ANALYSIS OF TAXIWAY PAVEMENT CONDITIONS WITH THE PAVEMENT CONDITION INDEX (PCI) METHOD AT JUANDA AIRPORT SURABAYA

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Abstract
Surabaya Juanda International Airport experiences an increase in aircraft transportation needs every year, where the increase results in reduced airside facility capabilities. The occurrence of some damage to taxiways N5N and N5S is caused by the temperature of the pavement reaching the soft point, the high groundwater level in the area, and aircraft loads that exceed capacity. This can interfere with flights that are about to take off and need to be analyzed regarding the level of damage and how to repair it. In analyzing damage to taxiway facilities can be planned with the Pavement Condition Index (PCI) method to determine the level of damage that occurs and can be used as a reference in maintenance efforts. Pavement maintenance uses guidelines from the regulation of the Director General of Civil Aviation Number: KP 94 of 2015 concerning Operational Technical Guidelines for Civil Aviation Safety Regulations. In analyzing pavement damage in taxiway N5N and N5S using the Pavement Condition Index (PCI) method, after obtaining the results of the analysis, then the repair method will be determined in accordance with the results of the analysis. The results of the analysis of Taxiway pavement conditions using the Pavement Condition index (PCI) method in the N5N and N5S taxiway areas at Juanda Airport Surabaya averaged 92.31. While the repair and maintenance methods in taxiway N5N and N5S are Patching and fogsealing. Furthermore, the estimated cost of the cost budget plan (RAB) for repairing damage with the patching and fog sealing method is IDR 13,918,200.00.

Keywords: Airport, Pavement Condition Index, Taxiway, Pavement Maintenance, Budget Plan

INTRODUCTION

Juanda Surabaya Airport itself has air side facilities, namely one runway with a runway length of 3000 meters and a width of 45 meters, 4 Exit taxiways namely N1, N2, N4, and N7, 3 Rapid Exit taxiways namely N3, N5 (N5N and N5S) and N6, and 2 parallel taxiways namely NP1 and NP2. In addition, on the south side of the runway there are 6 Exit taxiways namely S1, S2, S3, S4, S5 and S6, as well as 2 parallel taxiways namely SP1 and SP2. As a form of service to passengers and for convenience, the planning of runways, aprons and taxiways must be designed to have a pavement structure that can serve the load of aircraft running on it.

Based on data from the Juanda Airport manager, in the first half of 2023, the number of people traveling through the airport was 6.7 million. On average, there are 1.1 million people per month or 37,000 passengers per day served by the airport.

Therefore, field observations were required and some damage to the pavement was found in the form of rutting, cracking in the patching joints, block cracking, local depression, long cracking, and alligator cracking in the N5N and N5S taxiway areas. Thus, the damage that occurs in the N5N and N5S areas is feared to disrupt the operation of Juanda Airport Surabaya.. Therefore, it is necessary to analyze the condition of taxiways N5N and N5S based on field conditions and will later be planned regarding how to maintain or repair them. The development implementation of an APMS makes it possible to manage assets in a practical and sustainable manner, assisting management personel in decision making through priority setting, cost quantification and activity scheduling, resulting in the development of economically viale strategies for pavement maintenance. PCI is a mathematical index, with values ranging from 0 ~ 100, where 0 is denoted for failed pavement and 100 designates faultless (new) condition. In addition, it has been found that the ratings of the existing PCI depeloped for airports of various scales in the united states showed sognificants differences considering the management levels of juanda airpots, which mainly consist of mid-sized and large commercial airports.

The use of airside infrastructure that exceeds capacity, the damage is caused by the frequency of taxiway traffic due to the runway landing length recommendation for B-737-800/900 aircraft requires a runway for landing of 1,767 m (Part of Bellingham Washington State). The runway length of Juanda Airport Surabaya itself has a runway length of 3000 m. So that for B-737-800/900 aircraft that will land to runway 28 requires a length of 1,767 and the distance of STA 0+000 towards runway 10 to taxiway N5S is around 1,900 m. In addition, the groundwater table is at risk of water infiltration into the pavement structure and damage to the structure. An additional problem during the rainy season is a very high groundwater level that is difficult to remove from the airport area. High river discharge deviations in Semampir and Turen rivers, high tides, and the temperature of the pavement surface reaching the soft point can be the cause so it is necessary to analyze the damage with the pavement condition index (PCI) method and how to repair it.

