APRON FLOODLIGHT OF LIGHT INTENSITY ON THE FLIGHT SAFETY OF APRON TERMINAL 1 AT SOEKARNO-HATTA INTERNATIONAL AIRPORT

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ABSTRACT

Based on the current condition, the lighting intensity provided by the existing apron floodlight is insufficient and does not meet the standards or recommended lighting requirements by ICAO for apron lighting, which should be a minimum of 20 lux. The inadequate lighting quality will undoubtedly affect the smooth operation on the apron. Therefore, to improve the quality of service in the apron area, it is essential to have apron floodlights with strong illumination that comply with the established standards. Good research begins with the core problem formulation and setting research goals to be achieved. This research is analyzed using quantitative methods. In the research steps, including determining the research design, it must be based on existing problems and research objectives to be achieved. To use quantitative research more precisely, it is recommended to do field exploration or observation first. A flexible quantitative research design can provide guidance on steps to be taken and describe what will be done in the field. Based on observations during On the Job Training (OJT) at Soekarno-Hatta International Airport, during night flights, one of the important things is to ensure that the floodlight apron, part of the airport lighting system (AFL), is active and complies with the standards set by the International Civil Aviation Organization (ICAO). After data analysis and discussion, using the Statistical Program for Social Science (SPSS), it resulted in a conclusion from the research The Effect of Apron Floodlight on Terminal 1 Flight Safety at Soekarno-Hatta International Airport is the positive and significant influence of apron floodlight on flight safety at terminal 1 of Soekarno-Hatta International Airport. The results of the regression analysis obtained, the significant value of influence on the variables of apron floodlight research, so that the existence of an LED type floodlight apron can increase the level of flight safety of terminal 1 Soekarno-Hatta International Airport.

Keywords: light intensity, apron floodlight, flight safety

1. INTRODUCTION

The aviation industry is currently undergoing significant and rapid development, which is an essential element in driving developmental dynamics, supporting human mobility, goods and services, as well as facilitating regional growth and enhancing international relations [1].

Soekarno-Hatta International Airport, located in the Banten province, is one of several international airports in Indonesia operated by PT. Angkasa Pura II. The airport continuously strives to enhance flight safety facilities, including telecommunications, navigation equipment, and electrical systems on the premises. Additionally, improvements are expected in terms of passenger services for those departing and arriving [2]. Concerning maintenance, a crucial factor influencing equipment performance is its age.

Apron Terminal 1 at Soekarno-Hatta International Airport has 59 Floodlight poles, each consisting of 4 lights, using outdated HALOGEN HPI T products. Each Floodlight pole has an average capacity of 250-1000 Watts. Given the busy air traffic conditions, the author investigates the impact of Apron Floodlight's light intensity on flight safety.

The Airfield Lighting System (AFL) is a runway lighting system that serves as a visual aid for pilots during takeoff, landing, and aircraft taxiing processes, whether in daylight, nighttime, or adverse weather conditions. One component of the Airfield Lighting System at Soekarno-Hatta International Airport is the Apron Floodlight. Floodlights are a critical element of the Airfield Lighting System (AFL). Therefore, the author aims to conduct a study on the lights installed at Soekarno-Hatta International Airport [3].

Based on the current situation, the illumination intensity provided by the existing Apron Floodlights is

insufficient and does not meet the standards or recommended lighting requirements by ICAO for Apron lighting, which should be at least 20 lux. Inadequate lighting quality will inevitably affect the smoothness of activities taking place on the Apron. Therefore, to enhance the service quality in the Apron area, Apron Floodlights with strong illumination adjusted to the established standards are highly necessary.

Hence, the problem statements can be identified as follows:

1. Is there an impact of Apron Floodlights on flight safety?

2. Can LED-based Apron Floodlights improve flight safety?

The research aims to achieve the following objectives:

1. To determine the impact of Apron Floodlights on flight safety.

2. To ascertain whether LED-based Apron Floodlights can enhance flight safety.

2. LITERATURE REVIEW

2.1 Airport

An airport is defined as a specialized area on land or water that includes buildings, facilities, and equipment used for the purposes of aircraft arrival, departure, and movement on the ground, either wholly or partially [4].

