ANALYSIS THE CONDITION OF THE RUNWAY PAVEMENT UMBU MEHANG KUNDA AIRPORT WAINGAPU – NTT USING THE PAVEMENT CONDITION INDEX (PCI) METHOD

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Abstract
Transportation is very much needed in an effort to much needed for developing an advanced country, one of the transportation that is very influential is air transportation, Umbu Mehang Kunda Waingapu Airport is one of the accesses to air transportation in East Sumba Regency, East Nusa Tenggara. This airport has a runway dimension of 2000 x 30 m with PCN 48 F/C/X/T. Every year the growth of aircraft and passenger movements has always increased. This often causes the runway pavement structure to be damage prematurely, besides that natural factors also have an effect. Runway damage can be assessed using the Pavement Condition Index (PCI) method. In analyzing the condition of the runway pavement using the Pavement Condition Index (PCI) method, a visual inspection of the runway surface at Umbu Mehang Kunda Waingapu Airport was carried out. Distribution of samples and calculations based on the ASTM document. The repair method is regulated in KP 94 of 2015 concerning Operational Technical Guidelines for Civil Aviation Safety Regulation. The results of the analysis carried out on the runway at Umbu Mehang Kunda Waingapu Airport showed several types of damage, namely Raveling/ Weathering, Bleeding, and Depression with an average value obtained of 54 in sufficient condition. Therefore, the method of repair in accordance with KP 94 of 2015 regulations is Overlay and Patching.

Keywords: Runway, Pavement Condition Index (PCI), Pavement.

INTRODUCTION

Indonesia is the largest archipelago in the world with 17,508 officially recorded islands. The territory of Indonesia is divided into various islands separated by the ocean between the continents of Asia and Australia, as well as between the Pacific Ocean and the Indian Ocean. From year to year, every country in the world experiences development in order to become a developed country.

Transportation is needed in order to advance a country. Because our country is not a little separated by the ocean, so other alternatives are needed besides land transportation, namely air and sea transportation. This makes transportation a crucial thing in Indonesia, because it is with transportation that existing resources can move to be prepared to be part of the energy that will help develop the country until it can finally become a developed country.

Umbu Mehang Kunda Airport is one of the air transportation accesses in East Sumba Regency, East Nusa Tenggara. The airport is geographically located at a position of 09.04 South latitude and 120.18 East longitude. Located about 7 km from the city of Waingapu, which is administratively located in Mau Hau Village, Kambera District, East Sumba Regency and is at an altitude of 10 meters above sea level with a distance of 1 km from the sea, surrounded by rivers that flow into the sea. Umbu Mehang Kunda Airport has runway dimensions of 2000 x 30 m with PCN 48 F/C/X/T.

According to research by Barkah Wahyu Widianto Runway pavement condition at an airport is an important factor in determining the maintenance program. The method that can be used to determine the condition of an airport runway is PCI.

According to research by Lahun Wahidah, Retno Ligina Ayu, and Eko Wiyono maintain the runway

pavement condition so that it can operate properly according to the standard in order to prevent potential accidents that can be dangerous for safety.

According to research by Muhammad Djaya Bakri roads subjected to high and repetitive traffic volumes can degrade the quality of the road surface and make it uncomfortable and unsafe for road users. In this case the PCI method is used in assessing the condition of the road surface.

Along with the development of a better community economy, air transportation can develop rapidly because it has the advantage of being able to cover long distances quickly and can reach remote areas. The rapid growth of the aviation industry often causes non-ideal conditions that can lead to premature failure of runway pavement. The dynamic effects of aircraft loads in the form of impact, movement, and braking of aircraft provide an impact factor of 1.5 of the actual wheel load of the aircraft on the flexible pavement of the runway (Sultan, 2017). Damage generally occurs on runway flexible pavement in the form of cracking, distortion, disintegration, joint seal damage, loss of skid resistance (FAA, 2012).

The quantity of pressure on the runway pavement surface reflects the condition of the pavement. In an effort to obtain the runway pavement condition value, one of the methods often used by airport managers is the Pavement Condition Index (PCI) method. This visual inspection-based method is to obtain accurate field data by identifying the type and amount of damage to the pavement surface so that the pavement condition value can be calculated.

