GROUND RUN UP ENCLOSURE DESIGN USING SKETCHUP APPLICATION AT I GUSTI NGURAH RAI INTERNATIONAL AIRPORT

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ABSTRACT

I Gusti Ngurah Rai International Airport, located in Denpasar, Bali Province, is an airport managed by PT Angkasa Pura I. The airport features a runway with a length of 3000 m and a runway width of 45 m. It has two aprons on the north and south sides, with a capacity of 46 parking stands on the north apron and 16 parking stands on the south apron. Currently, there is no dedicated facility for engine ground run-up at I Gusti Ngurah Rai International Airport. The engine ground run-up activities are still conducted on taxiway N7 and runway 09. This project focuses on planning the design of a Ground Run-Up Enclosure, which is a designated area for conducting engine ground run-up. The aim of this design is to enhance safety during engine ground run-up operations. The reference used in this project refers to national and international regulations and the airport's needs. The method used to determine the design of the GRE facility involves 3D modeling using the SketchUp application. Based on the research conducted at I Gusti Ngurah Rai International Airport and relevant references, the design of the Ground Run-Up Enclosure has an area of 8,928.4 m^2, with a length of 137.36 m and a width of 65 m. The deflector design features a length of 65 m, a height of 10.13 m, a deflector width of 0.75 m, and a support width of 7.25 m.

Keywords: *engine ground run-up, SketchUp, Ground Run-Up Enclosure, design.*

1. INTRODUCTION

Transportation facilities are essential in daily life, especially in increasing regional affordability [1]. Each region has different conditions and characteristics, mainly geographical and regional contours [2]. Indonesia's geographic need, which consists of many islands stretching from Sabang to Merauke, means that several remote areas in Indonesia are challenging to reach by land or sea transportation [3]. Therefore, air transportation is the most appropriate way to increase regional reachability effectively and efficiently [4].

Airports spread throughout Indonesia were built to increase the efficiency and effectiveness of the air transportation system. Airport management in Indonesia is carried out by several airport operators, namely the Unit Penyelenggara Bandar Udara (UPBU), which is a unit of the Directorate General of Civil Aviation that is tasked with carrying out aviation services and services related to airports [5], UPTD or Regional Government, as well as Business Entities Airports (BUBU) are state owned enterprises, regional-owned enterprises, or Indonesian legal entities in the form of limited liability companies or cooperatives, whose main activity is operating airports for public services, such as PT. Angkasa Pura I (Persero), PT. Angkasa Pura II (Persero), and BP Batam [6].

I Gusti Ngurah Rai International Airport has a runway with dimensions of 3000 m x 45 m. This airport also has two apron facilities, namely the north side apron and the south side apron with 46 parking stands on the north apron and 16 parking stands on the south apron [7]. With the many facilities at I Gusti Ngurah Rai International Airport, this airport does not yet provide a special location for aircraft to carry out engine ground run-up.

Operational engine ground run-up is carried out on taxiway N7 or runway 09. Because of this, direct supervision by the AMC unit is still required during operational activities, both before and after engine ground run-up activities. The unavailability of this facility is considered less effective because it increases the workload of the AMC unit, where engine ground runup activities carried out in taxiway or runway areas require special supervision to ensure that the area used is clean from Foreign Object Debris (FOD) which poses a threat to flight safety [8].

Adverse events due to the unavailability of engine run-up facilities can occur anytime. This happened at I Gusti Ngurah Rai International Airport. Airbus A320200 aircraft are undergoing light maintenance and must carry out an engine run-up to ensure the aircraft functions well and can return to service immediately. The airport management, in collaboration with the air traffic controller, provides clearance for airlines to be able to carry out engine run-up in the NP7 taxiway area. To ensure that the engine run-up activity does not interfere with other aircraft flight operations, the airport management closed access to two other taxiways, namely taxiway N7 and N6, which are connected to taxiway NP7 during the activity. The closure of these three taxiways resulted in less than optimal flight operations and had a detrimental impact on many sectors.

Even though this incident is situational, this incident requires special attention for airport administrators to start developing facilities in the form of a particular area for engine run-up. This area can also be developed and equipped with other safety-supporting facilities so that this area not only increases operational efficiency but can also improve operational safety and minimize the impact of engine run-up activities.

2. THEORETICAL REVIEW

2.1. Aerodrome

Aerodrome is a defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft [9].

Aerodrome is a land and/or sea area with certain boundaries that is used as a place for landing and take-off of aircraft, boarding and disembarking of passengers, loading and unloading of cargo, and a place for intra and intermodal transfers, which is equipped with aviation safety and security facilities, as well as basic facilities and other supporting facilities [10].

2.2. Engine Run-Up

Engine Run-Up is any activity other than taxiing, takeoff, and landing that involves setting the aircraft engine power above idle power. Engine Run-Up is the operation of an aircraft engine with the engine power setting exceeding the standard power setting for taxiing the aircraft [11].

