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Evaluation Of Skid Resistance Testing and Maintenance for Runway 06/24 At Soekarno-Hatta International Airport

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Abstract. The aviation industry is one of the most highly regulated sectors which requiring strict facility maintenance to ensure aircraft operations and passengers. Essential airport facility that requires preventive maintenance is the runway, particularly through skid resistance test. This is in line with KP 94 of 2015, which mandates skid resistance test of runway surfaces to ensure meet the minimum standards. This study aims to analyze and evaluate the technical aspects and results of skid resistance test on Runway 06/24 at Soekarno-Hatta International Airport in March 2024 and compare these results with the results in February 2024. This research also analyzes factors that have the potential to influence the results of skid resistance level while providing recommendations regarding the skid resistance maintenance program for Runway 06/24. The research findings indicate that the skid resistance level on Runway 06/24 in March 2024 was 0.60 which meet the minimum standard, but showing a slight decrease of 0.01 compared to the skid resistance level of 0.61 in February 2024. The analysis results show that there are several potential factors affecting skid resistance test results, including the frequency and dimension of rubber deposit removal, the frequency of aircraft landings, and local weather conditions at Soekarno-Hatta International Airport.

Keywords : Runway 06/24, Soekarno-Hatta International Airport, Skid Resictance Test

Abstrak. Industri penerbangan adalah salah satu sektor yang paling banyak diatur yang membutuhkan pemeliharaan fasilitas yang ketat untuk memastikan operasi pesawat dan penumpang. Fasilitas penting bandara yang membutuhkan perawatan preventif adalah landasan pacu, terutama melalui uji ketahanan selip. Hal ini sejalan dengan KP 94 tahun 2015 yang mengamanatkan uji skid resistance pada permukaan landasan pacu untuk memastikan memenuhi standar minimum. Penelitian ini bertujuan untuk menganalisis dan mengevaluasi aspek teknis dan hasil skid resistance test pada Runway 06/24 di Bandara Internasional Soekarno-Hatta pada bulan Maret 2024 dan membandingkannya dengan hasil pada bulan Februari 2024. Penelitian ini juga menganalisis faktor-faktor yang berpotensi mempengaruhi hasil skid resistance level sekaligus memberikan rekomendasi terkait program pemeliharaan skid resistance untuk Runway 06/24. Hasil penelitian menunjukkan bahwa skid resistance level di Runway 06/24 pada bulan Maret 2024 adalah 0.60 yang memenuhi standar minimum, namun menunjukkan sedikit penurunan sebesar 0.01 dibandingkan dengan skid resistance level 0.61 pada bulan Februari 2024. Hasil analisis menunjukkan ada beberapa faktor potensial yang mempengaruhi hasil uji skid resistance, antara lain frekuensi dan dimensi pembersihan rubber deposit, frekuensi pendaratan pesawat, dan kondisi cuaca lokal di Bandara Internasional Soekarno-Hatta.

Kata Kunci : Landasan Pacu 06/24, Bandara Internasional Soekarno-Hatta, Uji Skid Resistance

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1. Introduction

Soekarno-Hatta International Airport currently has three runways to handle the high volume of aircraft. These include Runway 07R/25L, Runway 07L/25R, and Runway 06/24. The South Runway (07R/25L) and Runway 06/24 are mainly used for aircraft takeoff and landing at the airport, while Runway 07L/25R is primarily used for aircraft takeoff. However, from January to October 2024, there will be a maintenance project to improve the quality of the pavement on the South Runway (07R/25L) at the airport. As a result, there will be a decrease in the use of the South Runway for aircraft operations, including takeoff and landing. This will in turn lead to an increase in the use of Runway 06/24 and Runway 07L/25R to accommodate the frequency of aircraft movements, particularly in handling aircraft landings.

Special attention is needed for the maintenance of Runway 06/24 due to the high number of aircraft landings and the importance of ensuring operational safety. The movement of aircraft, particularly during landings, leads to the deposition of rubber on the runway surface, causing reduced firmness and increased slipperiness. This, in turn, poses a risk of planes skidding off the runway. In 2023, the National Transportation Accident Committee (KNKT) recorded seven aircraft accidents in Indonesia, with runway excursions being the predominant cause. Investigations by the NTSC have revealed that the poor condition of the runway surface, specifically the decreasing level of roughness, contributes to these incidents. Therefore, measures to address rubber contamination and ensure the adequate roughness of the runway surface are crucial for maintaining safe operations and preventing accidents.

