

Airport Pavement Condition Index Evaluation of Runway 12/30 at Budiarto Airport Indonesia

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ABSTRACT

Article info

Received: 18-6-2024
Final Revision: 5-6-2024
Accepted: 24-6-2024
Available online: 30-6-2024

Keywords:

Budiarto Airport; flexible pavement; pavement condition index; runway pavement repair.

The increasing activity of aircraft movement from year to year has a significant impact on the condition of the runway pavement. Managing airport pavement infrastructure will enhance air traffic safety and reduce the problem likelihood of future airport pavement renovation costs. Therefore, the evaluation of the Flexible Pavement condition in the runway area becomes a crucial step. The goal is to measure and assess the level of wear, damage, and overall pavement performance. **The research objective** of this study to evaluate the pavement condition of Runway 12/30 at Budiarto Airport using the Pavement Condition Index (PCI) method. **The research method** or approach involved visual surveys and quantitative analysis to identify types and levels of pavement surface distress. Data were collected on various types of distress such as cracking, depression, raveling, and others that affect the integrity and operational safety of the runway. After data collection, PCI values were computed by considering the severity and extent of distress in each sample unit along the runway. **The finding** of the research revealed that the average PCI value for all samples on Runway 12/30 was 98.44, indicating an overall good condition. However, there were some samples showing "fair" PCI values, highlighting specific areas needing additional attention for maintenance and repair. Based on these findings, the technicians and airport management at Budiarto Airport have shown proficiency in maintaining the runway and have implemented suitable maintenance strategies to extend its service life and ensure operational safety. Therefore, this PCI-based assessment of pavement condition provides valuable insights necessary for airport management to make informed decisions regarding maintenance priorities and infrastructure sustainability.

Recommended Citation:

APA Style

INTRODUCTION

Budiarto Airport, with a runway measuring 1,800 meters by 45 meters and utilizing flexible pavement, has a Pavement Classification Number (PCN) for the runway at 37 F/C/X/T. In flexible pavement, PCN implies specific characteristics that need to be understood. Similarly, the taxiway and apron at Budiarto Airport also use flexible pavement with PCN values of 37 F/C/X/T each. According to Presidential Decree Number 94 of 2015, flexible pavement is defined as an elastic type of construction that allows deformation or bending under load. This indicates that the pavement can absorb pressure and adapt to changes in load conditions, particularly beneficial for runways subjected to aircraft loads (Atmia, 2018). Airfield pavement is intended to provide a smooth and safe all weather riding surface that can support the weights of such heavy objects as aircraft on top of the natural ground base. (Santoso et al., 2017) On the other hand, rigid or concrete pavement is a type of construction that utilizes aggregates as the main material and cement as a binding agent. The assigned PCN also provides an indication of the strength and load-

bearing capacity of the flexible pavement. For example, a PCN of 37 F/C/X/T reflects the pavement's ability to handle relatively high wheel loads with resistance to varying weather conditions.

A profound understanding of these pavement characteristics is crucial for effective maintenance and sustainable infrastructure management at airports. By comprehending the differences between flexible and rigid pavements, airport managers can take proactive steps in planning and implementing maintenance actions tailored to the specific needs of runways, taxiways, and aprons (Perhubungan Udara, 2019; Pik, 2024; Surkova, 2022). The increasing activity of aircraft movement from year to year has a significant impact on the condition of the runway pavement. Managing airport pavement infrastructure will enhance air traffic safety and reduce the likelihood of future airport pavement renovation costs. On the other hand, aviation authorities must evaluate the efficiency and cost-effectiveness of maintaining airport pavement, including runways, taxiways, and aprons, at the required performance levels throughout their service life.