Engine Run-Up, a pre-takeoff check of the performance of the aircraft engine using greater power from idle, as well as other aircraft systems, as recommended by the manufacturer for maintenance purposes [12].

2.3. Ground Run-Up Enclosure

The Ground Run-up Enclosure (GRE) is a structure that provides a combination of protection against acoustic impacts and jet blasts that allows testing of aircraft engines for either the first operation of the engine after manufacture or other maintenance activities [13].

2.4. Pavement

Pavement has the function of withstanding a certain amount of load from each type of vehicle load operating during the service period by considering environmental factors in certain areas [14]. Pavement structures are grouped into two groups, namely rigid pavement structures and flexible pavement structures [15].

Rigid pavement, because the modulus of elasticity of cement as a pavement material has a relatively more significant value than the foundation and soil, the most prominent part that absorbs stress due to loads is the concrete plate itself [16].

Flexible pavement structural design is based on layer system analysis, where the load rests on all layers as one unit. The contribution of each pavement layer in supporting the load is determined by the characteristics of the tire and the thickness of each pavement layer.

2.5. Aircraft Stand Marking

An aircraft stand is part of the apron used to place aircraft. Markings are a collection of symbols displayed on the surface of a movement area to provide aeronautical information [17].

It can be concluded that aircraft stand markings are a symbol or collection of symbols displayed on the surface of an area used as an aircraft parking area

Rules related to marking design are also regulated in KP 326 of 2019 concerning Technical and Operational Standards for Civil Aviation Safety Regulations Part 139 Volume I Airports [18]. The aircraft stand must contain the following elements: stand identification, taxi lane centerline, lead-in line, lead-out line, Taxi Lead-in line Designation, stop line, and Apron safety lines [19].

3. METHODS

3.1. Research Design

In this research, the author uses a type of research in the form of Research and Development (R&D). Research and development is a method used to produce specific products and test the effectiveness of these products [20]. ADDIE (Analysis-Design-Develop-Implement-Evaluate) instructional design model.

3.2. Testing Techniques

Testing, carried out when the application design has been completed and can be used. Testing is required before the system is operated. This test is intended to determine the margin of error level before the system is ready to be implemented.

System Evaluation, to get answers about whether the design functions as it should according to the researcher's wishes. When the design works as it should, the design will be implemented.

Use the System, this stage is the stage of using a system tested and evaluated first.

3.3. Data Analysis Technique

In this research, descriptive qualitative methods were used as data analysis techniques. Qualitative data was obtained by observation and interviews so that the data obtained was more descriptive [21]. Analysis in qualitative research is carried out during data collection and after completion of data collection within a certain period. Qualitative data analysis activities are carried out interactively and continuously until completion. Activities at the data analysis stage are data reduction, data display, and conclusion drawing/verification.

3.4. Tools and Materials

The hardware used in creating this information system is a laptop unit with specifications of an Intel Core I5 CPU 2.67 GHz, 8 GB RAM, and the SketchUp application.

4. RESULTS AND DISCUSSION

Based on research on Ground Run-Up Enclosure Design Using the Sketchup Application, which was carried out by researchers based on R&D research design with the ADDIE design model, research results were obtained and discussions were explained at each stage.

4.1. Analysis Results

With the facilities and layout that I Gusti Ngurah Rai Airport currently has in providing operational engine ground run-up services at I Gusti Ngurah Rai International Airport, taxiway N7 and runway 09 are used as locations for engine ground run-up. Several international airports in America and Europe already have engine ground run-up service facilities. This facility is a Ground Run-up Enclosure. An area specifically for carrying out engine ground run-up with the addition of facilities and other supporting technology that protects against the impact of noise and jet blasts that may occur during aircraft engine testing [22]. Therefore, this simple Ground Run-up Enclosure Design was created to improve flight safety related to engine ground run-up operations at I Gusti Ngurah Rai International Airport. This GRE facility can also add value to flight operations services and become a source of income for airport managers. This simple GRE was designed based on several previous related studies and research, as well as applying supporting facilities and technology implemented in Indonesia. Based on the analysis and observations carried out, areas are determined that are considered suitable for GRE area planning. This area is on the south side of I Gusti Ngurah Rai Airport, adjacent to the south apron area. The selection of the site is based on several aspects, such as the area available is sufficient to develop GRE facilities, the area is separated from busy areas of flight operations, so that engine run-up activities will not have an impact on other flight operations, and the direction of jet blast exhaust. It leads to the sea area and is free of settlements, eliminating the risk of accidents due to jet blasts.