Alternatively, an airport can be defined as a territory on land and/or water with defined boundaries used for aircraft takeoff and landing activities, passenger embarkation and disembarkation, cargo transportation, and as a hub for intermodal transportation. This airport is equipped with aviation safety and security facilities, as well as essential amenities and other supporting facilities [5].

2.2 Apron

The apron is a specialized area at an airport designated for aircraft parking, passenger boarding and disembarking, cargo and mail loading and unloading, refueling, as well as performing light aircraft maintenance. This information refers to the provisions outlined in the Minister of Transportation Regulation No. 21 of 2005 regarding the Implementation of Indonesian National Standard (SNI) 03-7095-2005 concerning markings and signs applicable in the aircraft movement area at the airport. This regulation is a mandatory standard to be adhered to [6].

2.3 Flight Safety

Flight Safety is also a condition where safety requirements are fulfilled in the utilization of airspace, aircraft, airports, air transport, flight navigation, supporting facilities, and other public facilities [7].

The apron must have the capability to support the weight of aircraft while moving slowly or stationary. Therefore, the construction of the apron should preferably use rigid surfacing in the form of concrete plates.

2.4 Light Intensity

Luminous Intensity is the strength or level of illumination emitted from a light source in a specific direction, measured in Candela [8].

The magnitude of light intensity can be represented by a specific symbol. The concept of light intensity is used to explain how far the flux of light is emitted in a specific direction by a surface emitting light. Inadequate lighting quality will have a negative impact on visual function psychologically as well as work activities. When the intensity of lighting decreases, the work situation can become uncomfortable, and tasks that require a high level of precision become difficult to perform [9].

2.5 Apron Floodlight

Apron Floodlighting is a lighting fixture installed in a specific arrangement to provide sufficient illumination across the entire apron area when used during the night. Apron floodlights are designed to offer strong and uniform illumination in that area, thereby facilitating aircraft handling activities and passenger processing during nighttime or low-light conditions [10].

Apron floodlights generally have high power and are placed on tall lighting poles to provide wide light distribution. These lights typically use incandescent bulbs or LED lamps that emit bright white light to create optimal illumination conditions on the apron.

LED (Light Emitting Diode) is a state-of-the-art lighting technology that is highly efficient and durable compared to traditional lamps. They operate by harnessing the electroluminescence effect within semiconductors, where electrons meet holes in the semiconductor material and produce light. LEDs are widely used in various applications, including home and office lighting, electronic displays, indicator lights, vehicle lighting, and much more. The advantages of LEDs include energy efficiency, long lifespan, small size, and instant startup, making them an environmentally superior lighting alternative [11].

Good illumination on the apron is crucial for safety, security, and operational efficiency at the airport. With the presence of apron floodlights, activities such as cargo loading, aircraft maintenance, refueling, and passenger services can take place safely and efficiently, both during nighttime or even in adverse weather conditions.

2.6 Airside

Airside is the area at an airport that encompasses all its supporting facilities and can only be accessed by personnel involved in flight operations, such as flight crew, aircraft maintenance personnel, emergency personnel, and airport security officers. This area has strict security arrangements to ensure flight safety [12].

The airside of the airport includes runways, taxiways, apron, cargo terminal, passenger terminal, and other flight support facilities. On the airside, aircraft take off and land, are parked, inspected, and provided services such as refueling, maintenance, and loading of cargo.

2.7 Parking Stand

A Parking Stand at the airport refers to a designated area on the apron (airside of the airport) where aircraft park and remain for a specified period. Each parking stand typically has a number or identification marker used to identify its location [13].

