PLANNING FOR FLEXIBLE PAVEMENT REHABILITATION ON APRON ALPHA USING THE PAVEMENT CONDITION INDEX (PCI) METHOD AT DJALALUDDIN AIRPORT, GORONTALO

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ABSTRACT

The condition of flexible pavement in the airport apron area plays an important role in ensuring the safety and smoothness of flight operations. At the Djalaluddin Gorontalo Airport Operator Unit, there were findings of damage to the Flexible Pavement Apron Alpha indicating the urgency of the need for proper repair planning. This study aims to evaluate and plan flexible pavement repairs using the Pavement Condition Index (PCI) method, which has been widely recognized as a quantitative method for assessing the level of pavement damage. The methodology used includes a visual survey based on ASTM D5380-98 to identify the type and level of damage, calculating the PCI value for each sample unit, and comparing the results with the FAA maintenance standards and KP 94 of 2015. The results showed that the average PCI value of Apron Alpha was in the good to moderate category, with the dominance of damage in the form of Rutting and Long & Trans Crack. Based on the results of the study using the PCI method, repair planning was carried out in the form of patching and routine inspections according to the level of damage to each unit. The contribution of this research is to provide a technical reference based on actual data in airport infrastructure maintenance decision making, as well as to strengthen the importance of using evaluative methods such as PCI in flexible pavement maintenance management.

Keywords: *Pavement Condition Index (PCI), Flexible Pavement, airport, apron, rehabilitation planning,* Djalaluddin Gorontalo *Airport*

1. INTRODUCTION

According to the official website of Djalaluddin Gorontalo Airport, Djalaluddin Gorontalo Airport (ICAO: WAMG / IATA: GTO) is an airport located at Jalan Satria / Angkasa No. 274, Tolitio Village, Tibawa District, Gorontalo Regency, Gorontalo Province. This airport operates under the supervision of Airport Authority VIII Manado. Djalaluddin Gorontalo Airport is situated at coordinates 00° 38' 17" N and 122° 51' 07" E with an elevation of approximately 18 meters above sea level. The airport is named after a national hero, Colonel Djalaluddin Tantu, who died while carrying out Operation Dwikora in 1964.

In 1955, the first aircraft landing in Gorontalo Province was carried out by an Albatros aircraft at Lluta Airfield, Batuda'a District, Gorontalo Regency. The purpose of this landing was to review the construction of an airfield in Tolitio Village by the Directorate of Public Works for military purposes. After the initial construction of the airfield was completed, in 1956 a DC-3 Dakota aircraft landed at the Tolitio airfield. Tolitio Airfield, which originally served as a military airport, was later used as a commercial airport managed by the Directorate General of Civil Aviation (Lufritayanti and Annisa, 2013).

In 1974, the name of Tolitio Airfield was changed to Djalaluddin Gorontalo Airport upon the proposal of the ABRI faction in the Regional House of Representatives

(DPRD) of Gorontalo Regency. The name was taken from Lt. Col. (Pilot) Djalaluddin Gorontalo, an Indonesian Air Force pilot from Gorontalo who died during Operation Dwikora in Malaysia. He was lost along with the Hercules aircraft he piloted, hence the airport was named Djalaluddin Gorontalo Airport. On September 19, 2014, the airport was designated as a Class I Airport Operating Unit under the Directorate General of Civil Aviation - Ministry of Transportation. Currently, the airport can accommodate Boeing 737-900 ER aircraft operated by airlines such as Garuda Indonesia, Lion Air, Batik Air, and Wings Air. The supporting facilities at Djalaluddin Gorontalo Airport include Class III Health Services, Class III Animal and Plant Quarantine, Cargo, Taxi, Damri (airport shuttle bus), Bentor (motorized rickshaw), Hotel Shuttle Bus, Cafeteria/Restaurant, Mini Market, ATM machines, and others (https://www.djalaluddinairport.com/sejarah.htmlOpens a new window).

