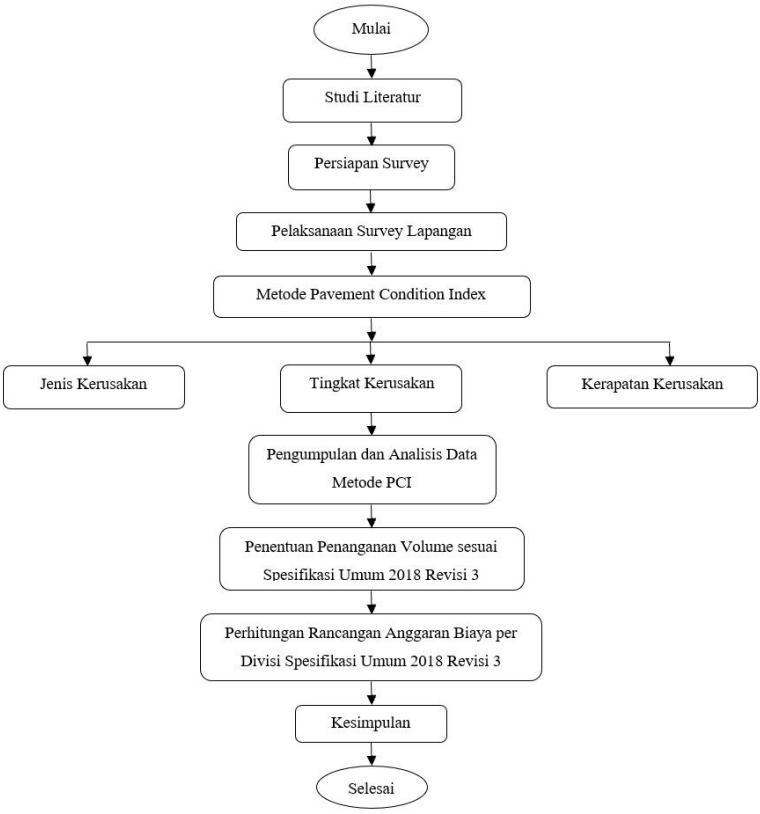

Fig. 2. Research Flow Chart.

After collecting data and analyzing it, it will be implemented using the pavement condition index method starting from determining samples, collecting primary data, determining PCI values, determining effective handling, to calculating the costs required to handle each activity which will be discussed in the next chapter.

3 RESULT AND DISCUSSION

3.1 Survey Result Value of Pavement Condition Index with Stripmap

Based on the results of field data collection to calculations using the pavement condition index method on the Tegal Binangun road section, it can be illustrated in the strip map drawn in the image below:

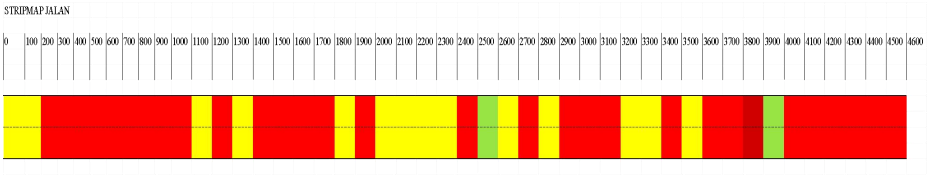

Fig. 3. Stripmap Condition of Jl. Tegal Binangun

It can be seen that on the stripmap there is satisfactory damage along 200 meters, condition fair damage with a length of 1400 meters, and condition poor and very poor damage along 3000 meters. This shows that on average the Tegal Binangun road has experienced quite severe and even damage along the road. The average damage that occurs on the Tegal Binangun road is pothole damage, Weathering/Raveling, longitudinal and transversal cracks, edge cracks, block cracks, crocodile cracks, to depression. The damage will then be determined based on the next graph.

3.2 Road Maintenance Determination

Determination of maintenance schemes for rigid and flexible pavements is adjusted to the level, type and density of damage that occurs in the field. Based on the life cycle cost analysis graph below, it can be seen that maintenance can be carried out when the PCI value obtained is 70, namely with fair conditions. Fair values and below can be carried out rehabilitation maintenance, but in the range of 70 - 100, the maintenance that can be carried out is off-pavement and preventive maintenance to maintain the condition of the pavement. When the calculated PCI value reaches 55, the handling that can be done is with reconstruction maintenance to restore the road condition to its initial condition, namely with a value of 100. Below you can see an illustration to explain that the decrease in the PCI value will continue to decrease if there is no comprehensive and significant handling.