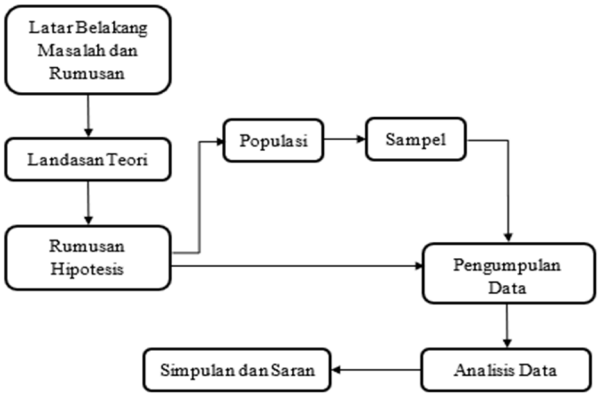
A Parking Stand is designed to allow aircraft to safely stop and provide necessary access for passenger services and aircraft operations. The parking stand is equipped with facilities such as taxiway paths connecting the stand to the runway, lighting equipment, and a ground power supply system to provide electricity when the aircraft is parked.

3. METHOD

This research employs a quantitative research approach. Quantitative research is a type of research that focuses on the collection and analysis of numerical data to comprehend and explain social, scientific, or business phenomena using a population or sample [14].

3.1 Research Design

In conducting quality research, the initial crucial step is to formulate the core problem and research objectives to be achieved. This study is analyzed using a quantitative method.



3.2 Research Variables

The variables in this study consist of independent variables (variabel bebas) and dependent variables (variabel terikat).

3.2.1 Independent Variable

In this study, the independent variable used is the Intensity of Apron Floodlight.

3.2.2 Dependent Variable

In this study, the dependent variable used is Flight Safety.

3.3 Population, Sample, and Research Object

3.3.1 Population

Population or universe refers to a defined area consisting of objects that possess characteristics as set by the researcher for investigation and drawing conclusions [15]. In this study, the population consists of personnel working on the airside of Terminal 1 apron (AMC, Ground Handling, Cargo). The research period was conducted from December 1, 2022, to December 23, 2022, at Soekarno-Hatta International Airport.

3.3.2 Sample

A sample can be described as a method of data collection, where only a small portion of the population is taken and used to determine the desired characteristics and attributes of a population [16].

In this study, a sample of 50 personnel who have work responsibilities in Terminal 1 Apron of Soekarno Hatta International Airport was taken.

3.3.3 Research Object

Research Object refers to the values, attributes, or characteristics of a person, object, or activity with a certain specified variation that researchers study and draw conclusions from [17].

In this study, the research objects are the influence of Apron Floodlight's light intensity on flight safety and the performance of airside personnel.

3.4 Data Collection Techniques and Research Instruments

Data collection technique is the most strategic step in research, as the primary goal of the research is to obtain data. The research instrument is a selected tool used by the researcher in the process of collecting data, making the activity systematic and easier for them [18]. The data collection techniques and research instruments used to assist the author in collecting data regarding the analysis of Apron Floodlight intensity's impact on flight safety are as follows:

3.4.1 Observation

Observation is a data collection technique that possesses distinct characteristics compared to other techniques. Observation also means obtaining information by directly observing an object, as well as a careful examination [19].

3.4.2 Questionnaire

A Questionnaire is a data collection method that involves presenting a series of written statements/questions to respondents for them to answer. A questionnaire is an efficient data collection technique when researchers have clearly identified the variables to be measured and have a clear understanding of what is expected from the respondents [20].

3.4.3 Literature Review

In this study, a literature review is utilized to address the issue of the impact of apron floodlighting on flight safety at soekarno hatta international airport [21].

3.5 Data Analysis Technique

The technique used to analyze the data in this final project is quantitative descriptive. According to sugiyono, quantitative research involves obtaining data in numerical form. The descriptive method emphasizes a natural and straightforward description. With this nature, direct involvement in the field through observation is required. After the data collected by the author from the field research is gathered, the next step is to analyze the data using the likert scale technique [22].

In analyzing the data of this research, the spss software is used, which is a tool utilized for statistical analysis. When conducting analysis tests, several tests are employed, including:

3.5.1 Instrument validation

Instrument validation in the research context refers to the process of testing and evaluating the instruments used for data collection in the study. It is important to ensure that the instrument is valid, reliable, and aligned with the research objectives.

3.5.2 Classic assumption tests

Classic assumption tests, also known as basic assumptions or classical regression assumptions, are a set of assumptions that must be met when using the classical linear regression model. These assumptions are important because if they are not met, they can influence the interpretation of regression results and the validity of statistical conclusions [23].

