

Analysis of Equipment Storage Area Facility Provision to Create Safety Flow for Ground Support Equipment (GSE) at Sultan Aji Muhammad Sulaiman Sepinggan Balikpapan International Airport

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Article Info	ABSTRACT
<p>Article History: Submitted: July 22, 2025 Revised : September 2, 2025 Accepted : October 1, 2025</p> <hr/> <p>Keywords: <i>Equipment Storage Area; GSE; Markings.</i></p>	<p>This research analyzes the provision of Equipment Storage Area (ESA) facilities to create a safe flow for Ground Support Equipment (GSE) at Sultan Aji Muhammad Sulaiman Sepinggan Balikpapan International Airport, given the increase in flight operations and the need for optimal ground handling. The main problems identified are the absence of clear markings in Storage B to indicate storage boundaries and the irregular layout of GSE. Using a qualitative descriptive method involving observation, interviews, and documentation in the airport's equipment storage area, the results indicate that Storage B does not meet operational safety standards due to the absence of markings, leading to unclear boundaries and disorganized GSE layout, which could hinder service delivery and reduce the safety and efficiency of GSE operations. As an improvement effort, it is strongly recommended to create clear storage markings in Storage B in accordance with the Director General of Civil Aviation Decision No. PR 21 of 2023, as well as to design a systematic GSE layout. This implementation aims to organize parking positions, improve land efficiency, prevent overlapping access routes, and ensure safer and more efficient ESA management in accordance with applicable regulations.</p>

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INTRODUCTION

Aviation represents an integrated system encompassing various interconnected components, including airspace utilization, aircraft operations, airport functionality as activity centers, air transport services, precise flight navigation systems, and stringent safety and security standards. Additionally, aviation considers environmental aspects and requires supporting facilities and public amenities to ensure smooth operational flow [1].

With the increasing flight operations at Sultan Aji Muhammad Sulaiman Sepinggan Balikpapan International Airport, ground handling services must be executed optimally to meet performance standards for efficiency, timeliness, and flight safety. Ground handling encompasses activities performed by companies related to aircraft and passenger services, including baggage handling, ticketing, and Ground Support Equipment (GSE) provision to support aircraft services during ground operations. These services are essential for passenger boarding and disembarkation, baggage and cargo loading/unloading, and other critical airport operations [2].



Figure 1 SAMS Sepinggan Airport Ground Support Equipment Layout[3]

Sultan Aji Muhammad Sulaiman Sepinggan Airport maintains three Equipment Storage Areas (ESA) to support GSE availability: Alpha storage (adjacent to the old terminal), Bravo storage (between main apron and helicopter apron), and Charlie storage (between cargo terminal and Charlie hangar).

The lack of clear markings in the Equipment Storage Area (ESA), particularly Storage B, at SAMS Sepinggan Airport significantly affects operational safety and efficiency. This condition increases the risk of collisions between GSE and worker accidents because equipment is parked too close together and in an unorganized manner, making it difficult for personnel to maneuver and access the area safely. As a result, the time wasted searching for the required GSE increases, storage space utilization becomes suboptimal, and ultimately, this prolongs the aircraft turnaround time on the ground, negatively impacting the overall operational efficiency of the airport. Based on ICAO Annex 14 Volume I (Aerodromes) in Chapters 5.3 and 5.4, ICAO emphasizes the importance of GSE storage areas being designed so as not to interfere with the movement of aircraft or other operational vehicles. These areas must have clear and adequate markings to ensure the orderly and efficient movement of GSE.[4]

Previous research by Hidarwanti identified similar problems, including faded and overlapping markings in airside areas, irregular GSE placement, and unavailable Equipment Parking Area (EPA) markings. These issues stem from the lack of standardized markings in airside areas, particularly the apron area of SAMS Sepinggan Balikpapan International Airport [5].

The current safety and security conditions of GSE in the Equipment Storage Areas are significantly influenced by this factor. Additionally, compliance with safety standards outlined in Directorate General of Civil Aviation Regulation No. PR 21 of 2023 concerning Technical and Operational Standards of Civil Aviation Safety Regulations Part 139 (Manual of Standard CASR Part 139) Volume I Aerodrome must be ensured to support flight operations in accordance with applicable regulations.