According to the airport's website: DJALALUDDIN - Directorate General of Civil Aviation, Djalaluddin Gorontalo Airport has two aprons: Apron Alpha is used as the cargo apron, while Apron Bravo is used for passenger aircraft. Apron Alpha itself has dimensions of 230 m x 80 m with a PCN strength of 56/F/C/W/T and uses flexible pavement. Apron Alpha is used for landing cargo planes operated by Rimbun Air. The Boeing 737-500 is the aircraft used by Rimbun Air to conduct cargo landing activities at Djalaluddin Gorontalo Airport (Djalaluddin Airport: Directorate General of Civil Aviation). With an average of 14 cargo aircraft movements per week by Rimbun Air, Apron Alpha is used as the parking apron for these aircraft. As a result, several types of damage have been observed on the surface layer of the flexible pavement at Apron Alpha (Cargo Apron) of Djalaluddin Gorontalo Airport, including deflection and cracking at the aircraft wheel stop points in the parking stand as well as rutting along the aircraft pathway on the guideline parking stand.

These cracks and deflections on Apron Alpha (Cargo Apron) were discovered during routine inspections conducted by the Runway Unit of Djalaluddin Gorontalo Airport, particularly focusing on the maintenance of the airport pavement construction. This is in accordance with the guidelines of KP 94 of 2015 concerning the "Technical Operational Guidelines for Civil Aviation Safety Regulations Part 139-23 (Advisory Circular CASR Part 139-23), Pavement Management System Guidelines for Airport Pavement Construction Maintenance Programs." KP 94 of 2015 also regulates the handling of damage to airport pavement construction. Before carrying out repair activities (and treatment) on the pavement construction, an analysis of the damage on Apron Alpha is first conducted to determine the pavement value, identify critical areas, establish the appropriate repair method, and calculate the planned budget for the repairs.

Therefore, in this analysis, the PCI (Pavement Condition Index) method recommended by the FAA (Federal Aviation Administration) is used. This test was carried out directly by the author, as no PCI test had previously been conducted on Apron Alpha at Djalaluddin Gorontalo Airport. Based on the explanation above, a further discussion regarding the use of the PCI method for flexible pavement analysis on Apron Alpha at Djalaluddin Gorontalo Airport is necessary, as no PCI study has ever been conducted there. All of these are summarized in this final project report entitled:

"PLANNING FOR FLEXIBLE PAVEMENT REHABILITATION ON APRON ALPHA USING THE PAVEMENT CONDITION INDEX (PCI) METHOD AT DJALALUDDIN AIRPORT, GORONTALO"

2. METHOD

Figure 1 Research Flow

Primary Data

This research also utilized primary data, specifically regarding the types, degrees, and forms of runway damage. The data was collected through visual inspection techniques and direct observation in the field.

Secondary Data

In this study secondary data were used, namely the Djalaluddin Gorontalo Airport Apron data as follow :

1. Surface : Flexible Pavement.
2. Streght : PCN 56/F/W/C/T.
3. Dimension : 230 m x 80 m.

Analysis with PCI Method

The Pavement Condition Index (PCI) is a system for evaluating the state of road surfaces by examining the types and severity of damage present. This index serves as a guideline for planning maintenance activities. The analysis steps for assessing pavement condition using the PCI method are as follows

1. Desinty

   Desinty or damage level refers to the percentage of the area affected by a specific type of damage relative to the area of a segment unit, measured in square meters. The desinty value for each type of damage is also distinguished based on its severity level. The formula for calculating desinty is as follows :

   Desinty = $\frac{Ad}{AS}\ X\ 100$ or $\frac{Ld}{As}\ X\ 100\ \%$

   Ad = Total area of each type of damage (in square meters)

   Ld = Total area of each Type of damge for each severity level (in meters).

   As = Total area of the segment unit (in square meters)

2. Deduct Value is the reduction value assigned to each type of damage, which is determined from the curve that shows the relationship between Density and Deduct Value. The Deduct Value curve can be seen in the figure in ASTMD 5430 – 98.