4.2. Design Results

4.2.1. Deflector Design

The jet blast jet from the Airbus A320-200 aircraft has a speed of 45 m/s, the furthest blast distance is 20m, the blast height is 10 m, and the blast temperature is 80℃ [23]. With the jet blast jet specifications, a deflector design was designed with specifications of length 65 m, height 10.13 m, deflector width 0.75 m, and support width 7.25 m. The deflector surface design has a tilt angle of 20° to provide a deflection effect on the jet blast [24].

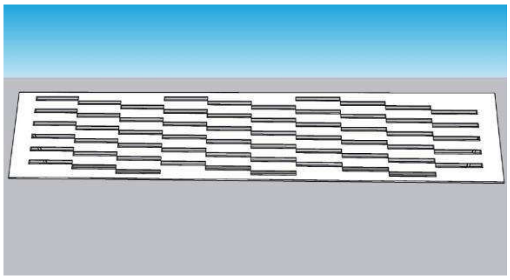

Figure 1 Front View Deflector Design

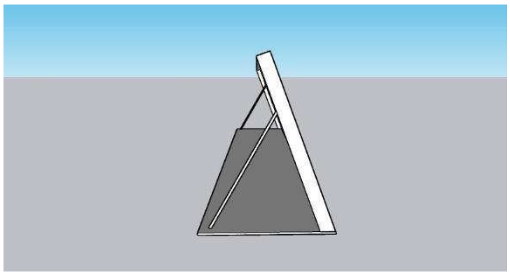

Figure 2 Side View Deflector Design

4.2.2. Ground Run-up Enclosure Design

The GRE area in the design is 8,928.4 m², with a length of 137.36 m and a width of 65 m. The length and width of the GRE stand area are adjusted to your needs. In this design, the GRE stand is able to accommodate Airbus A320-200 type aircraft with a wingtip length of 34.1 m and a fuselage length of 37.57 m. With an area width of 65 m, this design can facilitate the width of the A320-200's wingtip, including a clear distance for the aircraft to make movements that require sufficient space, such as when turning.

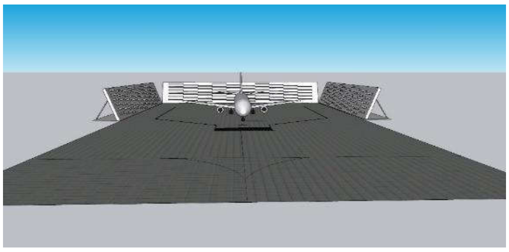

Figure 3 Front View Ground Run-Up Enclosure Design

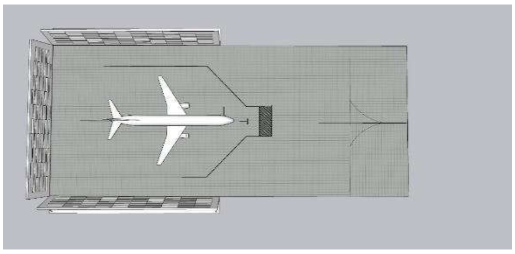

Figure 4 Top View Ground Run-Up Enclosure Design

4.3. Development Results

In the development stage, the GRE design is developed using SketchUp software. SketchUp was chosen as a design development medium because its use is easier to understand, and the resulting 3D modeling output is detailed. At this stage, the design receives additional details and developments, such as setting dimensions, adding details in the form of apron markings, adding access designs to facilities, and other structural components.

4.4. Implementation Results

The implementation stage is the application of the results of the development stage by placing the GRE design on the layout of I Gusti Ngurah Rai International Airport.

Figure 5 Top View Design

Figure 6 Top View Design

Figure 7 Rear View Design

4.5. Evaluation Results

The evaluation stage is the final step of the ADDIE system design model. Data at the evaluation stage comes from expert validation and several cadet respondents. Data consists of the results of interviews conducted regarding designs that have been implemented [25]. Data from expert validation comes from airport employees as validators of the Ground Run-up Enclosure design.

5. CONCLUSIONS

This simple Ground Run-Up Enclosure design is an innovation expected to improve the quality of the aviation industry in Indonesia and become one of the aircraft service facilities. This facility is designed to enhance flight safety in aircraft engine ground run-up services.

The Ground Run-Up Enclosure is a separate area from the apron, which is equipped with safety facilities in the form of deflectors on three sides of the GRE area which provide a deflection effect on the jet blast to minimize the impact of jet blasts that occur due to ground run up engine operational activities. This design is also equipped with markings following the standard markings that must be available in a parking stand.

Design creation involves gathering information regarding GRE and aircraft specifications and requirements, creating layouts, and creating more detailed 3D models using SketchUp. This GRE design is expected to be an efficient solution for I Gusti Ngurah Rai International Airport in providing aircraft engine testing services before flights.

Further analysis and testing are needed for actual implementation in the aviation industry in Indonesia. Apart from that, when implementing GRE facilities, Standard Operating Procedures related to the use of the GRE are also required so that they can be implemented optimally.