Therefore, it is necessary to analyze the conditions on taxiways N5N and N5S based on field conditions and will later be planned regarding how to maintain or repair them. In this Final Project, a flexible pavement maintenance program planning will be carried out with the damage analysis method using the pavement condition index (PCI), in order to analyze damage to the pavement and determine how to repair it so that the aircraft can operate optimally.

METHOD

Research techniques to analyze the condition of taxiway pavement with the Pavement Condition Index (PCI) method as follows:

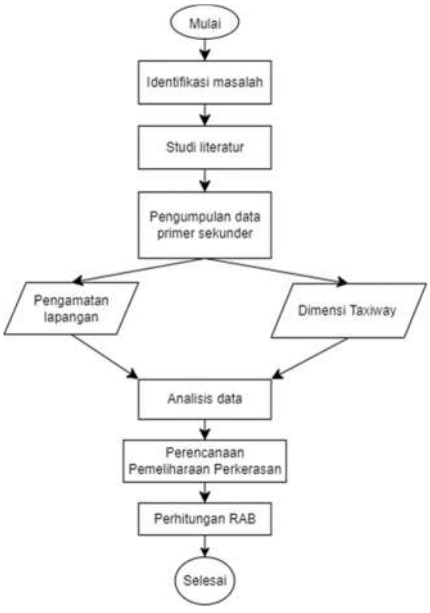


Figure 1: **Research flow chart**

Secondary Primary Data Collection

Primary Data

Primary data is obtained from the results of reviewing field conditions with juanda airport airside team personnel.

Secondary Data

Secondary data obtained is the collection of airport layout data, taxiway dimensions, and HSPK for Surabaya City in 2019 and East Java Governor Regulation in 2023.

Data Analysis

Data analysis is done by calculating all the results of data collection, data processing in order to get the value of each. The stages of data analysis include :

a. Determine the sample unit as per ASTM 5340-98.
b. Calculate the distress density and deduct value (DV) of each advanced sample.
c. Calculating the total deduct value (TDV)
d. Calculate the "CDV" value from the total DV data using the CDV chart in ASTM D5340-98.
e. Calculating the PCI value with the "100-CDV maximum" value (each sample) and (all samples).
f. Assign a pavement condition classification to the PCI values using a scale.

Pavement Maintenance Planning

Maintenance can prevent further damage and possible ways that damage can occur. Juanda Airport Surabaya can plan and reference for pavement maintenance planning by referring to guidelines or regulations.

Pavement maintenance planning must ensure that pavement maintenance can be carried out appropriately to prevent, restore and improve pavement performance. Therefore, the analysis of taxiway pavement conditions using the Pavement Condition Index (PCI) Method at Juanda Airport Surabaya can plan follow-up improvements to the results of the Pavement Condition Index value generated in the analysis.

In the planning of pavement maintenance, the calculation of the volume of work is determined based on the area of damage that occurs after observation on the pavement in the N5N and N5S taxiway areas in one unit. For the calculation of the volume of work itself is guided by observation data in the field at Juanda Airport Surabaya.

RAB calculation

The calculation of RAB in planning a flexible pavement repair program leads to a cost budget plan that can show some of the price requirements for materials, tools, labor costs and materials to repair damage that has occurred that has been analyzed by the PCI method. In making the RAB itself, the author is guided by the standard unit price of wages, materials and tools of the Java Governor Regulation Number 30 of 2023 concerning Standard Unit Prices for Goods of the East Java Provincial Government in 2023, HSPK Surabaya City in 2019.