This study focuses on the condition of markings in Storage B at the Equipment Storage Area (ESA) of SAMS Sepinggan Airport. The scope of this study is limited in order to conduct an in-depth analysis of whether the existing markings comply with Standard Operating Procedures (SOP) to ensure operational safety and security. To determine whether the surface conditions of the equipment storage area facilities comply with Standard Operating Procedures (SOP) to ensure operational safety and security, and whether the layout of Ground Support Equipment (GSE) is optimal for creating a safety flow in the equipment storage area, the researcher chose the title "Analysis of Equipment Storage Area Facility Provision to Create a Safety Flow for Ground Support Equipment (GSE) at Sultan Aji Muhammad Sulaiman Sepinggan International Airport in Balikpapan."

METHODS

This research employs a descriptive qualitative methodology, which studies the current state of groups of people, objects, situations, circumstances, thought systems, or specific events in the present context[6]. The objective is to create systematic, accurate, and factual descriptions of facts, characteristics, and relationships between phenomena studied in natural circumstances without experimental manipulation, producing comprehensive, detailed, accurate, and factual overall pictures.

This research object is the airside area of SAMS Sepinggan Balikpapan International Airport, specifically the equipment storage area. This area is used to store ground support equipment (GSE) before and after it is used for service. Data was collected through direct observation during On-the-Job Training (OJT), direct interviews with the Apron Movement Control Supervisor and Ground Handling personnel regarding the storage conditions and placement of GSE, as well as documentation. The collected data will then be analyzed using qualitative descriptive data analysis techniques, an approach that understands the object naturally without the need for experimentation.

The research process began with field observations to observe conditions directly in the field, followed by interviews with relevant parties and document reviews to gather additional relevant information. After all data is collected through the data collection phase, the next step is data coding to organize the existing information, followed by thematic analysis to identify patterns and main themes. To ensure the validity of the findings, validation is conducted using triangulation techniques before finally formulating the conclusions & recommendations of the research.

RESULTS AND DISCUSSION

Observation and Documentation Results

Direct observations conducted at the Equipment Storage Areas revealed that conditions at Storage B do not meet operational safety standards established by aviation regulations. As shown in figures 2, it was found that the condition of Storage B does not yet have equipment storage markings, resulting in untidy GSE placement.

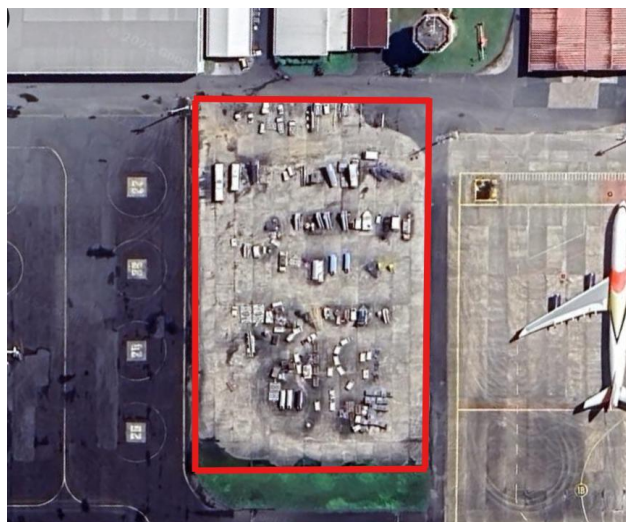


Figure 2 Equipment Storage Area B Location [3]



Figure 3 Storage B Condition

From the author's observations, the number of operational Motorized and Non-Motorized GSE, and the total area of Equipment Storage Area (ESA) available at Sultan Aji Muhammad Sulaiman Sepinggan International Airport Balikpapan were obtained.

Table 1 GSE Quantity

GSE CATEGORY	QUANTITY
Motorized	158
Non-Motorized	479
Total	637

Table 2 Equipment Storage Area Specifications

STORAGE LOCATION	LAND AREA (m ²)
GSE Hotel Santika (A)	3.111
GSE Timur Terminal (A)	2.580
GSE B	8.992
GSE C	2.625

Equipment Storage Condition Analysis

After observing the equipment storage area, it was found that the placement of Ground Support Equipment (GSE) in Storage B was not neatly arranged and obstructed the flow of other GSE. This is due to the lack of equipment storage markings that would indicate the boundaries of the storage area. This is regulated by the Decision of the Director General of Air Transportation No. PR 21 Year 2023 concerning Technical and Operational Standards of Civil Aviation Safety Regulations - Part 139 (Manual of Standard CASR - Part 139) Volume I Aerodrome. In response, the airport, specifically the Apron Movement Control (AMC) unit, has advised ground handling personnel to store and monitor their respective GSE to avoid disrupting other GSE operations.