3.5.3 Hypothesis testing

Hypothesis testing is a statistical procedure used to make judgments about a claim or hypothesis regarding a population based on available sample data. The aim is to conclude whether the available evidence supports or rejects the claims presented in the research hypothesis [24].

3.5.3 The coefficient of determination test

The coefficient of determination test or r2 aims to describe the variation of the dependent variable by measuring the ability of the model [25]. The coefficient of determination becomes a value between zero and one. If the dependent variable is limited, the coefficient of determination has a low R2 value. To increase the R2 value, the addition of an independent variable is necessary. According to many researchers, the use of the R2 value is recommended for evaluating the best regression model. However, when independent variables are added to the model, the adjusted R2 value can experience an increase or decrease.

3.6 Research Location and Time

The research location for this final project was taken at Terminal 1 Apron of Soekarno Hatta International Airport.

This research was conducted during the on the job training period from december 1, 2022, to january 23, 2023.

4. RESULT AND DISCUSSION

4.1 Analysis Results

4.1.1 Observation Results

Based on the author's observations during the On the Job Training at Soekarno Hatta International Airport, during nighttime flights, one crucial aspect is the active condition of apron floodlights and their adherence to the standards set by the International Civil Aviation Organization (ICAO) for the airfield lighting system (AFL). However, the situation in the field is slightly different because there are still some poles with apron floodlights that are not operational. This can happen due to several factors, such as the lack of available spare apron floodlights. When there's a malfunctioning or non-operational apron floodlight, it may not be immediately repaired. Given that apron floodlights are a crucial aspect for ensuring flight safety, this situation can pose challenges.

4.1.2 Questionnaire Results

No	Statements	5	4	3	2	1	total
1	Question 1	15	33	8	19	0	75
2	Question 2	29	30	14	2	0	75
3	Question 3	18	22	16	17	2	75
4	Question 4	27	34	10	3	1	75
5	Question 5	21	30	21	2	1	75
6	Question 6	29	32	11	3	0	75
7	Question 7	16	34	22	2	1	75
8	Question 8	27	35	12	0	1	75
9	Question 9	22	34	18	1	0	75
10	Question 10	19	35	16	5	0	75

4.1.3 SPSS Results

Validity test result

Indicator	R (Count)	R (Table)	Status
X1	0.790	0.227	Valid
X2	0.818	0.227	Valid
X3	0.535	0.227	Valid
X4	0.664	0.227	Valid
X5	0.580	0.227	Valid
Y1	0.733	0.227	Valid
Y2	0.829	0.227	Valid
Y3	0.702	0.227	Valid
Y4	0.646	0.227	Valid
Y5	0.703	0.227	Valid

Based on the results of the instrument test above, which involved distributing questionnaires to 75 respondents, the researcher conducted a validity test on all 75 samples. As shown in Table 4.3, it is known that all the indicators of the variables in this study are valid, with a calculated r greater than the table r (0.227).

In this study, the author conducted a normality test using the On-Sample Kolmogorov-Smirnov statistical analysis, which compares the calculated Kolmogorov-Smirnov value with the significance level.

Normality test results

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		75
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	2.35141835
Most Extreme Differences	Absolute	.094
	Positive	.094
	Negative	-.038
Test Statistic		.094
Asymp. Sig. (2-tailed)		.099[c]
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		

Normality test refers to the Kolmogorov-Smirnov (KS) test for two-tailed values. The criterion is that when the Kolmogorov-Smirnov (KS) result > 0.05, then it follows a normal distribution. Based on the normality test, the table above shows that the result of 0.099 > 0.05, indicating that the data follows a normal distribution.

Partial t-test

The decision in this test is based on the significance value as follows:

1) If the significance value is < 0.05 probability, there is a significant influence of the independent variable (X) on the dependent variable (Y). In the context of the hypothesis, the alternative hypothesis (Ha) is accepted, and the null hypothesis (Ho) is rejected.