This journal discusses the importance of maintaining the firmness level of Runway 06/24 at Soekarno-Hatta International Airport to ensure the safety of aircraft operations. This maintenance is required as a preventive measure to prevent accidents and ensure smooth movement of aircraft on the runway. The text mentions that this maintenance is in accordance with the regulations outlined in KP 94 of 2015, which specifies the standards for airport pavement construction and requires the level of roughness on runways to be maintained at a minimum standard. The regulations also provide guidelines for conducting runway roughness checking surveys and recommend cleaning schedules for rubber contamination based on the frequency of landings per day. Based on these requirements, the text states that the researcher aims to conduct a research study to evaluate the test level of firmness and develop a maintenance program for Runway 06/24 at Soekarno-Hatta International Airport.

The aviation industry is known to be highly complex and highly regulated. Increased global mobility has had a major impact on the sector, especially with the growing public interest in air transport. (Frasawi, 2023) This is particularly evident at Soekarno-Hatta International Airport, which is Indonesia's main gateway and the largest airport in Southeast Asia. According to the Badan Pusat Statistik (2023), the increasing public interest in air transport has greatly affected the world of aviation.

The concept of "Zero Failure" is the main principle to promote best practices or innovations in order to achieve the lowest possible failure or error rate, even close to zero, in order to maintain the safety and security of each stakeholder involved in the world of aviation, especially the main service users, in this case passengers. (Maulana et al., 2022)

In addition that airside facilities, especially runways or taxiways, are critical areas in airports that need to maintain the quality of infrastructure or facilities, especially airside facilities such as runways. (Fajrin, 2016)

The research findings also show that the high number of aircraft movements at Soekarno-Hatta International Airport is certainly consistent with the need to maintain the quality of infrastructure or facilities at the airport to safely accommodate aircraft movements. (Saifullah, 2017)

According to The risk of rubber contamination or rubber deposits on the runway will increase, which can reduce the tightness and increase the risk of accidents. This will be experienced by Runway 06/24 in serving the landing process when experiencing an increase in the frequency of aircraft movements on the Runway 07R/25L overlay or resurfacing maintenance project for the period January - October 2024, affecting the reduction in the level of use of Runway 07R/25L. (Saputri & Ginusti, 2022)

2. Research Method

This research uses a quantitative method by processing and analyzing data in the form of numbers obtained from the test of roughness level using the BV11-VI Skiddometer and Moventor software on Runway 06/24 Soekarno-Hatta International Airport. All data obtained from the results of the test of the level of roughness of Runway 06/24 are then processed and analyzed by taking a data that represents 90% of the total data of the test of the level of roughness conducted, so that the value taken represents the condition of the roughness of Runway 06/24 for both the entire runway area and the touchdown area (Jepriando et al., 2018). Primary data were obtained from the roughness level test conducted directly on March 22, 2024 on the Runway 06/24 of Soekarno-Hatta International Airport. Meanwhile, secondary data was obtained from several sources, including the test report on the level of roughness of Runway 06/24 in February 2024, data on the frequency of aircraft landing in the area of Runway 06/24 in January - March 2024, data on the frequency and dimensions of cleaning rubber deposits on Runway 06/24 in February and March 2024, data on local weather conditions in January - March 2024 from the Soekarno-Hatta Meteorological, Climatological and Geophysical Agency (BMKG), and provisions for SOPs related to the maintenance of airside facilities, in particular the level of runway roughness.

3. Results And Discussion

The Runway 06/24 test was carried out at distances of 1.5 m, 3 m, 4.5 m and 6 m from the left and right sides of the runway centreline. There are a total of eight lines of roughness testing carried out according to the distance range, as shown in Figure 1 below. In the roughness tests carried out, only the runway centre line or the 0-0.75 m zone to the left and right of the runway centre line was not tested for various reasons.