This evaluation should be based on decisions made and an analysis of airport pavement management (Adeli et al., 2021; Noori, 2024). Therefore, the evaluation of the Flexible Pavement condition in the runway area becomes a crucial step. The goal is to measure and assess the level of wear, damage, and overall pavement performance. This evaluation is carried out by applying the Pavement Condition Index (PCI) method, a commonly used approach in the aviation infrastructure industry. The Pavement Condition Index (PCI) is a test conducted with the aim of assessing the surface condition of the pavement through visual surveys. PCI is a direct input into a PMS that assists the decision-making processes (Konstantinos Gkyrtis, 2021) This approach provides numerical values as a representation of the overall pavement surface condition. Using this method, each segment or section of the runway is assessed in detail to identify potential damage, deformations, or wear that may occur (Xu et al., 2021).

The evaluation of pavement condition using PCI not only provides a general overview of pavement quality but also generates data that can be used to make repair recommendations. The results of this evaluation can provide valuable insights to the relevant units at the airport, enabling them to take necessary corrective actions to ensure the safety and reliability of runway operations. The importance of pavement condition evaluation lies not only in routine maintenance but also in the ability to plan long-term investments. By understanding pavement conditions through the PCI method, airport managers can identify areas that require special attention, allocate resources efficiently, and plan preventive maintenance to extend the lifespan of the pavement (Qiao et al., 2021). Thus, the evaluation of runway pavement condition becomes a critical aspect in maintaining and enhancing the overall airport infrastructure.

The aim of this research is to conduct a survey on the pavement condition and collect damage data on Runway 12/30, identify damage locations at the earliest stage possible for interim intervention or planning permanent repairs promptly, determine the index of damage conditions for the flexible pavement on Runway 12/30, ascertain the calculated value of pavement layer damage on Runway 12/30 using the Pavement Condition Index (PCI) method which is practical tool supporting the operation of airport services in the field of managing airport pavements made of asphalt concrete (Wesołowski & Iwanowski, 2020) The study intends to determine the index of damage conditions specifically for the flexible pavement on Runway 12/30. By calculating the PCI values, this research seeks to provide a quantitative assessment of the extent and severity of pavement layer damage on Runway 12/30. This assessment is crucial as it directly supports the effective management of airport services, ensuring the operational integrity and safety of the runway.

Moreover, the PCI method aids in identifying areas of severe damage that could potentially disrupt airport operations if left unaddressed. Thus, the study aims to provide insights into necessary solutions and prioritize maintenance efforts to mitigate risks and enhance the longevity of the runway infrastructure. Furthermore, the research emphasizes the importance of timely intervention and proactive maintenance strategies based on PCI findings. It aims to contribute to the development of informed decision-making processes for airport authorities and pavement engineers, guiding them in optimizing resource allocation and ensuring sustainable management of airport pavements. Ultimately, by integrating PCI assessments into routine maintenance practices, this study aims to enhance the overall reliability and safety of Runway 12/30 at the airport, thereby supporting smooth and uninterrupted airport operations.

METHOD

In this study, the methods used are visual inspection and quantitative analysis to evaluate the Pavement Condition Index (PCI) of Runway 12/30 at Budiarto Airport. The visual inspection is conducted to identify the type, severity, and extent of pavement surface distress. (Qureshi et al., 2022)

The data obtained from the visual inspection is then analyzed quantitatively to calculate the PCI value, which provides an overall assessment of the pavement condition and assists in maintenance and repair planning. According to the Directorate General of Civil Aviation Regulation Number KP 94 of 2015 on the Technical Operational Guidelines for Civil Aviation Safety Regulations Part 139-23 (Advisory Circular Casr Part 139-23), the main focus of this regulation is on the Guidelines for the Airport Pavement Construction Maintenance Program, also known as the PAVEMENT MANAGEMENT SYSTEM. Pavement construction, as outlined in this regulation, is designed, constructed, and maintained with a specific purpose – to provide optimal support for the applied loads. The objective is to achieve the required smoothness and skid resistance for the safety of flight operations.