RESULT AND DISCUSSION

Juanda Airport Surabaya has four parallel taxiways, and for taxiway north 5 north and north 5 south itself has a length of 650 meters. On the N5N and N5S pavements

there are often several damages such as surface subsidence on the wheel path (rutting), cracks in the patching joints, block cracking, local subsidence (depression), longitudinal cracking (long cracking), alligator cracking. The following is damage data on taxiway pavement N5N and N5S in 2023 which can be seen as follows:

Table 1. **Damage to Taxiway N5N and N5S**

No	No STA	Jenis Kerusakan	Tingkat Kerusakan
1	0+000 s/d 0+050	Penurunan Jalur Roda (*Rutting*)	MEDIUM
		Retak Pada Sambungan *Patching*	MEDIUM
2	0+50 s/d 0+100	Retak Pada Sambungan *Patching*	MEDIUM
3	0+100 s/d 0+150	-	MEDIUM
4	0+150 s/d 0+200	Retak Blok (Block cracking)	MEDIUM
5	0+200 s/d 0+250	Penurunan Setempat (*Depresszion*)	MEDIUM
6	0+250 s/d 0+300	Retak Pada Sambungan *Patching*	MEDIUM
7	0+300 s/d 0+350	Retak Memanjang (*Long Cracking*)	MEDIUM
8	0+350 s/d 0+400	Retak Blok (Block cracking)	MEDIUM
9	0+400 s/d 0+450	Penurunan Setempat (*Depresszion*)	MEDIUM
10	0+ 450s/d 0+500	Retak Kulit Buaya (*Alligator cracks*)	MEDIUM
11	0+500 s/d 0+550	Retak Pada Sambungan *Patching*	MEDIUM
		Retak Pada Sambungan *Patching*	MEDIUM
12	0+550 s/d 0+600	Retak Memanjang (*Long Cracking*)	MEDIUM
13	0+600 s/d 0+650	-	MEDIUM

Pavement Condition Index (PCI) Calculation

This method is used to analyze the level of damage to the N5N and N5S taxiway areas. In this analysis, the dimensions of taxiway N5N and N5S that are sampled are 650 meters long and 30 meters wide, for each sample length per 50 meters is taken using the PCI method as shown in the layout below:

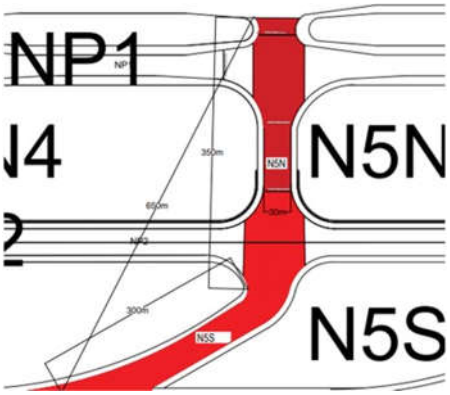


Figure 2. **N5N and N5S locations**

1. STA 0+000-0+050

Table 2. **Calculation of Damage Area and Density STA 0+000-0+050**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
1	0+000 s/d 0+050	31M	28	1,867
		25M	9	0,600

Table 3. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
27	27			2	27	18
5	5				5	

Determining the PCI Value:
PCI = 100 – HCDV PCI = 100 – 18
PCI = 82

2. STA 0+050 – 0+100

Table 4. **Calculation of Damage Area and Density STA 0+050-0+100**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
2	0+50 s/d 0+100	25M	5,5	0,367

Table 5. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
4	4			1	4	5

Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 5
PCI = 95

3. STA 0+100 – 0+150

Table 6. **Calculation of Damage Area and Density STA 0+100-0+150**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
3	0+100 s/d 0+150	-	-	0,000

Table 7. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
-	-			-	0	0

Determining the PCI Value PCI :
PCI = 100 – HCDV
PCI = 100 – 0
PCI = 100

4. STA 0+150 – 0+200

Table 8. **Calculation of Damage Area and Density STA 0+150-0+200**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
4	0+150 s/d 0+200	13M	2,4	0,160

Table 9. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
7	7			1	7	8

Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 8
PCI = 92

5. STA 0+200 – 0+250

Table 10. **Calculation of Damage Area and Density STA 0+200-0+250**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
5	0+200 s/d 0+250	33M	60	4,000