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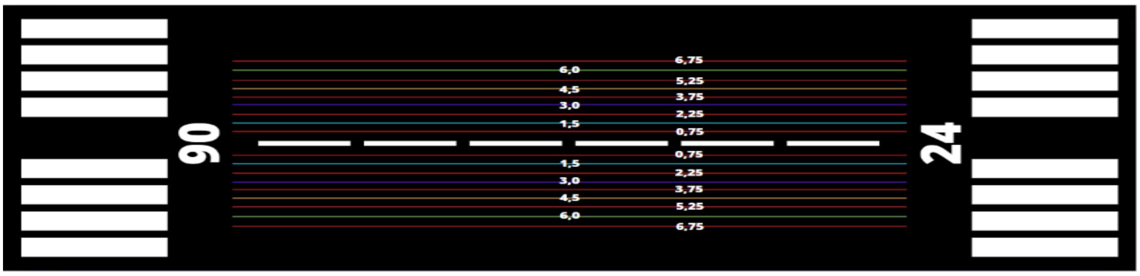

Fig. 1 Runway Impermeability Test Area 06/24

Source: Research Analysis (2024)

The first consideration is due to the centre of gravity of the aircraft, which is basically located on the main landing gear of the aircraft (Alfath & Rasyid, 2018)When the aircraft lands, most of the load is placed on the main landing gear area, which is 95% of the total weight of the aircraft, so the greatest friction is on the main wheel with the runway surface where the position of the main wheel of the aircraft is not exactly on the centreline of the runway, while the nose landing gear only supports a load of 5% of the total weight of the aircraft during landing (Alfath & Rasyid, 2018)Therefore, there is minimal friction when the nose wheel touches the runway surface, especially in the area of the runway centreline, and this is the rationale for not testing the roughness level in this area.

Furthermore, an important aspect that is taken into consideration is the size of the OMGWS of each aircraft operating at Soekarno-Hatta International Airport as shown in Table 3 below, which shows that in January - March 2024, Airbus 320 (A-320) aircraft will operate the most at Soekarno-Hatta International Airport, which has an OMGWS of 8.95 metres and the size of the test line is 4.48 metres (Airbus 320 Manual, 2005). Therefore, with this size, roughness testing on Runway 06/24 at four areas of 1.5 m, 3 m, 4.5 m and 6 m on the left and right sides of the runway centreline can cover the area passed by the A-320 aircraft, especially during landing.

Tabel 1 Aircraft Type Data Landing on RWY 06/24 January – March 2024

Aircraft Type	22 January – 14 February 2024	15 February - 21 March 2024	OMGWS (m)	Testing Line (m from CL)
A320	1692	2682	8.95	4.48
A320 Neo	56	117	8.95	4.48
A321	19	34	8.97	4.49
A330	5	1	12.61	6.31
A330 - 200	22	43	12.61	6.31
A330 - 300	139	219	12.61	6.31
A330 - 900	28	30	12.61	6.31
A350-900	106	176	12.87	6.44
B737-300	24	7	5.2	2.6
B737-400		8	5.2	2.6
B737-500	10	16	5.2	2.6

Aircraft Type	22 January – 14 February 2024	15 February - 21 March 2024	OMGWS (m)	Testing Line (m from CL)
B737	1		5.2	2.6
B737-800	847	1340	5.7	2.85
B737-900	179	360	5.7	2.85
B737 AX 8	2		5.9	2.95
B747-400	1	8	11	5.5
B747-800		3	11.5	5.75
B767-200		7	9.3	4.65
B767-300	8	24	9.3	4.65
B777-200	17	20	11	5.5
B777-200 ER	4		11	5.5
B777-300	21	27	11	5.5
B777-300 ER	170	303	11	5.5
B787		3	12.46	6.23
B787-800	21	47	12.46	6.23
B787-900	65	114	12.46	6.23
C27J SPARTAN	22	34	3.67	1.84
B76F		1	8.3	4.15
B77F		2	9.3	4.65
B77L		5	9.3	4.65
B77F		4	9.3	4.65
DF7		1	5.7	2.85
H25		1	5.7	2.85
TOTAL	3459	5637		

Source: CGK Airport Data Management (2024)

This is also true for several other types of aircraft operating at Soekarno-Hatta International Airport, as listed in Table 1 above, that the OMGWS size of each aircraft is still within the range of the tests conducted, namely 1.5 m, 3 m, 4.5 m and 6 m to the left and right of the runway centreline. Another consideration is that in the area of the runway centreline there are obstacles that can interfere with the process of testing the level of hardness, namely there are markings whose material is thermoplastic. The existence of these obstacles means that there are areas on the runway centreline surface that are slippery, so it will affect the results of the test of the level of pavement compaction, which may cause the value of the test of the level of pavement compaction to decrease at several points where there are obstacles, and will affect the results of the test of the overall level of pavement compaction.