Figure 4 Storage B Condition

Equipment Storage Marking Deficiencies

After observing the equipment storage area, it was found that the placement of Ground Support Equipment (GSE) in Storage B was not neatly arranged and obstructed the flow of other GSE. This is due to the lack of equipment storage markings that would indicate the boundaries of the storage area. This is regulated by the Decision of the Director General of Air Transportation No. PR 21 Year 2023 concerning Technical and Operational Standards of Civil Aviation Safety Regulations - Part 139 (Manual of Standard CASR - Part 139) Volume I Aerodrome. In response, the airport, specifically the Apron Movement Control (AMC) unit, has advised ground handling personnel to store and monitor their respective GSE to avoid disrupting other GSE operations.

DISCUSSION OF RESEARCH RESULTS

Based on the observations conducted by the researcher, the efforts expected to be carried out involve improving the storage area by repairing the surface structure and adding equipment storage markings. This will allow GSE service operations and placement to be implemented regularly, and the storage area to be used efficiently, orderly, and safely. The available storage areas are A, located east of the Terminal; B, situated between the main apron and the heli apron; and C, positioned between the Cargo Terminal and the Hangar. In Storage B, it was found that the placement of GSE was not neatly arranged and obstructed the movement flow of other GSE, due to the absence of equipment storage markings. These conditions can disrupt flight operations by hindering services and reducing safety and security levels. The uneven and undulating surface condition of the storage area, along with the untidy and unorganized placement of Ground Support Equipment (GSE), can increase the risk of disturbances to operational safety, security, and smoothness.

With efforts to improve the storage area, GSE can be arranged in an orderly and efficient manner, and the apron can be used optimally and safely, minimizing the risk of disruptions. After conducting direct observations and measurements, the researcher also found that Storage B has an area of 120 m in length and 75 m in width.

Creation of GSE Layout by Completing Equipment Storage Markings



Figure 5 Storage B Condition [3]

The author's observations indicate that the placement of Ground Support Equipment (GSE) in Storage B still does not meet ideal operational order and safety standards. The primary factor causing this condition is the absence of equipment storage markings, which serve as clear boundary indicators for the GSE storage area. Markings play a very important function in aviation operations. The lack of markings leads to disorderly and irregular GSE placement, with some GSE even obstructing the traffic flow of other GSE. This condition not only complicates operator access to specific GSE but also creates the potential for incidents and service disruptions.

Referring to the Decision of the Director General of Air Transportation No. PR 21 Year 2023 concerning Technical and Operational Standards of Civil Aviation Safety Regulations Part 139, markings for equipment storage should be:

1. In the form of a single line with a width of 0.1 meter.
2. Equipped with the words "EQUIPMENT STORAGE" in red with a font size of 0.3 meters and a distance of 0.15 meters from the line, with writing repetition intervals of no more than 50 meters along the boundary line.

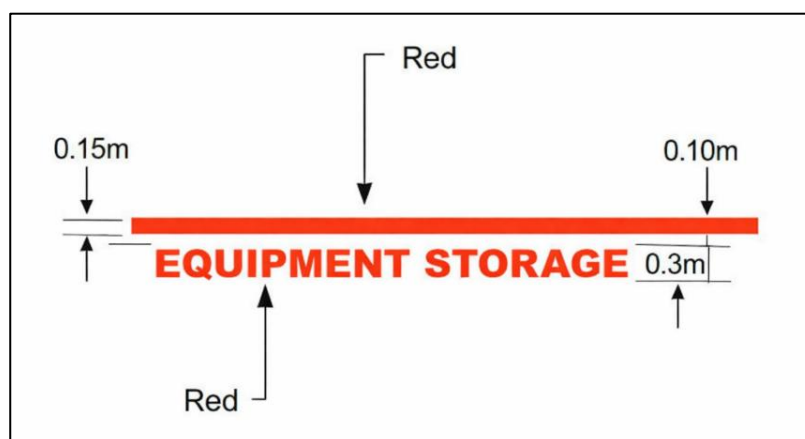


Figure 6 Equipment Storage Area Marking Recommendations[7]

Therefore, to create optimal safety flow, the placement of markings in storage B is a priority that must be realized immediately. This effort is expected to :

1. Bring order to the parking position of each GSE unit according to its type and function.
2. Increase the efficiency of storage land use.
3. Prevent overlapping lanes so that GSE units do not intersect with each other and minimize the risk of accidents.