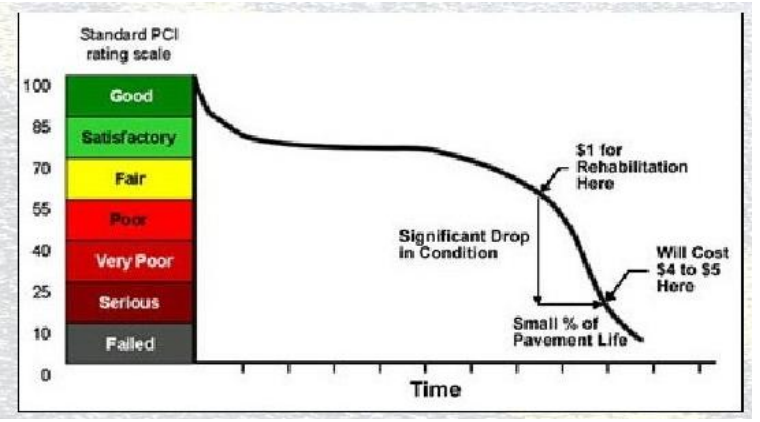

Fig. 4. Life Cycle Cost Diagram for PCI Value and Time

Based on the illustration above, a handling scheme can be presented according to the conditions and detailed treatment alternatives to restore the pavement condition to its original condition, namely with a PCI value of 100. This condition must be maintained with several alternatives submitted.The handling provided to maintain the condition can be seen in the table below:

Table 1. Maintenance Condition Field and Treatment.

PCI Scale	Condition Field	Treatment	Treatment Detail
85 – 100	**Good**	**Routine**	**OffPavement**
70 – 84	**Satisfactory**	**Preventive**	**Overlay with 5 cm**
55 – 69	**Fair**	**Rehabilitation**	**Scrap and Fill with Layer 1 until AC-BC**
40 – 54	**Poor**		
25 – 39	**Very Poor**	**Reconstruction**	**Scrap and Fill with Layer 1 and 2 until Rigid**
10 – 24	**Serious**		
0 – 9	**Failed**		

3.3 Unit Price Analysis Maintenance

Based on the previously determined alternative treatment that there are three treatments involving pavement, for PCI good value only requires offpavement treatment, namely grass cleaning and maintenance of rumija. for the three treatments determined, namely overlay with a thickness of 5 cm (AC-WC), scrap and fill with a layer thickness of up to AC-BC which is 20 cm, and scrap and fill treatment with a layer thickness up to rigid pavement with a thickness of 5 cm for the AC-WC layer, 20 cm for the AC-BC layer, and 30 for the rigid pavement layer.

The following is a calculation of the General specifications that have been calculated based on the unit price of the province of South Sumatra for each maintenance scheme starting from only overlaying on the road surface using an AC-WC layer with a thickness of 5 cm, a road width of 7 meters, and a road length of every 1 km. for the second alternative with rehabilitation treatment which has an AC-WC thickness of 5 cm, AC-BC of 20 cm, a road width of 7 meters, and a length of every 1 km. The third alternative with reconstruction treatment which has an AC-WC thickness of 5 cm, AC-BC of 20, rigid pavement construction of 30 cm, a road width of 7 meters, and a length of every 1 km for the treatment:

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No. Divisi	Uraian	Jumlah Harga Pekerjaan (Rupiah)
1	Umum	195,394,833.33
2	Drainase	0.00
3	Pekerjaan Tanah Dan Geosintetik	0.00
4	Pelebaran Preventif	0.00
5	Pekerasan Berbutir Dan Perkerasan Beton Semen	0.00
6	Perkerasan Aspal	580,100,133.33
7	Struktur	0.00
8	Rehabilitasi Jembatan	0.00
9	Pekerjaan Harian Dan Pekerjaan Lain-Lain	0.00
10	Pekerjaan Pemeliharaan Kinerja	0.00
(A) Jumlah Harga Pekerjaan (*termasuk Biaya Umum dan Keuntungan*)		775,494,966.67
(B) Pajak Pertambahan Nilai (PPN) = 10% x (A)		77,549,496.67
(C) JUMLAH TOTAL HARGA PEKERJAAN = (A) + (B)		853,044,463.33
(D) JUMLAH TOTAL HARGA PEKERJAAN (DIBULATKAN)		**853,044,000.00**
Terbilang :	*Delapan Ratus Lima Puluh Tiga Juta Empat Puluh Empat Ribu Rupiah*	