The main requirements for pavement construction involve appropriate thickness and quality, ensuring that the pavement has sufficient load-bearing capacity to withstand various loads and remains resilient against potentially damaging influences from loads, weather conditions, and other factors. (Mohamed & Zaltuom, 2011) In this context, it is important for airport operators to consider various parameters related to design, construction, and materials to ensure the structural integrity of the pavement and prevent potential unexpected damage. (Ndume et al., 2020)

The evaluation of pavement depends on the observation and recording of its condition, identified surface characteristics, and also its structural condition. The evaluation of these elements can differ in terms of functional or structural aspects. (Pinatt et al., 2020). The evaluation of these parameters includes detailed information about the composition of pavement construction and functional aspects related to pavement components, both in rigid and flexible pavements. Specifically, flexible pavements, which exhibit elastic properties with the ability to deform under loading, require special attention. The construction of flexible pavements involves the careful selection and combination of several layers of materials designed to distribute loads from the pavement surface to the layers beneath. (Lin & Ho, 2016) For example, the structure of a flexible pavement typically consists of several key components, starting from the subgrade, subbase course, base course, to the surface course. In the design phase, it is crucial to ensure that each layer can distribute the applied load to the layer beneath it without exceeding the capacity or support of each respective layer. (Ahmad et al., 2018).

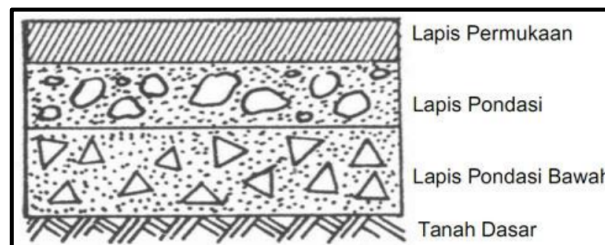


Figure 1. Flexible Pavement Structure

Mohammad Imaduddin (2017): Pavement layers often experience damage or failure before reaching their planned lifespan. Failures in pavement can be observed through functional and structural conditions. Functional damage occurs when the pavement's hardness can no longer function as intended. On the other hand, structural damage is characterized by damage to one or more parts of the road pavement structure. Functional failure primarily depends on the degree or level of surface roughness, while structural failure is caused by unstable subgrade layers, traffic loads, surface fatigue, and the influence of surrounding environmental conditions. Types of flexible pavement damage include: alligator cracking, bleeding, block cracking, corrugation, depression, reflection cracks, longitudinal/transversal cracks, oil spillage, patching, polished aggregate, raveling, rutting, and slippage cracking.

The Pavement Management System is an efficient technique for investigating and addressing airport pavement conditions. It is a valuable tool that alerts airport managers about deteriorating conditions throughout the lifespan of the airport pavement. A crucial feature of PMS is its ability to assess the current condition of the pavement network and predict future conditions. PMS can be conducted using the Pavement Condition Index (PCI) method. (Zafar et al., 2019). The Pavement Condition Index (PCI) is a highly important evaluation method for assessing the condition of a road pavement. The Pavement Condition Index (PCI) is an assessment method developed by the U.S. Army Corps of Engineers, expressed in the Pavement Condition Index (PCI) index. The use of PCI for

evaluating airport runways, highways, and parking lots has been widely adopted in the United States. (Psalmen Hasibuan & Sejahtera Surbakti, 2019) This approach involves visual observation to identify pavement conditions and assign a numerical value, known as the Pavement Condition Index (PCI), within the range of 0.0 to 100. This PCI value reflects the overall condition of the pavement surface on a road section, where a perfect score (100) characterizes the best condition, while a score of 0.0 indicates the worst condition. (Issa et al., 2022). In this case, field officers are always stationed with full visibility on the edge and in the center of the runway pavement. Scores for each section are assigned at the end of each section because, in this way, field officers can observe all existing damages. The score approaches 100 when at the end of a section only minimal damages are found, or the damages are nearly imperceptible. Some examples include surface cracks, fissures, patches, and small holes, or low wear in small areas. As the level and severity of defects increase, the PCI score decreases. Using the PCI value, the pavement condition is determined. (Pinatt et al., 2020) More than just a number, the Pavement Condition Index (PCI) also provides a ranking of the condition that offers a more detailed overview of the level of damage to the pavement. Although PCI only provides information at the time of the survey, it is important to note that this method cannot predict the pavement's condition in the future. Therefore, periodic pavement condition surveys are crucial to ensure that the obtained information remains relevant and can be used as a basis for more detailed maintenance actions. By integrating data from repeated surveys, stakeholders can monitor changes in pavement conditions over time and take proactive steps to extend the road's lifespan while minimizing the risk of further damage.