Table 11. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
30	30			1	30	19

Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 19
PCI = 81

6. STA 0+250 – 0+300

Table 12. **Calculation of Damage Area and Density STA 0+250-0+300**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
6	0+250 s/d 0+300	25M	1,5	0,100

Table 13. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
5	5			1	5	6

Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 6
PCI = 94

7. STA 0+300 – 0+350

Table 14. **Calculation of Damage Area and Density STA 0+300-0+350**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
7	0+300 s/d 0+350	11M	4,8	0,320

Table 15. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
6	6			1	6	7

Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 7
PCI = 93

8. STA 0+350 – 0+400

Table 16. **Calculation of Damage Area and Density STA 0+350-0+400**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
8	0+350 s/d 0+400	13M	2,75	0,183

Table 17. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
5	5			1	5	6

Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 6
PCI = 94

9. STA 0+400 – 0+450

Table 18. **Calculation of Damage Area and Density STA 0+400-0+450**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
9	0+400 s/d 0+450	33M	18	1,200

Tabel 19. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
7	7			1	7	8

Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 9
PCI = 91

10. STA 0+450 – 0+500

Table 20. **Calculation of Damage Area and Density STA 0+450-0+500**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
10	0+ 450s/d 0+500	12M	1,65	0,110

Table 21. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
8	8			1	8	9

Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 9
PCI = 91

11. STA 0+500 – 0+550

Table 22. **Calculation of Damage Area and Density STA 0+500-0+550**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
11	0+500 s/d 0+550	25M	3,96	0,264
		25M	4,56	0,304

Table 23. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
4	4	4		1	8	9
4				1		

Determining the PCI Value:
PCI = 100 – HCDV

PCI = 100 – 9
PCI = 11

12. STA 0+550 – 0+600

Table 24. **Calculation of Damage Area and Density STA 0+550-0+600**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
12	0+550 s/d 0+600	11M		0,096

Table 25. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
4	4			1	4	5

Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 5
PCI = 95

13. STA 0+600 – 0+650

Table 26. **Calculation of Damage Area and Density STA 0+600-0+650**

Sampel	No STA	Jenis Kerusakan	Total (m2)	Density %
13	0+600 s/d 0+650	-	0	0,000

Table 27. **Calculation of Deduction Value and Corrected Deduction Value**

Deduct Value	DV 1	DV 2	DV 3	q	Total DV	CDV
-	-			-	0	0

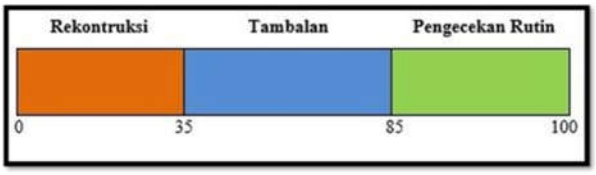
Determining the PCI Value:
PCI = 100 – HCDV
PCI = 100 – 0
PCI = 100

Table 28. Calculation Results of PCI Value of Each Sample

Sampel	No STA	Nilai PCI	Kondisi Perkerasan
1	0+000 s/d 0+050	84	Sangat Baik
2	0+050 s/d 0+100	95	Sempurna
3	0+100 s/d 0+150	100	Sempurna
4	0+150 s/d 0+200	92	Sempurna
5	0+200 s/d 0+250	81	Sangat Baik
6	0+250 s/d 0+300	94	Sempurna
7	0+300 s/d 0+350	93	Sempurna
8	0+350 s/d 0+400	94	Sempurna
9	0+400 s/d 0+450	92	Sempurna
10	0+ 450s/d 0+500	91	Sempurna
11	0+500 s/d 0+550	91	Sempurna
12	0+550 s/d 0+600	95	Sempurna
13	0+600 s/d 0+650	100	Sempurna

Damage Repair Planning Handling on Damage

Based on the PCI method the improvements made can be seen in Figure 4.3, for a PCI value of 0 - 35 it is necessary to do Reconstruction, a PCI value of 35 - 85 needs to be patched on damage, while for a PCI value of 85 - 100 it is only necessary to carry out routine maintenance or checks carried out every day.