Problems caused by operational engine ground runup, both with micro and macro impacts, should be of special concern to airport service managers, especially I Gusti Ngurah Rai International Airport. Developing a

particular engine run-up area is one option for airport managers to increase operational efficiency and safety.

This design research is likely to be a solution for I Gusti Ngurah Rai International Airport in solving existing problems. With the actual development and implementation of the design, of course, still requires more in-depth research and analysis, this design is expected to be able to have a positive impact on airport managers and related stakeholders.

a. Increases the safety value of engine run-up operations.
b. Increase the effectiveness and efficiency of engine run-up operations.
c. Increase the value of airport service quality.
d. Minimize the percentage of accidents in engine run-up operations.
e. Increase the work effectiveness of related units, such as AMC, in monitoring engine run-up activities.
f. Able to become a new source of income for airport managers obtained from using facilities by airlines.

With the positive points above, this research design is worthy of consideration by airport service managers for actual development.

REFERENCES

[1] Fatimah, S. (2019). Pengantar Transportasi. Myria Publisher.

[2] KEMENTRIAN PERHUBUNGAN REPUBLIK INDONESIA, “Menuju Normalisasi Aktivitas Penerbangan di Bandara Bandara Indonesia,” debhub.go.id, Oct. 06, 2022.

[3] Dr. H. A. SE. , M. Karim et al., MANAJEMEN TRANSPORTASI. 2023.

[4] H. Rohaeni, “Kualitas Pelayanan Terhadap Kepuasan Pelanggan,” Marwa, Nisa, vol 2, Sep. 2018.

[5] Republik Indonesia, UU RI No 1 tentang Penerbangan. 2009.

[6] Peraturan Menteri Perhubungan Nomor PM 118 Tahun 2016 Tentang Perubahan Kedua Atas Peraturan Menteri Perhubungan Nomor PM 40 Tahun 2014 Tentang Organisasi Dan Tata Kerja Kantor Unit Penyelenggara Bandar Udara. 2016.

[7] AIP INDONESIA (VOL II), WADD/BALI

[8] Direktur Jendral Perhubungan Udara, KP 39 STANDAR TEKNIS DAN OPERASI PERATURAN KESELAMATAN PENERBANGAN SIPIL(AERODROMES). 2015.

[9] The International Civil Aviation Organization. (2018). Annex 14 Volume 1 (8th Edition).

[10] Sandhyafitri, A. (2017). Teknik Lapangan Terbang 1, Jurnal Teknik Sipil.

[11] Cottonwood Municipal Airport Operating Rules. (2010).

[12] Munich Airport Rules and Regulations. (2015).

[13] Gooden, J. H. M., & Hoelmer, W. (2016). Aerodynamic development of a ground run-up enclosure for propeller transport aircraft. Journal of Aircraft, 43(3), 692–699. https://doi.org/10.2514/1.16633

[14] Hendarsin, S. L. (2016). Perencanaan Teknik Jalan Raya.

[15] Kosasih, D., & Fibryanto, A. (2012). Analisis Kerusakan Retak Lelah pada Struktur Perkerasan Kaku Landasan Pesawat Udara dengan menggunakan Program Airfield.

[16] Saondang, H. (2015). Konstruksi Jalan Raya.

[17] Dwi Pratama Putra, R. (2017). Perencanaan Pemeliharan Dan Perbaikan Sisi Udara Bandara Internasional Ahmad Yani Semarang.

[18] Direktorat Jenderal Perhubungan Udara. (2019). Peraturan Direktur Jenderal Perhubungan Udara Nomor 326 Tahun 2019 Tentang Standar Teknis Dan Operasional Peraturan Keselamatan Penerbangan Sipil-Bagian 139 Volume I Bandar Udara.

[19] 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.

[20] Sugiono. (2017). Penelitian Kuantitatif, Kualitatif, dan R&D.

[21] Jones, B. A. (2014). ADDIE model (Instructional design).

[22] Barrett, D. (2013). The Port of Portland constructed an aircraft ground run-up enclosure (GRE) at Portland International Airport (PDX) to allow unrestricted day-time and nighttime aircraft maintenance run-ups while complying with Oregon Department of Environmental Quality (DEQ) standards for.

[23] Airbus A320 Aircraft Characteristics Airport And Maintenance Planning. (2020).

[24] Kusumo, P. A., Purwayudhaningsari, R., Wulandari, S. N., Surabaya, P. P., & Jemur Andayani, J. (2021). Perencanaan Pembuatan Pagar

Penahan Jet Blast Pada Apron Terhadap Gedung Tower Di Bandar Udara Silampari Lubuklinggau.

[25] Mulyatiningsih, E. (2014). Pengembangan Model Pembelajaran ADDIE.