The Pavement Condition Index (PCI) assessment process for a pavement begins with the identification phase of the pavement section, defined as an area of pavement adjacent and unitary in maintenance, design, structure, climate conditions, similar traffic volume demand, usage history, and the same structural and geometric characteristics. (Issa et al., 2022). Afterward, this section is visually inspected to detect and assess potential pavement damages that may occur. The method of determining the PCI value for a pavement involves a series of steps. Firstly, the pavement is categorized into pavement types, and then it is further divided into sample units representing the overall condition. At the sample unit level, the type and extent of pavement damage are determined, and measurements of the damage density are taken on one sample unit for the entire runway pavement area. The reduction value is then calculated by referring to the available curve, and the Total Deduct Value (TDV) is obtained by summing up the reduction values for one segment. The process continues by completing the TDV calculations, including determining corrections to the reduction values (CDV). Afterward, the PCI value is calculated using the equation: $PCI = 100 - CDV$. The next step involves calculating the average PCI value for all identified sample units. Finally, the pavement condition is classified based on the obtained PCI values, providing an overall indication of the integrity and sustainability of the pavement. (Isradi et al., 2020).

According to regulations, the PCI indicator for a specific sample is determined. The final PCI index value for the evaluated sample is calculated as the average value of all PCI index values per sample. If the selected sample for testing has different surface areas, the weighted average PCI indicator is considered as the final value of the PCI indicator. (Wesołowski & Iwanowski, 2020). This process not only provides numerical values for a pavement but also offers a deeper understanding of the types and levels of damages that may occur. This enables infrastructure managers to take more targeted and effective maintenance actions to extend the lifespan of the pavement. (A.R. Temimi et al., 2021) Therefore, the detailed evaluation steps in the PCI assessment process are an integral part of sustainable and operationally safe airport pavement management. (Kim et al., 2019) In recent years, machine-based surveys have become a vital component in the routine evaluation of pavement conditions, as they provide technology for collecting detailed and timely surface pressure data. However, there is a need to enhance the analysis methods to efficiently manage large amounts of data and generate detailed information. Software techniques have increasingly become the preferred choice in airport pavement engineering in the last few decades. (Osman et al., 2023)

The capabilities of advanced software and infrastructure, coupled with abundant resources for software, enable the storage and processing of very large volumes of data at an affordable cost. This provides the ability to process pavement survey data more effectively, generating more accurate and relevant information. With this approach, pavement condition evaluations can be more efficient, providing a robust basis for decision-making related to maintenance and repairs. (Pavement et al., 2022)

Table 1. PCI Indicator

PCI INDICATOR	CONDITION
0 – 10	Failed
11 – 25	Serious
26 - 40	Very poor
41 – 55	Poor
56 – 70	Fair
71 – 85	Satisfactory
86 - 100	Good

The manual calculation method, involving visual inspection, influences the pavement's PCI value. The calculation is based on the assessment of the pavement surface conditions by defining the type of distress, its level, and severity. (Al-Rubae et al., 2020). This research was conducted using a visual inspection method involving the research supervisor and the inspection team. The researchers conducted on-site surveys utilizing flight aids to meticulously record any potential damages on the runway surface. The next step involved analyzing the collected data using quantitative methods with the aim of obtaining the Pavement Condition Index (PCI) values in accordance with the standards set by ASTM (American Society for Testing and Materials) and KP 94 of 2015. (Peraturan Direktur Jenderal Perhubungan Udara, 2015)

The data collection process began with the initial preparation phase, involving planning and coordinating the data collection schedule with the head of the Airport Operating Unit (UPBU) Budiarto. Once the schedule was confirmed, equipment and necessary supporting documents were prepared, such as airport passes, flight aids, cameras, Occupational Health and Safety (K3) equipment, and others. The research supervisor and the inspection team then conducted a comprehensive visual survey of the runway area. They carefully identified and documented various types of damages and wear that could occur, including but not limited to cracks, deformations, holes, chunks, and various other damages that might affect the integrity and safety of the runway. (Lee et al., 2022).