Tabel 2 Results Of The Roughness Level Test On The Full Runway 06/24 In March 2024

Data	Frequency	Data Passed / n (≥ Data)	Percentage (n/19200)
0.48	1	19200	100%
0.49	6	19199	99.99%
0.50	8	19193	99.96%
0.51	8	19185	99.92%
0.52	14	19177	99.88%
0.53	37	19163	99.81%
0.54	73	19126	99.61%
0.55	117	19053	99.23%
0.56	180	18936	98.63%
0.57	274	18756	97.69%
0.58	392	18482	96.26%
0.59	740	18090	94.22%
0.60	184	17350	90.36%
0.61	960	17166	89.41%
0.62	1000	16206	84.41%
0.63	1298	15206	79.20%
0.64	1266	13908	72.44%
0.65	1287	12642	65.84%
0.66	1429	11355	59.14%
0.67	1329	9926	51.70%
0.68	1327	8597	44.78%
0.69	1093	7270	37.86%
0.70	999	6177	32.17%
0.71	886	5178	26.97%
0.72	781	4292	22.35%
0.73	746	3511	18.29%
0.74	632	2765	14.40%
0.75	601	2133	11.11%
0.76	417	1532	7.98%
0.77	447	1115	5.81%
0.78	330	668	3.48%
0.79	158	338	1.76%
0.80	81	180	0.94%
0.81	30	99	0.52%
0.82	24	69	0.36%
0.83	21	45	0.23%
0.84	8	24	0.13%

Data	Frequency	Data Passed / n (≥ Data)	Percentage (n/19200)
0.85	1	16	0.08%
0.86	6	15	0.08%
0.87	2	9	0.05%
0.88	4	7	0.04%
0.89	1	3	0.02%
0.90	1	2	0.01%
0.91	1	1	0.01%

Source: Research Analysis (2024)

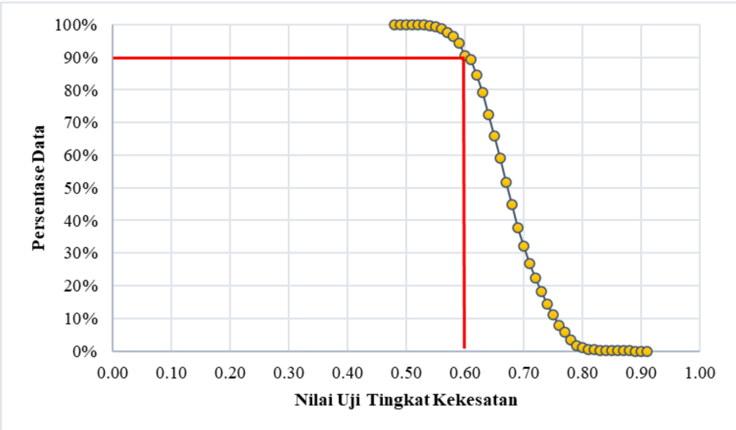

Figure 1 Graphical representation of the results of the stress level tests on the 24th of March 2024.

Source: Research Analysis (2024)

Based on the results of data analysis in Table 2 and the graph in Figure 2 above, it is found that the roughness value of 0.60 has a percentage of passing data of 90.36% or when rounded down to 90%, which means that 90.36% or 90% of all test data have a roughness value greater than or equal to 0.60, so this value is taken as a roughness value representing the roughness condition of Runway 06/24 in March 2024.

Furthermore, for the test results of the landing area from the direction of both Runway 06 and Runway 24 in March 2024 along 0-600 metres, the amount of data available is 4,800 data for each landing area. The following are the results of the test of the level of tightness in the 0-600 metre touchdown area from the direction of Runway 06 and Runway 24 in March 2024.