3. calculating the allowable number of deducts (mi) Allowable Number of Deducts is the minimum Deduct Value for each type of pavement distress that is permitted to be included in the pavement condition assessment. The (mi) value serves as a correction factor for the Deduct Value. If all Deduct Values are greater than (mi), then each Deduct Value is reduced by (mi). If a Deduct Value is less than (mi), no reduction is applied.

   (mi) = $1 + \left(\frac{9}{95}\right)(100 - HDV)$

   (mi) = *Allowable Number Of Deduct Sample Unit*.

   HDV = *Highest Deduct Value,* biggest score in every unit.

4. Calcualating the deduct value and the corrected deduct value.

   The Total Deduct Value is the sum of all individual deduct values. From this data, the value of q can be determined, which represents the number of deduct values greater than 5. The value of q is combined with the total deduct value (TDV) to obtain the corrected deduct value, or Corrected Deduct Value (CDV). The CDV is derived from the curve that shows the relationship between TDV and CDV, by selecting the appropriate curve based on the number of deduct values.

5. According to ASTM D5340 – 98, the PCI value for each sample unit can be calculated after obtaining the CDV value by using the following equation:

   PCI (s) = 100 – CDV

   PCI (s) = Pavement Condition Index for every Unir.

   CDV = Corrected Deduct Value.

   PCI $= \frac{\sum \mathrm{PCI(s)}}{N}$

   PCI = PCI score for pavement.

   PCI(s) = Pavement Condition Index for every Unit.

   N = Summary unit.

How to repairs

Once the types of damage have been identified and the pavement condition value has been determined using the PCI method, it is possible to plan the appropriate maintenance and repair strategies to be implemented on the Apron Alpha Pavement at Djalaluddin Gorontalo Airport.

3. RESULT

Apron alpha Condition

Djalaluddin Gorontalo Airport has a Apron Alpha with dimensions of 230 M x 80 M. On the surface of this apron there is damage in the form of patching and utilty cuts, weathering and ravelling, depression, long and trans crack, rutting.

PCI Calculation

In the analysis of surface damage on Apron Alpha at Djalaluddin Gorontalo Airport using the PCI method, the author divided the apron into five samples. The sizes of samples 1 through 4 are 50 m x 80 m, while sample 5 measures 30 m x 80 m. An example of PCI calculation on one of the Apron samples at Apron Alpha Djalaluddin Gorontalo Airport is as follows.

Table 1 Sample 5 STA 0 + 250

Segmen C ; Sampel 5

LEMBAR DATA SURVEY
KONDISI PERKERASAN LENTUR PADA APRON
UNTUK UNIT SAMPEL

Lokasi	: UPBU BLU Djalaluddin Gorontalo.	STA : 0+230	Segmen	: C
Pensurvey	: Ahmad Jimi Satriyo Utomo (Poltekbang Surabaya)	Tahun : 2024	Sampel	: 5

11. Retak memanjang dan melintang	21. Lepas terurai	31. Penurunan jalur roda	42. Tumpahan Minyak
12. Retak Kulit Buaya	22. Lubang	32. Gelombang	43. Keluarnya Material Aspal ke Permukaan
13. Retak Blok	23. Mengelupas	33. Penurunan Setempat	
14. Retakan Slip	24. Erosi Semburan	34. Mengembang	
15. Retakan Reflektif Sambungan	25. Tambalan dan Galian Utilitas	41. Agregat Licin	

Kode	Luasan (m²)								
	1	2	3	4	5	6	7	Total	Desinty %
11M	3							3	0,125
								0	0
								0	0

Calculating Desinty :

$$\frac{Ad}{As} \text{ X } 100\ \% = \frac{3}{2400} \text{ X } 100\ \% = 0{,}125\ \%$$