The condition of the runway at Umbu Mehang Kunda Airport in Waingapu is experiencing Material Loss, Bleeding, and Depression on the runway surface. The main factors for this damage are due to the long age of the pavement and natural factors due to floods that have hit East Sumba Regency in April 2021, causing the runway to be submerged in water for a long time and resulting in the current condition of the runway surface being damaged.

METHOD

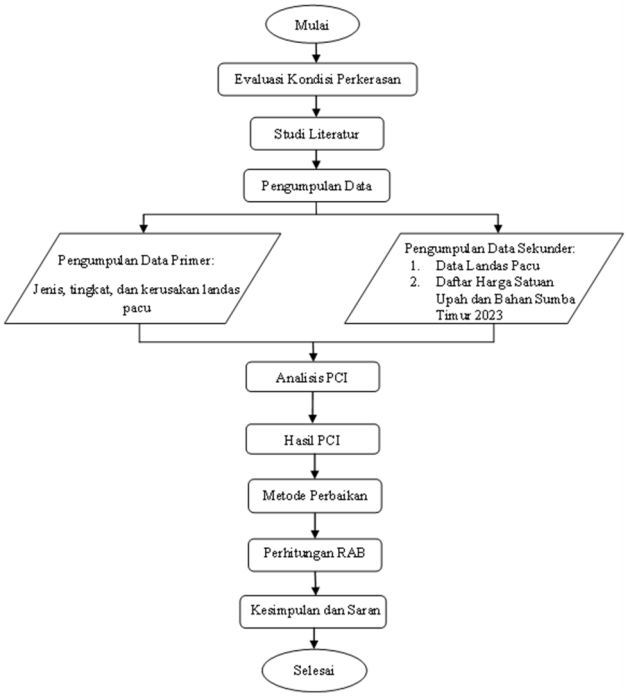

Figure 1 Research Flow Chart

Primary Data

This study also used primary data, namely the type, level and damage of the runway. This data was obtained using visual methods and direct field observations.

Secondary Data

In this study secondary data were used, namely the Umbu Mehang Kunda Waingapu Airport runway data as follows:

- Pavement type: Flexible Pavement

- Strength: PCN 48 F/C/X/T

- Dimension: 2000 x 30 meters

Analysis with PCI Method

Pavement Condition Index (PCI) is a road surface condition assessment system based on the type and level of damage, which can be used as a reference for maintenance work. The following is the sequence of analysis for pavement condition assessment using the (PCI) method:

1. Determine the number of samples.

   Based on ASTM D 5340-98, the determination of the number of samples can be calculated using the formula:

   Total sample = Total Area: Sample Unit Area

   Unknown:

   Sample unit area 450 ± 180 m^2

   The number of samples taken in this study was 20 samples with each sample dimensioned 100 x 30 meters.

2. Determining the minimum number of samples.

   The minimum number of samples reviewed is calculated using the following formula:

   $$n = \frac{Ns^2}{\frac{e^2}{4}(N-1) + s^2}$$

   Unknown:

   n : Minimum sample size

   N : Total number of sample units in a pavement section

   e : Allowable error in estimation of PCI section (e = 5 (ASTM D 5340-98))

   s : Standard deviation of PCI from one sample to another within a segment (standard deviation assumed to be 10 for AC and 15 for PCC).

   Alternative determination of the number of samples reviewed based on the total number of samples based on ASTM D 5340-98 can be seen in the following table:

   Table 1 Alternative Recommendation Number of Samples

Given	*Survey*
1 to 5 sample units	*1 sample units*
6 to 10 sample units	*2 sample units*
11 to 15 sample units	*3 sample units*
16 to 40 sample units	*4 sample units*
Over 40 sample units	*10%*

3. Calculating the degree (density) of damage by the percentage of damaged area within a study area. The density value of a type of damage is differentiated based on the level of damage. The formula used to calculate density is:

   Density = Ad/As x 100% or

   Density = Ld/As x 100%

   Unknown:

   Ad: Total area of damage type for each level of damage (m^2)

   Ld: Total length of damage type for each level of damage (m)

   As: Total area of the sample unit (m^2)

4. Calculate the deduct value for each research unit. Deduct value is the deduct value of each damage type obtained from the relationship curve between density and deduct value.