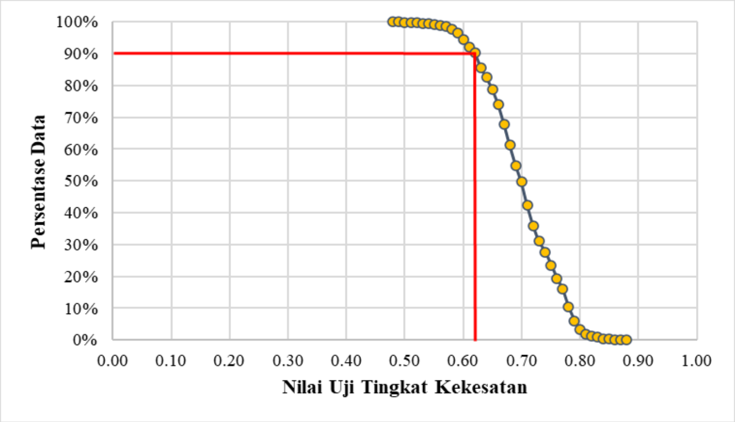

Figure 2 Graph of the test results of the level of impermeability in the 0-600 m landing area of runway 06 in March 2024

Source: Research Analysis (2024)

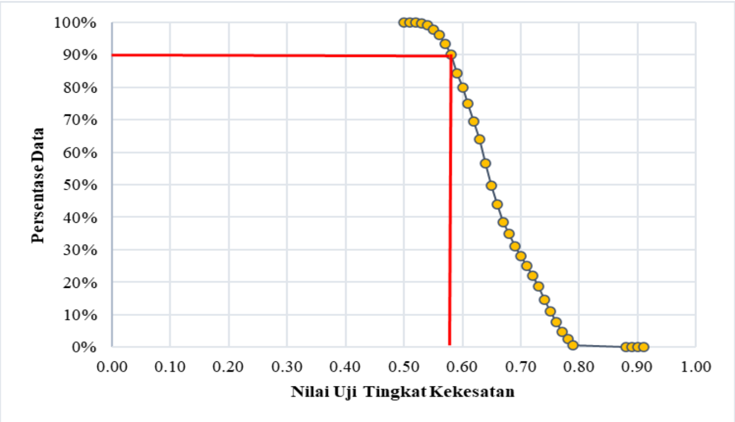

Figure. 3 Graph of the test results of the level of impermeability in the 0-600 m Touchdown area of runway 24 in March 2024

Source: Research Analysis (2024)

Based on the results of the data analysis in Figure 3 above, it is found that the roughness level value of 0.62 has a percentage of passing data of 90.42% or when rounded down by 90%, which means that 90.42% or 90% of the total test data in the landing area 0-600 metres from the direction of runway 06 have a roughness level value greater than or equal to 0.62. Meanwhile, Figure 4 above shows that the roughness value of 0.58 has a pass percentage of 90.13% or if rounded down to 90%, which means that 90.13% or 90% of the total test data in the 0-600 metre touchdown area from Runway 24 has a roughness value greater than or equal to 0.58.

Further analysis was also carried out on the results of the roughness level tests carried out on Runway 06/24 in February 2024, which were intended as comparative data to the results of the roughness level tests carried out in March 2024. Figure 5 below shows the results of the roughness test carried out on Runway 06/24 in February 2024.

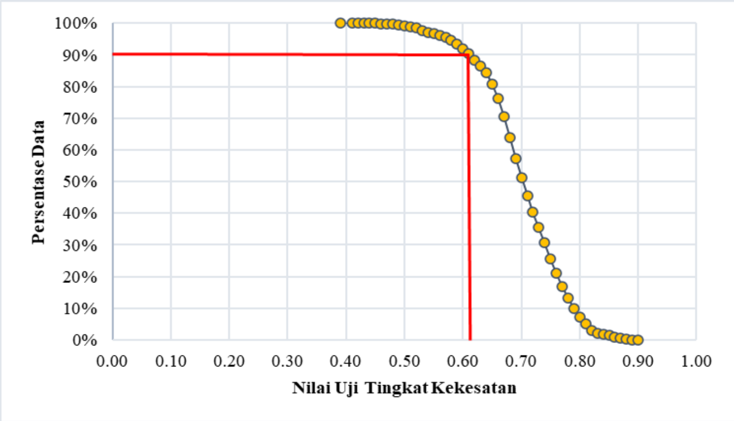

Figure 4 Graph of the Results of the impermeability Test on Full Runway 06/24 in February 2024

Source: Research Analysis (2024)

Based on the results of data analysis in Figure 5 above, it is found that the roughness value of 0.61 has a percentage of passing data of 90.35% or when rounded down to 90%, which means that 90.35% or 90% of all test data have a roughness value greater than or equal to 0.61, so this value is taken as the roughness value representing the roughness condition of Runway 06/24 in February 2024.