After the data was collected, the analysis process was conducted using quantitative methods, referring to ASTM and KP 94 of 2015 standards. This method ensures that the assessment of pavement conditions is based on measurable and objectively measurable parameters. Thus, the results of this research not only provide PCI values but also offer a deep understanding of specific and detailed pavement conditions, providing a foundation for more precise and effective maintenance and repair decision-making. The processing of runway evaluation data with the Pavement Condition Index (PCI) is a process that involves careful analysis and calculations to generate figures that provide a holistic overview of the overall runway condition. This process begins with the initial step of collecting data, involving information related to cracks, deformations, wear, damages, and previous repairs on the runway.

The next step in the PCI data processing is the meticulous visual assessment of each runway segment, aiming to identify any potential issues, such as cracks, holes, chunks, or other damages. It is important to assign weights to each type of damage according to the severity they possess. Severity assessment is done using metrics that are dependent on the guidelines used, and in this context, ASTM (American Society for Testing and Materials) guidelines are used with a rating scale from 0 to 100. The next process involves calculating the Sub-PCI for each runway segment. This involves summing up scores for various types of damages and their severity levels according to the predetermined weights. After that, the PCI value is calculated by combining the Sub-PCI from all runway segments using a specific mathematical formula. The results of this calculation provide numerical values reflecting the overall runway condition. The higher the PCI, the better the condition of the runway. (Peraturan Direktur Jenderal Perhubungan Udara, 2015).

The evaluation and calculation process of the Pavement Condition Index (PCI) on the runway is a crucial step in monitoring and maintaining airport infrastructure. PCI measurements are conducted to provide an overview of the overall condition of the runway surface. For easier understanding, PCI is interpreted within a specific range, where certain values indicate different conditions. For example, if the PCI value is above 70, it can be interpreted as a good condition, indicating that the runway is in optimal condition. Conversely, a PCI value below 40 may indicate a poor condition, requiring immediate attention and repair.

During the evaluation process, the severity and types of damages on the runway are analyzed in-depth. Based on these findings, repair recommendations are provided with the goal of preserving or improving the overall condition of the runway. These recommendations may include structural repairs, routine maintenance, or other necessary actions to ensure the safety and optimal performance of the runway. The results of the entire evaluation and calculation process are then presented in a comprehensive written report. This report includes all relevant measurement data, the calculation methods used to obtain the PCI value, the obtained PCI values, and details based on specific segments of the runway. Additionally, the report also includes suggested repair recommendations, providing practical guidance for steps to be taken to maintain or improve the overall condition of the runway. Through this written report, stakeholders, including airport authorities, can understand the actual condition of the runway and take appropriate actions to ensure safe and efficient operations.

RESULT AND DISCUSSION

In conducting the PCI survey, it is crucial to confirm the existing pavement surface conditions in relation to the maintenance that has been or will be undertaken. This is highly important because PCI values for each condition may differ due to changes in the surface of Runway 12/30 at Budiarto Airport while it is still in use during the survey. Budiarto Airport has Runway 12/30 with dimensions of 1,800 meters x 45 meters and a flexible pavement surface. To obtain the PCI value for the runway, sample determination is required following ASTM D5340-98 guidelines, as outlined below: 1. Identifying the pavement area to be examined (branch). In this case, the area under consideration is Runway 12/30 at Budiarto Airport, 2. Dividing the work area into sample units. The researcher divides the area with intervals of every 20 meters, 3. Conducting on-site survey work involving two teams, each consisting of 1 supervisor, 1 damage recorder, and 1 measurer.