5. Calculate the total deduct value for each study unit. TDV is the sum of the individual deduction values for each type of damage and the level of damage in the research unit.

6. Calculate the Corrected Deduct Value obtained from the relationship curve between TDV and CDV values according to the q value obtained. The q value is obtained from the deduct value data where what is declared q is any DV data that has a value above 5.

7. If the CDV value is known, the PCI value for each unit can be known and the calculation of the overall PCI value will continue. The formula for obtaining the PCI value of each sample is obtained by the formula:

   PCI(s) = 100 – CDV

How to Repair

After knowing the type of damage and getting the value of the pavement condition with the PCI method, we can plan the right form of maintenance and repair to be applied to the Umbu Mehang Kunda Waingapu Airport runway pavement.

RESULT

Runway Pavement Condition

Umbu Mehang Kunda Airport Waingapu has a runway with dimensions of 2000 m x 30 m. On the surface of this runway there is damage in the form of Weathering / Ravelling, Bleeding, and Depression.

PCI Calculation

In this PCI calculation, the runway is divided into 20 samples, with each sample having dimensions of 100 x 30 meters. An example of PCI calculation on one of the runway samples at Umbu Mehang Kunda Airport Waingapu is as follows.

Table 2 STA 0+000 - 0+100 Survey Data

AIRFIELD ASPHALT PAVEMENT CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT									
BRANCH	UMBU MEHANG KUNDA AIRPORT				DATE	2022-2023			
SURVEYED BY	POLITEKNIK PENERBANGAN SURABAYA				SAMPLE AREA	RUNWAY			
SECTION	STA 0+000 – 0+100								
1. Aligator Cracking 2. Bleeding 3. Block Cracking 4. Corrugation	5. Depression 6. Jet Blast 7. Jt. Reflection (PCC) 8. Long. & Trans Cracking				9. Oil Spillage 10. Patching 11. Polished Aggregate 12. Raveling/Weathering		13. Rutting 14. Shoving from PCC 15. Slippage Cracking 16. Swell		
DISTRESS SEVERITY	QUANTITY					TOTAL	DENSITY %	DEDUCT VALUE	
12M	3000					3000	100	57	

Calculating density:

$$\text{Density} = \frac{Ad}{As} \times 100\%$$

$$= \frac{3000}{3000} \times 100\% = 100$$

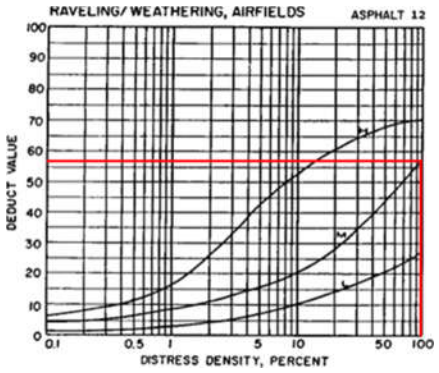

Figure 2 DV Raveling/Weathering Chart

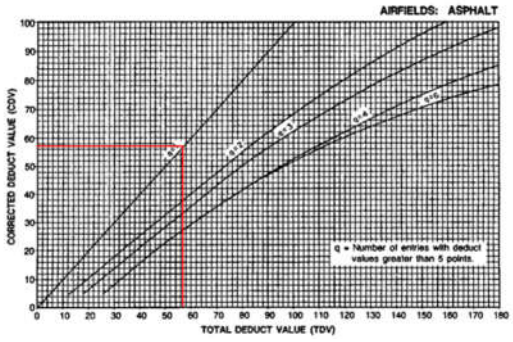

Figure 3 Corrected Deduct Value (CDV) Chart

PCI = 100 – HCDV

= 100 – 57

= 43

DV1	DV2	DV3	q	TDV	CDV	HCDV	NILAI PCI	KATEGORI
57			1	57	57	57	43	CUKUP

Figure 4 Calculation of DV and CDV

After calculating all STAs, the PCI value is 53.85. The calculated PCI value becomes a reference in determining the condition of the pavement in each sample to determine the appropriate type of handling. The results of the PCI value and how to handle it are in the following table.