For the results of testing the landing area from the direction of both Runway 06 and Runway 24 in February 2024 along 0-600 metres, the amount of data available is 4,800 data for each landing area. The following are the results of testing the level of tightness in the 0-600 metre touchdown area from the direction of Runway 06 and Runway 24 in February 2024.

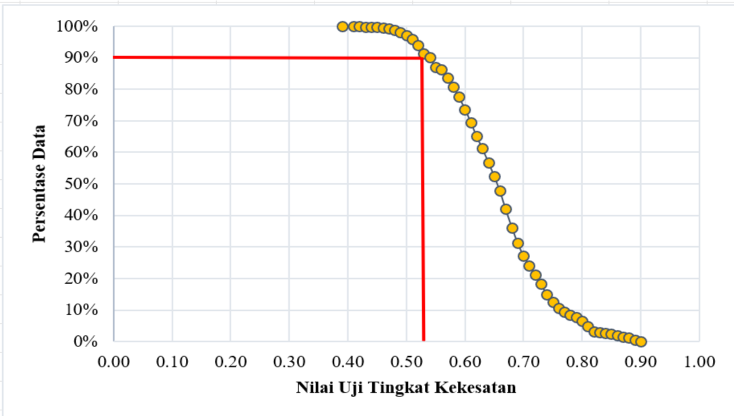

Figure 5 Graph of the Test Results of the Level of impermeability in the Touchdown Area 0-600 meters Runway 06 in February 2024

Source: Research Analysis (2024)

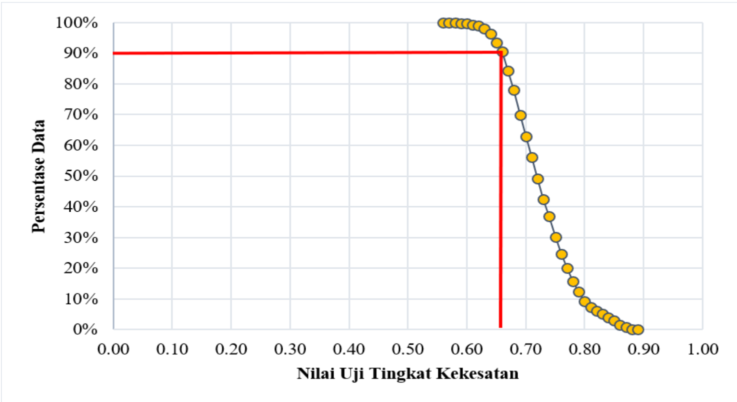

Figure 6 Graph of the Test Results of the Level of impermeability in the Touchdown Area 0-600 meters Runway 24 in February 2024

Source: Research Analysis (2024)

Based on the results of data analysis in Figure 6 above, it is found that the roughness level value of 0.54 has a percentage of passing data of 90.17% or when rounded down by 90%, which means that 90.17% or 90% of the total test data in the landing area 0-600 metres from the direction of runway 06 have a roughness level value greater than or equal to 0.54. Meanwhile, Figure 7 above shows that the roughness value of 0.66 has a pass percentage of 90.54% or if rounded down to 90%, which means that 90.54% or 90% of the total test data in the 0-600 metre touchdown area from Runway 24 has a roughness value greater than or equal to 0.66.

Following the presentation and analysis of the March and February 2024 roughness test results data, a comparison of the roughness test results between the two months was made and further analysis was undertaken to determine if there was an increase or decrease in the roughness of Runway 06/24 and the factors that could potentially influence this.

Tabel 3 Recap Of Comparison Of Roughness Test Results For Runway 06/24 MARCH 2024 WITH FEBRUARY 2024

Area	TESTING MONTH		Difference Increase/Decrease	Comparison Results
	February	March		
Full Runway	0.61	0.60	0.01	⬇ DOWN ⬇
Touchdown 0-600 m Runway 06	0.54	0.62	0.08	⬆ UP ⬆
Touchdown 0-600 m Runway 24	0.66	0.58	0.08	⬇ DOWN ⬇

Source: Research Analysis (2024)

Table 3 above shows that after going through the data processing process of the test results of the roughness level and comparing the test results between the two months, it can be concluded that there is a decrease in the roughness level of 0.01 along the whole Runway 06/24 in March 2024 compared to February 2024. Meanwhile, for the touchdown area of Runway 06, there is an increase in the roughness level of 0.08 in March 2024 compared to February 2024, and for the touchdown area of Runway 24, there is a decrease in the value of the roughness level of 0.08 in March 2024 compared to February 2024.