Fig. 5. Cost of Treatment for Preventive Method

No. Divisi	Uraian	Jumlah Harga Pekerjaan (Rupiah)
1	Umum	195,394,833.33
2	Drainase	0.00
3	Pekerjaan Tanah Dan Geosintetik	0.00
4	Pelebaran Preventif	0.00
5	Pekerasan Berbutir Dan Perkerasan Beton Semen	0.00
6	Perkerasan Aspal	2,825,510,611.70
7	Struktur	0.00
8	Rehabilitasi Jembatan	0.00
9	Pekerjaan Harian Dan Pekerjaan Lain-Lain	0.00
10	Pekerjaan Pemeliharaan Kinerja	0.00
(A) Jumlah Harga Pekerjaan (*termasuk Biaya Umum dan Keuntungan*)		3,020,905,445.03
(B) Pajak Pertambahan Nilai (PPN) = 10% x (A)		302,090,544.50
(C) JUMLAH TOTAL HARGA PEKERJAAN = (A) + (B)		3,322,995,989.53
(D) JUMLAH TOTAL HARGA PEKERJAAN (DIBULATKAN)		**3,322,995,000.00**
Terbilang :	*Tiga Milyar Tiga Ratus Dua Puluh Dua Juta Sembilan Ratus Sembilan Puluh Lima Ribu Rupiah*	

Fig. 6. Cost of Treatment for Rehabilitation Method

No. Divisi	Uraian	Jumlah Harga Pekerjaan (Rupiah)
1	Umum	195,394,833.33
2	Drainase	0.00
3	Pekerjaan Tanah Dan Geosintetik	0.00
4	Pelebaran Preventif	0.00
5	Pekerasan Berbutir Dan Perkerasan Beton Semen	0.00
6	Perkerasan Aspal	2,825,510,611.70
7	Struktur	7,098,905,463.93
8	Rehabilitasi Jembatan	0.00
9	Pekerjaan Harian Dan Pekerjaan Lain-Lain	0.00
10	Pekerjaan Pemeliharaan Kinerja	0.00
(A)	Jumlah Harga Pekerjaan (*termasuk Biaya Umum dan Keuntungan*)	10,119,810,908.96
(B)	Pajak Pertambahan Nilai (PPN) = 10% x (A)	1,011,981,090.90
(C)	JUMLAH TOTAL HARGA PEKERJAAN = (A) + (B)	11,131,791,999.86
(D)	JUMLAH TOTAL HARGA PEKERJAAN (DIBULATKAN)	**11,131,791,000.00**
Terbilang :	*Sebelas Milyar Seratus Tiga Puluh Satu Juta Tujuh Ratus Sembilan Puluh Satu Ribu Rupiah*	

Fig. 7. Cost of Treatment for Reconstruction Method

Based on the determination of maintenance treatment, the divisions calculated are general division 1 to calculate work mobilization, division 6 Asphalt Pavement to accommodate the volume of AC-WC and AC-BC pavement, to division 7 Structure to accommodate the volume of rigid pavement with a quality value of fc' = 50 MPa.

3.4 Estimation Cost For Maintenance

After obtaining an estimate of the cost per kilometer for each calculated treat-ment, the total treatment cost for the Jalan Tegal Binangun during the maintenance period will then be calculated. The total length of the road section of 4600 meters, the handling carried out is 200 meters for routine maintenance (OffPavement), Rehabilitation handling (scrap and fill/overlay) of 1400 meters, to reconstruction handling (scrap and fill/Deep) of 3000 meters. The following table below calculates maintenance according to the planned age and total length of the section being reviewed.

Table 2. Maintenance Condition Field and Treatment.

No	Treatment	Segmentation (m)	Estimation Cost/km (Rp)	Total Cost (Rp)
1	**Routine (Off Pavement+Overlay)**	**200**	**853,044,000.00**	**170,608,800.00**
2	**Rehabilitation (Scrap and Fill/Overlay)**	**1400**	**3.322.000,000.00**	**4,652,193,000.00**
3	**Reconstruction (Scrap and Fill/Deep)**	**3000**	**11,131,791,000.00**	**33,395,373,000.00**
	Total			**38,218,174,800.00**

Based on the calculation above, it shows that with a larger volume of reconstruction handling, it will result in the total handling being inflated, but if the road is not routinely maintained, the resulting value will be even cheaper. the difference in value between each activity is 3 times greater than the reconstruction value, then the reconstruction of our planned road can be avoided.

4 CONCLUSION

From this research the following conclusions were obatained:

a. The average PCI value for the Tegal Binangun road section is 54.26 (poor), so it can be concluded that this value is in poor condition, meaning that comprehensive repairs need to be carried out according to the location of the damage.
b. The result of the scenario for life cycle cost analysis have to spend amount Rp 38,218,174,000.00. This shows that the price that has the most influence on handling needs is when the need for reconstruction handling is very large and is very much needed.
c. When the government does not routinely repair roads until the road is assessed as poor by the independent police team, the investment costs of the road will be greater, on the other hand, if the government routinely maintains, the road will produce an investment value that is not great, but the handling is gradual.

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