Table 3 PCI Calculation Results

NO	STA	PCI VALUE	CATEGORY	HANDLING
1	0+000 – 0+100	43	FAIR	Overlay
2	0+100 – 0+200	30	POOR	Overlay
3	0+200 – 0+300	30	POOR	Overlay
4	0+300 – 0+400	30	POOR	Overlay
5	0+400 – 0+500	30	POOR	Overlay
6	0+500 – 0+600	30	POOR	Overlay
7	0+600 – 0+700	30	POOR	Overlay
8	0+700 – 0+800	30	POOR	Overlay
9	0+800 – 0+900	30	POOR	Overlay
10	0+900 – 1+000	30	POOR	Overlay
11	1+000 – 1+100	30	POOR	Overlay
12	1+100 – 1+200	30	POOR	Overlay
13	1+200 – 1+300	100	EXCELLENT	Inspections
14	1+300 – 1+400	93	EXCELLENT	Inspections
15	1+400 – 1+500	100	EXCELLENT	Inspections
16	1+500 – 1+600	100	EXCELLENT	Inspections
17	1+600 – 1+700	55	FAIR	Patching
18	1+700 – 1+800	56	GOOD	Patching
19	1+800 – 1+900	100	EXCELLENT	Inspections
20	1+900 – 2+000	100	EXCELLENT	Inspections

The following is a graph of the results of the PCI value of the Umbu Mehang Kunda Waingapu Airport runway.

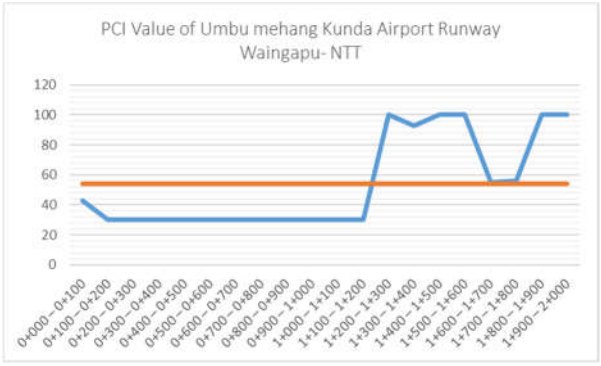

Figure 5 Comprehensive PCI Value Chart

From the results of the analysis using the PCI method on the runway of Umbu Mehang Kunda Waingapu Airport, it can be seen that at STA 0+000 - 2+000 shows that the overall runway surface condition produced an average PCI value of 53.85% with a sufficient scale. There are 11 in the poor category, 2 in the fair category, 1 in the good category, and 6 in the perfect category.

Maintenance Planning

The repair methods corresponding to the level of damage present in the damage construction are as follows:

1. In mild conditions (no cracks are caused and found in non-critical areas), regular inspections and site cleaning are carried out.
2. In moderate to severe conditions in areas that are not large, localized cutting (patching) can be done perpendicularly according to the thickness of the surface layer and filled with hot asphalt / hotmix asphalt mixture according to technical specifications and implementation methods. This method can be done on the type of Depression damage that occurs on the runway of Umbu Mehang Kunda Airport Waingapu.
3. In the condition that the damage has a large dimension, an overlay can be done by first treating the existing layer. This method can be done on the type of Raveling / Weathering damage that occurs on the runway of Umbu Mehang Kunda Airport Waingapu.

The following is a map of runway improvements at Umbu Mehang Kunda Airport Waingapu.

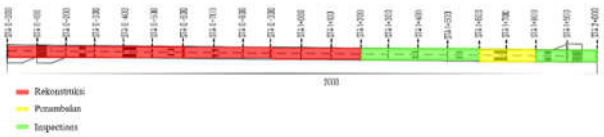

Figure 6 Repair Map

CONCLUSION

From the results of the analysis of the condition of the flexible pavement of the runway using the PCI method at Umbu Mehang Kunda Airport, Waingapu can be concluded as follows:

1. The value of pavement conditions using the PCI method obtained an average of 53.85% is included in the sufficient scale category with damage to almost the entire runway surface, namely Raveling / Weathering, Bleeding, and Depression.
2. Repair handling is carried out by the patching method if the damage is only a little and at certain locales with a PCI value of less than 70 and more than 55, while the reconstruction or overlay method if the damage is extensive and severe with a PCI value below 55.

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