Gambar 3. Damage Handling with the PCI Method (Road Damage Analysis and Handling with the PCI Method, 2020)

Based on the PCI method the improvements made can be seen in Figure 4.3, for a PCI value of 0 - 35 it is necessary to do Reconstruction, a PCI value of 35 - 85 needs to be patched on damage, while for a PCI value of 85 - 100 it is only necessary to carry out routine maintenance or checks carried out every day.

Table 29: Damage Handling of Each Sample

Sampel	No STA	Nilai PCI	Kondisi Perkerasan	Penanganan
1	0+000 s/d 0+050	84	Sangat Baik	Tambalan
2	0+050 s/d 0+100	95	Sempurna	Pengecekan Rutin
3	0+100 s/d 0+150	100	Sempurna	Pengecekan Rutin
4	0+150 s/d 0+200	92	Sempurna	Pengecekan Rutin
5	0+200 s/d 0+250	81	Sangat Baik	Tambalan
6	0+250 s/d 0+300	94	Sempurna	Pengecekan Rutin
7	0+300 s/d 0+350	93	Sempurna	Pengecekan Rutin
8	0+350 s/d 0+400	94	Sempurna	Pengecekan Rutin
9	0+400 s/d 0+450	92	Sempurna	Pengecekan Rutin
10	0+ 450s/d 0+500	91	Sempurna	Pengecekan Rutin
11	0+500 s/d 0+550	91	Sempurna	Pengecekan Rutin
12	0+550 s/d 0+600	95	Sempurna	Pengecekan Rutin
13	0+600 s/d 0+650	100	Sempurna	Pengecekan Rutin

Repair with Patching Method

According to KP 94 Year 2015 on airport pavement maintenance, patching is one of the maintenance activities in repairing damage to the pavement by cutting locally/partially in the damage area and patching the area so that the pavement returns to good condition. The following is the technical repair work using the patching method:

a. Determine location and measurement.
b. Existing asphalt demolition process.
c. Cleaning the patching area.
d. Application of tack coat.
e. Asphalt hotmix ACWC overlay process.
f. Asphalt compaction process
g. Site cleaning after patching

Repair with Fogsealing Method

According to KP 94 of 2015 concerning airport pavement maintenance, fogsealing is a patching activity on flexible pavement using emulsified asphalt which aims to close gaps or cracks in the pavement and strengthen patching joints. The following are the techniques in repair work using the fogsealing method:

a. Prepare Fogsealing Materials and Tools.
b. determine the location and measurement of the damage.
c. patching using asphalt emulsion.
d. cleaning the location after fogsealing.

Volume of Repair Work

Patching repairs will be carried out on the first layer of existing asphalt with an average damage depth of 15 cm. The following is the damage area on 13 (thirteen) samples.

Table 30: Extent of Damage

C	Sampel STA	Kondisi Perkerasan	Penanganan (Tambalan)	Jenis Kerusakan	Volume Luasan (m2)
1	0+000 s/d 0+050	Sangat Baik	Tambalan	Penurunan Jalur Roda (Rutting)	28
			Fog Sealing	Retak Pada Sambungan Patching	9
2	0+50 s/d 0+100	SEMPURNA	Fog Sealing	Retak Pada Sambungan Patching	5,5
3	0+150 s/d 0+200	SEMPURNA	Fog Sealing	Retak Blok (Block cracking)	2,4
4	0+200 s/d 0+250	SEMPURNA	Patching	Penurunan Setempat (Depression)	60
5	0+250 s/d 0+300	Sangat Baik	Fog Sealing	Retak Pada Sambungan Patching	1,5
6	0+300 s/d 0+350	SEMPURNA	Fog Sealing	Retak Memanjang (Long Cracking)	4,8
7	0+350 s/d 0+400	SEMPURNA	Fog Sealing	Retak Blok (Block cracking)	2,75
8	0+400 s/d 0+450	SEMPURNA	Fog Sealing	Penurunan Setempat (Depression)	3,6
9	0+ 450s/d 0+500	SEMPURNA	Fog Sealing	Retak Kulit Buaya (Alligator cracks)	1,65
10	0+500 s/d 0+550	SEMPURNA	Fog Sealing	Retak Pada Sambungan Patching	3,96
			Fog Sealing	Retak Pada Sambungan Patching	4,56
11	0+550 s/d 0+600	Sangat Baik	Fog Sealing	Retak Memanjang (Long Cracking)	1,44