2) If the significance value is > 0.05 probability, there is no significant influence of the independent variable (X) on the dependent variable (Y). In the context of the hypothesis, the null hypothesis (Ho) is accepted, and the alternative hypothesis (Ha) is rejected.

The second aspect considers the comparison of the calculated t-value and the tabulated t-value:

1) When the calculated t-value > tabulated t-value, there is an influence, or it can be said that Ha is accepted and Ho is rejected.

2) When the calculated t-value < tabulated t-value, there is no influence, or it can be said that Ha is rejected and Ho is accepted.

T test results

Research Variable	T_{count}	T_{table}	Significant Value (sig.)	Status
Apron Floodlight to Flight Safety	5,564	1,993	0,000	Ho rejected, Ha accepted

For the first decision-making step, there is a significant t-test value of 0.000 > 0.05. Therefore, in this study, Ha is accepted, and Ho is rejected. In the second decision-making step, comparing the calculated t-value with the t-table value, based on the t-test result, the calculated t-value is 5.564, and the t-table value is obtained from

α/2;n-k-1
[26]

Consequently, the t-table result for 0.025;72 is distributed to the t-table value of 1.993. When comparing the calculated t-value of 5.564 with the t-table value of 1.993, it can be concluded that in this study, Ho is rejected, and Ha is accepted. This can also be summarized in the research hypothesis that Apron Floodlight has an impact on the flight safety of Terminal 1 at Soekarno-Hatta International Airport.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.546[a]	.298	.288	2.367

a. Predictors: (Constant), Apron_Floodlight

b. Dependent Variable: Keselamatan_Penerbangan

Based on the formed linear regression model and knowing the coefficient of determination between the apron floodlight variable and flight safety is 0.298 or 29.8%. This means that apron floodlight has a coefficient of determination on flight safety of 29.8%.

This study was conducted using questionnaire data obtained from a total of 75 respondents in accordance with the intended results. Based on the analysis conducted, the following discussions can be obtained: Significance testing of linear regression or t-test can be seen in the table. The significance value of the apron floodlight variable on flight safety is 0.000. This decision is based on the significance test result < 0.05, which means that Ha is accepted and Ho is rejected. This implies that apron floodlight has a significant and positive influence on flight safety at Terminal 1 of Soekarno-Hatta International Airport. It can also be interpreted that better quality apron floodlights will further enhance the level of flight safety at Terminal 1 of Soekarno-Hatta International Airport.

5. CONCLUSION

Based on the results and discussions in the data analysis conducted by the author regarding the study on the Influence of Apron Floodlight Light Intensity on the Flight Safety of Terminal 1 at Soekarno-Hatta International Airport, supported by tests using the SPSS (Statistical Program for Social Science) program, the author draws the following conclusion:

1. Based on the SPSS test results, the intensity of apron floodlight has a positive and significant effect on the flight safety of Terminal 1 at Soekarno-Hatta International Airport.

2. Based on the T-test results, the obtained regression analysis outcomes show a significant influence value on the research variable of apron floodlight. Therefore, with the presence of LED-type apron floodlights, the flight safety level of Terminal 1 at Soekarno-Hatta International Airport can be enhanced. According to several respondents, there is still a need for improvement in the quality of apron floodlights in order to enhance the flight safety of Terminal 1 apron.

References

[1] B. D. Utama and J. F. Rezki, "Perkembangan Industri Penerbangan Dan Pertumbuhan Ekonomi Di Indonesia," *Jurnal Ilmu Pemerintahan Suara Khatulistiwa,* vol. IV, 2021.

[2] D. D. Kania, E. Probo and H. , "Analisis Faktor Budaya Keselamatan dan Kesehatan Kerja," *Jurnal Manajemen Transportasi & Logistik,* vol. 03, 2016.

[3] K. and A. Setiawan, "Rancangan Proteksi Otomatis menggunakan Motion Detector, Radio Frequency," *Jurnal Penelitian Poltekbang Surabaya,* vol. 4, 2019.

[4] I. C. A. O. "AERODROME," in *ANNEX 14*, 2004.

[5] K. P. "Penerbangan". Indonesia Patent UU no 1, 2009.