The increase or decrease of the roughness level value is potentially influenced by several related factors, such as the frequency and dimensions of rubber depot cleaning, the frequency of aircraft landings, and the local weather conditions at Soekarno-Hatta International Airport. Based on the Notice to Airmen (NOTAM) issued by the Air Traffic Control (ATC) of Soekarno-Hatta International Airport from February to March 2024, the frequency of rubber deposit cleaning in February was carried out for four days from 10 to 13 February 2024, covering an area of 19,200 m2, which ended with testing the roughness level of runway 06/24 on 14 February 2024. Meanwhile, the frequency of rubber deposit cleaning in March 2024 was also carried out for four days from 18 to 21 March 2024 over an area of 19,200 m2, ending with a test of the roughness level of runway 06/24 on 22 March 2024.

From these data, it can be seen that the frequency and dimensions of the cleaning of rubber deposits in February and March 2024 are carried out with the same scale. Therefore, it can be concluded that the decrease or increase in the level of roughness that occurs in the whole area of Runway 06/24, the touchdown area of Runway 06 and the touchdown area of Runway 24 in this case the frequency and dimensions of the cleaning rubber deposits that have been carried out have the potential to influence the increase or decrease in the level of roughness (Sitepu, 2021). But there are things that need to be considered, namely related to the number of areas or the distance between the day of testing the level of roughness carried out in January 2024 and the schedule for cleaning rubber deposits as well as testing the level of roughness in February 2024 and the number or the distance between the day of testing the level of roughness in February 2024 and the schedule for cleaning rubber deposits as well as testing the level of roughness in March 2024 as listed in Table 6 below.

Tabel 4 Number of Days to Remove Rubber Deposit and Test Firmness

NUMBER OF DAYS SPAN OR DISTANCE RUBBER DEPOSIT CLEANING AND ROUGHNESS TESTING *January - March 2024*			
Previous Month Impermeability Testing	Next Month Rubber Deposit Cleaning	Next Month Impermeability Test Phase 1	Time Gap Between Impermeability Test and Rubber Cleaning.
21 January 2024	10-13 February 2024	14 February 2024	20 Days
14 February 2024	18-21 March 2024	22 March 2024	33 Days

Source: Research Analysis (2024)

Based on Table 4 above, the range of days between the day of testing the roughness level on 21 January 2024 and the first day of cleaning rubber deposits in the following month, namely 10 February 2024, is 20 days, which compared to the day of testing the roughness level on 14 February 2024 and the first day of cleaning rubber deposits in the following month, namely 18 March 2024, is 33 days. The longer period of days between the day of testing the roughness level on 14 February 2024 and the first day of cleaning rubber deposits in the following month, i.e. 18 March 2024, has the potential to influence the results of the roughness level test on the entire runway and the landing area of runway 24 in March 2024, which has decreased, and also has the potential to cause the rubber contamination on runway 06/24 to also increase, so that it is related to the level of effectiveness of the rubber deposit cleaning process and the results of the roughness tests carried out.

In addition to the frequency and magnitude of cleaning rubber deposits, aircraft movement factors certainly have the potential to affect the performance of a runway, in particular when the aircraft lands there will be friction between the wheels of the aircraft and the runway surface. This will result in rubber contamination of the runway, so the higher the frequency of aircraft landings on a runway, the greater the potential impact on the roughness value. Table 7 below shows the frequency of aircraft landings on runway 06/24 for the period January to March 2024, more specifically from 22 January to 14 February 2024 there were 3459 landings and from 15 February to 22 March 2024 there were 5637 landings.