The implementation of markings should also be complemented by a GSE layout that considers equipment traffic, the position of access and exit to the apron. Thus, the management of the Equipment Storage Area (ESA) will be more safety, efficient, and meet the applicable regulatory standards. The following layout is made by the researcher as a suggestion for GSE layout in storage B at Sultan Aji Muhammad Sulaiman Sepinggán Balikpapan International Airport :



Figure 7 Layout of GSE Placement

The flow of Ground Support Equipment (GSE) in and out of the storage area is carefully designed to ensure smooth operations. This process begins with the GSE access point, which must always be free of obstacles and have sufficient width to allow large vehicles to pass through easily, serving as the main gateway for all GSE before entering the storage area. Inside Storage B, the arrangement of GSE is highly strategic, based on the frequency of its use during daily operations, meaning that the most frequently used GSE is placed in easily accessible locations. Meanwhile, the empty area at the back of the storage can be flexibly utilized, either as a temporary repair area or a location for placing damaged GSE, with the primary objective of optimizing Equipment Storage B as an efficient main storage area throughout flight operations. Once the GSE is ready for use, access from the storage area to the service road and apron must be direct and aligned with the direction of assignment, always free of obstacles, and if necessary to ensure safety, supervisory personnel will escort the movement of the GSE until it reaches the apron area. The entire design flow and layout are clearly reflected in the detailed layout plan for the Equipment Storage Area (ESA) provided.

The diagram visually maps the arrangement of various types of Ground Support Equipment (GSE) at the airport, displayed with dimensions in millimeters. The layout divides the storage area into several segments identified by specific colors and labels, such as EMPTY, BCT, TPS, CONVEYOR, ASU, GPU, PBS, ATB, LST, WST, FIREX, BTT, ATT, and BUS, each marking the specific location of certain GSE. Thick white arrows scattered throughout the layout clearly indicate the designated movement directions for GSE, ensuring safe movement flow and preventing congestion, while the dimensions listed on each segment guarantee sufficient space for parking and maneuvering. Thus, overall, this design aims to optimize space utilization, enhance operational efficiency, and, most importantly, create a safe movement flow within the equipment storage area.

CONCLUSION

Based on the research conducted, it can be concluded that Storage B at Sultan Aji Muhammad Sulaiman Sepinggan International Airport in Balikpapan does not yet have essential equipment storage markings to indicate the boundaries of the Ground Support Equipment (GSE) storage area, which is directly correlated with the disorganized layout of the GSE, thereby posing potential operational disruptions, time inefficiencies in locating equipment, and suboptimal space utilization. Therefore, this study makes a significant contribution to SAMS Sepinggan Airport by highlighting the urgency of improvements to enhance safety and efficiency; The recommendation is that Sultan Aji Muhammad Sulaiman Sepinggan Balikpapan International Airport, particularly the Apron Movement Control (AMC) team responsible for GSE movement and arrangement, is strongly urged to immediately implement improvement efforts by creating clear and standard-compliant markings in Storage Area B, in accordance with the regulations set forth in Director General of Civil Aviation Decision No. PR 21 of 2023. Furthermore, a systematic layout for the equipment storage area should be designed and implemented to ensure efficient use of space, ease of access, and clarity of movement flow, thereby achieving safe GSE movement and enhancing overall GSE operational safety and efficiency. The urgency of implementing these changes cannot be delayed given their impact on operational risks, although this study, which relies on visual observation as one of its methodological limitations, has provided sufficiently strong findings to recommend urgent corrective actions.

ACKNOWLEDGMENTS

With gratitude, we have successfully completed this article. Although not perfect, hopefully it can enrich the aviation science repertoire and be useful for those who read it.

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