From the results of PCI analysis in taxiway N5N and N5S, there are 2 (two) samples that will be repaired and there are 13 (thirteen) types of damage. Each damage has a different total area.

Table 31: Total Area of Damage

No	Jenis Kerusakan	Jumlah Total Luasan (m2)
1	Retak Memanjang (Long Cracking)	6,24
2	Retak Setempat (Block Cracking)	5,15
3	Penurunan Setempat (Depression)	63,6
4	Penurunan Jalur Roda (Rutting)	28
5	Retak Pada Sambungan Patching	24,52
6	Retak Kulit Buaya (Alligator cracks)	1,65

Cost Budget Plan

The following is an example of the calculation of RAB in repair planning which shows how much material or financial needs such as the number of workers, material requirements, tools and materials for repairs to the planned N5N and N5S taxiways. The value in this RAB planning is used for one repair on taxiways N5N and N5S.

Table 32: Budget Plan

RINCIAN ANGGARAN BIAYA (RAB)					PT. ANGKASA PURA I KANTOR CABANG BANDAR UDARA JUANDA SURABAYA	
PEKERJAAN : PERBAIKAN PADA PERKERASAN TAXIWAY N5N DAN N5N						
FASILITAS : TAXIWAY						
LOKASI : NORTH RAPID EXIT TAXIWAY (N5N DAN N5S)						
NO	URAIAN PEKERJAAN	VOLUME	Sat	HARGA SATUAN (Rp)		JUMLAH HARGA (Rp)
a	b	c	d	f		e = c x f
A	Pengaspalan Jalan					
1	Pembongkaran Perkerasan dengan Jack Hammer	6,60	m3	Rp	101.336,63	Rp 668.821,73
2	Pembuangan Aspal Eksisting Hasil Bongkaran	6,60	m3	Rp	47.783,00	Rp 315.367,80
3	Pekerjaan Tack Coat Aspal Emulsi	9,34	kg	Rp	16.185,41	Rp 151.171,72
4	Pekerjaan Laston (AC-WC)	15,51	ton	Rp	661.746,19	Rp 10.263.683,34
5	Pekerjaan Fogsealing Aspal Emulsi	36,12	kg	Rp	83.803,22	Rp 3.026.972,22
B.	Pekerjaan Lain-Lain					
1	Pembersihan Akhir	124,12	m3	Rp	26.596,12	Rp 3.301.110,10
2	Seragam Kerja	10,00	pcs	Rp	100.000,00	Rp 1.000.000,00
					JUMLAH	Rp 11.399.044,58
					KEUNTUNGAN JASA 10%	Rp 1.139.904,46
					JUMLAH + KEUNTUNGAN JASA 10%	Rp 12.538.949,04
					PPN (11%)	Rp 1.379.284,39
					TOTAL	Rp 13.918.233,43
					PEMBULATAN	Rp 13.918.200,00
TERBILANG : Tiga Belas Juta Sembilan Ratus Delapan Belas Ribu Dua Ratus Rupiah						

CONCLUSION

From the discussion of chapter 4 above, it can be concluded:

1. The method of repairing damage at STA 0+000 to 0+050 and 0+200 to 0+250 gets a value of 84 and 81, so repairs are carried out in the form of patching, while for other points getting a value above 85, the maintenance method is carried out, daily and weekly routine checks and fog sealing on samples that get a PCI value of 86-100 at that location.
2. Furthermore, the estimated cost of the cost budget plan (RAB) for repairing damage is IDR 13,918,200.00 (Thirteen Million Nine Hundred Eighteen Thousand Two Hundred rupiah).

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