Tabel 5 Aircraft Landing Frequency on Runway 06/24 January - March 2024

TOTAL AIRCRAFT LANDED ON RUNWAY 06/24*January - March 2024*		
Runway in Use	22 January – 14 February 2024	15 February – 22 March 2024
Rwy 06	115	293
Rwy 24	3344	5344
TOTAL	3459	5637

Source: Research Analysis (2024)

There is a difference of 2178 aircraft landings on runway 06/24 between the period 22 January - 14 February 2024 and the period 15 February - 22 March 2024. The data in Table 5 above shows an increase in the frequency of aircraft landings in the period February to March 2024 compared to the previous month, which means that the level of use or aircraft movements on Runway 06/24 has increased in this period. Of course, this is one of the factors that could potentially influence the decrease in the level of congestion along the whole of Runway 06/24 in March 2024, the results of which show a decrease of 0.01.

Furthermore, the increase in the level of congestion in the landing area of Runway 06 is also potentially influenced by the frequency of landings, because based on the data in Table 7 above, it can be seen that the frequency of landings on Runway 06 is lower than on Runway 24, so it has the potential to influence the increase in the level of congestion in the landing area of Runway 06, and vice versa, the level of congestion in the landing area of Runway 24 has decreased, so the high frequency of landings has the potential to be one of the influencing factors.(Paliska et al., 2016)

Another factor that has the potential to affect the increase or decrease in the degree of tightness of runway 06/24 is related to the local weather conditions at Soekarno-Hatta International Airport. These weather conditions always have the potential to affect aircraft operations, especially take-offs and landings. Table 8 below provides a summary of the weather condition data for the period January to March 2024 at Soekarno-Hatta International Airport.(Berster et al., 2015)

Tabel 6 Recap of Soekarno-Hatta International Airport Local Weather Conditions January - March 2024

Periodt	Overall Total Days	Total Clear Days	Total Rainy Days
22 January – 14 February 2024	24 Days	7 Days	17 Days
15 February – 22 March 2024	37 Days	15 Days	22 Days

Source: Research Analysis (2024)

Based on the data in Table 6 above, it shows that the frequency or quantity of sunny days or no rain in the range of 22 January - 14 February 2024 is 7 days, while in the range of 15 February - 22 March 2024 is 15 days. Based on the analysis conducted by researchers in the field, the air temperature is higher when it is sunny or no rain than when it is raining, where the friction between the aircraft wheel and the runway surface is higher when it is sunny or high temperature when the aircraft is landing. (Dimitriou, 2018; Phang, 2016; Wanke & Barros, 2017)

These conditions have the potential to have a large rubber deposit contamination effect due to the large friction between the aircraft wheels and the runway surface, so it has the potential to affect the test results of the level of roughness, which shows a decrease in value, especially in the full touchdown area of Runway 06/24 and Runway 24 in March 2024 compared to February 2024.

4. Conclusion

Based on the results of the research conducted, it can be concluded that the test of the level of roughness on Runway 06/24 at Soekarno-Hatta International Airport in February and March 2024 shows that the roughness value of the entire runway meets the minimum standard of the results of the test of the level of roughness using the BV11-VI Skiddometer of 0.60 as stipulated in KP 94 of 2015. In February 2024, the test result of the roughness level on the entire runway 06/24 was 0.61, while in March 2024 it was 0.60. For the touchdown area of Runway 06, the roughness value in February 2024 was 0.54, while in March 2024 it was 0.62. In addition, for the Runway 24 touchdown area, the roughness value in February 2024 is 0.66, while in March 2024 it is 0.58.

Although these results meet the standard, there are some significant findings, namely a decrease in roughness along the entire Runway 06/24 in March 2024 compared to February 2024 with a decrease of 0.01 and a decrease in the touchdown area of Runway 06 with a decrease of 0.08. Factors that could affect this decrease include the frequency of rubber deposition cleaning, the frequency of aircraft landings, and local weather conditions. (Bao et al., 2016; Fasone et al., 2016)

The novelty of these findings suggests that improvements in runway roughness testing and maintenance procedures could potentially impact roughness testing results. Suggested recommendations include the use of more accurate benchmarks or distance markers during testing to ensure that the tested area is consistent with the established line, and adjustments to the frequency of rubber deposit cleaning based on aircraft landing data and weather conditions. Specifically, it is recommended that aircraft OMGWS size and landing frequency be considered when determining the frequency and dimensions of rubber debris removal to determine priority areas for removal.

The implication of this finding is that any decrease or variation in roughness value requires attention to testing procedures and a more measured maintenance program in accordance with established standards or regulations. Future research is expected to empirically examine the effect of rubber debris removal on runway roughness and to analyze other factors that could potentially affect roughness, such as pavement type and structural damage.

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