This process allows for the collection of representative data from various sections of the runway, and each team is responsible for ensuring that all damages and changes are accurately documented. With this approach, the PCI survey can provide a comprehensive overview of the runway's condition and assist in planning the necessary maintenance actions.

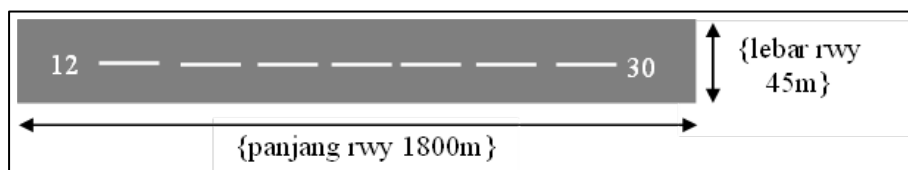


Figure 3. Budiarto Airport Runway Length

Runway area total : 45 m x 1.800 m = 81.000 m²
Sample area total : 45 m x 10 m = 450 m²
Sample total : 81.000/450 = 180 sample

Due to the need for comprehensive recording of pavement damages along the runway for research purposes, the required number of samples to be surveyed is 180 samples. After determining the survey samples, several tools need to be prepared, one of which is the survey form. Field survey data collection is carried out according to the predetermined samples. The recorded damages will be inputted into their respective samples. Here is an example layout of damages for the entire Runway 12/30, divided per sample:



Figure 4. Budiarto Airport Runway 12/30 Layout

The analysis of the causes of damage to the Runway 12/30 surface at Budiarto Airport provides in-depth insights into the pavement conditions that can affect the overall Pavement Condition Index (PCI) value. Here is a detailed explanation of the identified causes of damage: a) Alligator Crack: Repetition of traffic loads exceeding the surface layer's capacity. The repeated loads result in cracks resembling an alligator scale pattern. b) Bleeding: At high temperatures, asphalt becomes soft and may leave wheel imprints. Contributing factors include the use of a high asphalt content in the mix and excessive application of asphalt during prime coat/tack coat work. c) Depression: Loads exceeding the planned capacity, poor construction execution, or settlement of the pavement due to subsidence or settlement of the subgrade. d) Longitudinal Crack: Long, unconnected cracks can be caused by lateral expansion and contraction of the surface layer due to temperature differences. e) Raveling: Raveling is the phenomenon of aggregate loss from a surface course. Damage in the form of potholes caused by dirty aggregates, leading to suboptimal bonding between asphalt and aggregates. Often associated with the presence of cracks and deformations on the surface layer. f) Patching: Original pavement areas that have experienced damage are removed and replaced with new filler material as a repair measure Patching is a common technology used in repairing asphalt-pavement potholes(Wang et al., 2024). g) Rutting: The layer(s) in which rutting occurs is influenced by the loading magnitude and the relative strengths of the pavement layers (Chilukwa & Lungu, 2019).

This analysis of the causes of damage provides a deeper understanding of specific conditions that can influence the PCI value. By knowing these causes, airport management can plan more targeted maintenance actions, such as structural repairs, optimizing asphalt mixes, improving traffic load management, and implementing other preventive measures. Thus, maintenance and care can be carried out effectively to extend the runway's lifespan and ensure the airport's operational safety (Belete Werkinneh & Arega Demissie, 2019). Determine the density value for each type of distress by summing the areas of all distresses, dividing by the total area of the sample unit, and multiplying by 100%. After obtaining the density value for each type of distress in each unit, calculate the Deduct Value based on the graph relating density and Deduct Value. The Deduct Value graph below refers to UFC 3-260-16, Standard Practice for Airfield Pavement Condition Surveys.