[6] Menteri Perhubungan, "Pemberlakuan Standar Nasional Indonesia (SNI) 03-7095-2005 mengenai marka dan rambu yang berlaku di area pergerakan pesawat udara di bandar udara.". Indonesia 2005.

[7] V. D. S. Putri and Suprapti, "Analisis Kinerja Petugas Apron Movement Control (AMC) Dalam Meningkatkan Keselamatan Penerbangan Di Bandara Udara Internasional Adi Soemarmo Solo," *Jurnal Akuntansi, Ekonomi dan Manajemen Bisnis,* pp. 190-197, 2022.

[8] Azriyenni, R. Febriyursandi and A. Hamzah, "TEKNIK PENCAHAYAAN RUANGAN VIA DIALUX EVO 8.1," 2019.

[9] R. Friadi and J. , "Sistem Kontrol Intensitas Cahaya, Suhu dan Kelembaban Udara Pada GreenhouseBerbasis Raspberry PI," *JTIS,* vol. 2, 2019.

[10] A. Pratama. Y, Taryana and R. Soebiantoro, "ANALISA APRON FLOODLIGHT MENGGUNAKAN LAMPU LED," *Jurnal Ilmiah Aviasi Langit Biru,* vol. 13, 2020.

[11] S. Palaloi, E. Nurdiana and A. Wibowo, "PENGUJIAN DAN ANALISIS KINERJA LAMPU TL LED UNTUK PENCAHAYAAN," *Jurnal Standardisasi,* vol. 20, 2018.

[12] F. . A. Wallong, "PERAN PENGGUNAAN GROUND SUPPORT EQUIPMENT (GSE) TERHADAP," *Jurnal Kewarganegaraan,* vol. 6, 2022.

[13] R. Nurdin, "PENDEKATAN SIMULASI UNTUK MENGOPTIMALKAN PARKING," *Jurusan Teknik Industri,* vol. VI, 2019.

[14] Sugiyono, "Metode Penelitian Kuantitatif, Kualitatif dan R&D," 2022.

[15] S. Metode Penelitian Kuantitatif Kualitatif dan R&D, Bandung: Alfabeta, 2020.

[16] S. Siregar, Metode Penelitian Kuantitatif : Dilengkapi dengan perbandingan perhitungan manual & SPSS, Jakarta: Kencana, 2017.

[17] Sugiyono, Metode Penelitian Kuantitatif dan Kualitatif Dan R&D, Bandung: ALFABETA, 2019.

[18] S. Arikunto, Prosedur Penelitian, Suatu Pendekatan Praktik, Jakarta: Rinneka Cipta, 2019.

[19] Sugiyono, "Statistika Untuk Penelitian," p. 229, 2018.

[20] V. Herlina, Panduan Praktis Mengolah Data Kuesioner Menggunakan SPSS, Jakarta: PT Elex Media Komputindo, 2019.

[21] E. R. Syafitri and W. Nuryono, "STUDI KEPUSTAKAAN TEORI KONSELING," *Jurnal BK UNESA,* vol. 11, 2020.

[22] S. Arikunto, Prosedur Penelitian, Suatu Pendekatan Praktik, Jakarta: Rinneka Cipta, 2020.

[23] Yoshinta and I. Ghozali, "PENYALAHGUNAAN PENGUNGKAPAN INFORMASI TANGGUNG JAWAB SOSIAL PERUSAHAAN UNTUK MANAJEMEN LABA PERUSAHAAN," 2021.

[24] Sugiyono and A. Susanto, "CARA MUDAH BELAJAR SPSS DAN LISREL," 2017.

[25] B. Nugraha, Pengembangan Uji Statistik: Implementasi Metode Regresi Linier Berganda

dengan Pertimbangan Uji Asumsi Klasij, Sukoharjo: Pradina Pustaka, 2022.

[26] S. Raharjo, "Cara Melakukan Uji t Parsial dalam Analisis Regresi dengan SPSS," 08 Maret 2019. [Online]. Available: https://www.spssindonesia.com/2014/02/cara-mudah-melakukan-uji-t-dengan-spss.html.