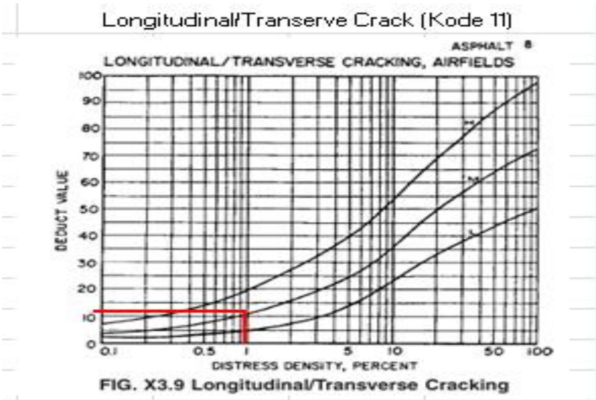

Figure 2 Deduct Value Longitudinal/Transerve Crack

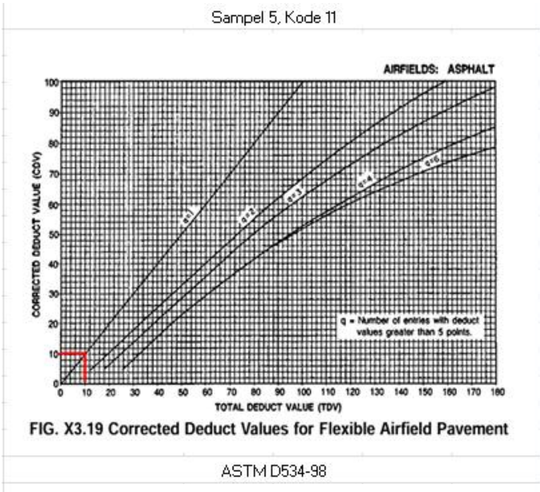

Figure 3 Corrected Deduct Value (CDV) Chart

Deduct Value	HDVI	mi
10	10	9,52631579

Figure 4 HDVi, mi Sample 5

After obtaining the deduct value and corrected deduct value for the pavement damage in sample 5, the PCI value for sample 5 can then be determined using the PCI calculation formula: **PCI = 100 - HDVi**. Thus, the PCI value for sample 5 is as follows :

100 - 10
(where 10 is the HDVi value for sample 5).

The following are the PCI results for samples 1 through 5, along with the corresponding damage category assessments.

Tabel 2 PCI score each sample

No	Sta	Kerusakan	Deduct Value					TDv	q	CDv	HCDv	Nilai PCI	keterangan
			1	2	3	4	5						
1	Sampel 1	21 M	5	1				6	1	9	15	85	Cukup Baik
		25 M	5	1				6	1	15			
2	sampel 2	21 M	8					8	1	9	9	91	Baik
3	sampel 3	33 M	15	6	5			26	3	11	27	73	Cukup Baik
		11 L	15	6	5			26	2	13			
		33 M	15	6	5			26	1	27			
4	sampel 4	31 M	11	5	5			21	3	9	21	79	Cukup Baik
		33 M	11	5	5			21	2	11			
		11 L	11	5	5			21	1	21			
5	sampel 5	11 M	10					10	1	10	10	90	Baik

4. MAINTENANCE PLANNING

The flexible pavement condition on Apron Alpha at the Djalaluddin Gorontalo Airport Operating Unit (BLU) can be categorized as GOOD based on the Pavement Condition Index (PCI) value. Using five research samples, the average PCI value for the flexible pavement of Apron Alpha at UPBU BLU Djalaluddin Gorontalo is 83.6. However, there are five damage units in several samples that require repairs using the patching method (utility patching). These five damage units are located at Sta 0+100 m (one damage with a PCI value of 91), Sta 0+150 m (two damages with a PCI value of 73), and Sta 0+200 m (two damages with a PCI value of 79). The methods used to address the damage found in the flexible pavement of Apron Alpha at Djalaluddin Gorontalo Airport are the patching method (utility patching) and routine inspection**. The estimated budget for carrying out repairs using the patching method is Rp 27,695,000.00 (twenty-seven million six hundred ninety-five thousand rupiah).**

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