Sampel 3 (STA 0+040 – 0+050)

a. Calculate the distress density value

Longitudinal/transversal crack damage

$$\text{Density} = \frac{A_d}{A_s} \times 100\% = \frac{2.2}{450} \times 100\% = 0.24\%$$

b. Calculate the deduct value (DV)

Deduct Value is the reduction value for each type of damage obtained from the curve relationship between density and reduction value. (Amelia Setiaputri et al., 2021)

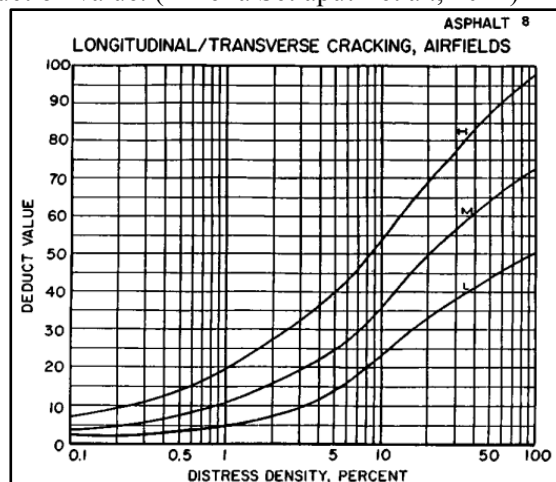


Figure 5. Deduct Value of 3rd sample (STA 0+040 – 0+050)

$$DV = 5$$

$$HDV = 5$$

c. Calculate Allowable Deduct Value (m)

$$m = 1 + 9/95 (100 - HDV)$$

$$m = 1 + 9/95 (100 - 13)$$

$$m = 10$$

After determining the Deduct Value that will be used, it is then summed per sample to obtain the Total Deduct Value (TDV).

Table 2. Total Deduct Value of the entire sample

Sample	Distress Severity	Density (%)	DV	TDV
STA 0+040 - 0+050	8 M	0.24%	5	5
STA 0+290 - 0+300	12 M	8.89%	19	19
STA 0+330 - 0+340	10 M	0.02%	5	5
STA 0+420 - 0+430	12 M	6.22%	16	16
STA 0+740 - 0+750	12 M	0.78%	7	7
STA 0+840 - 0+850	12 M	0.22%	5	5
STA 0+860 - 0+870	12 M	0.11%	5	5
STA 0+890 - 0+900	12 M	0.11%	5	5
STA 1+090 - 1+100	12 M	0.33%	6	6
STA 1+430 - 1+440	1 M	0.11%	11	11
STA 1+470 - 1+500	5 M	0.01%	5	5
STA 1+550 - 1+560	12 M	0.11%	5	5
STA 1+630 - 1+640	12 M	0.17%	5	10
	2 M	0.67%	5	
	1 M	0.33%	18	
STA 1+700 - 1+710	2 M	0.33%	18	41
	5 M	0.05%	5	
	2 H	0.89%	11	
STA 1+720 - 1+730	5 M	0.04%	5	21
	12 M	2.00%	5	

Corrected Deduct Value (CDV) is the corrected deduction value obtained from the curve relationship between the total deduction value (TDV) and the deduction value (DV) by drawing the corresponding curve. (Isradi et al., 2019). The overall total of samples that have damage is 15 samples; therefore, there will be 15 graphs to be analyzed.

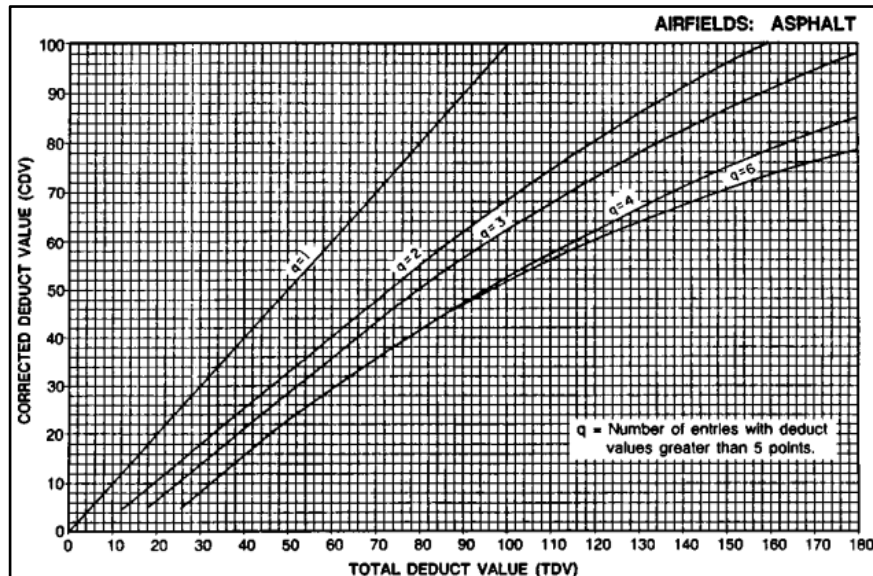


Figure 7. Corrected Deduct Value of 3rd sample (STA 0+040 – 0+050)

The PCI value represents the quality of the pavement layer, in this case, Runway 12/30. The PCI value can be determined from the CDV value calculated from the previous computations. The PCI for a pavement section is determined in accordance with ASTM D6433 by calculating the average PCI from all sample units within the section under examination. With an overall average Pavement Condition Index (PCI) value of 98.44 for all samples of Runway 12/30 at Budiarto Airport, it can be concluded that the surface condition of the runway is at a good level. However, it should be noted that there are three specific samples, namely samples 15, 22, and 86, which obtained PCI values that can be considered as "satisfactory" or reasonably good. A specific analysis of these samples can provide deeper insights into specific conditions that may require extra attention in terms of maintenance and repair. The three samples achieving the "satisfactory" level, samples 15, 22, and 86, indicate that there are some specific areas on the runway that need deeper attention. Therefore, special handling and maintenance are required to ensure the overall continuity and safety of runway operations. The table below provides an overview of the types of treatments that can be undertaken to repair and maintain the runway pavement surface. Each type of treatment has its own focus based on the observed conditions, and the selection of these maintenance strategies can be crucial to ensuring that the runway continues to meet the required safety and operational standards.

Table 3. Type of handling for runway damage

Index	Condition	Type of Handling
0 – 10	failed	Reconstruction
11 – 25	serious	Reconstruction
26 – 40	very poor	Reconstruction
41 – 55	poor	Corrective
56 – 70	fair	Preventive
71 – 85	Satisfactory	Preventive
86 – 100	Good	Preventive

By detailing the required maintenance procedures, airport management can make informed decisions and plan effective maintenance actions to ensure that the runway remains in optimal operational condition. This is a critical step to minimize the risk of further damage and extend the lifespan of Budiarto Airport's runway.

CONCLUSION

From the results of the Pavement Condition Index (PCI) survey on Runway 12/30 at Budiarto Airport, it can be concluded that the assessment and survey methods applied are in accordance with FAA AC No. 150/5380-7B and ASTM D 5340. The assessment process involves calculating the PCI

value as an average of statistically selected segments from the chosen samples. In this context, the number of samples taken reached 90, representing the entire length and width of Runway 12/30 with dimensions of 1800 x 45 meters. The data analysis results indicate that the PCI value for Runway 12/30 at Budiarto Airport is 98.44, which can categorically be classified as "good." This assessment was obtained through a visual evaluation of the functional condition, where the runway pavement surface was judged to be in good condition. This condition reflects the overall integrity and operational capability of the runway. The most common type of damage with the widest percentage on the runway surface is raveling, with a severity level reaching 12M. The cause of this raveling is attributed to the presence of dirty aggregates, resulting in suboptimal bonding between asphalt and aggregates. Additionally, the survey also noted frequent lightning strike incidents on the asphalt runway surface. This is a factor that needs attention for further safety and maintenance. Overall, the achieved good condition indicated by the PCI value of 98.44 signifies that Runway 12/30 at Budiarto Airport is still in good operational condition. However, special attention is needed, especially regarding raveling due to dirty aggregates and the potential impact of lightning strikes, to ensure continuous maintenance and operational safety of the runway. This evaluation provides a solid foundation for proactive maintenance planning, allowing the runway to remain operational optimally.

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