PASSENGER TERMINAL CAPACITY ANALYSIS IN 2045 AT MELAAN AIRPORT, WEST KUTAI

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ABSTRACT

Air transportation in Indonesia plays a strategic role in strengthening inter-island connectivity, accelerating population mobility, and driving economic growth, tourism, and equitable development. As the world's largest archipelagic nation, its vast geographical distances make airplanes an effective mode of transportation for reaching remote areas. Melalan Airport, located in West Kutai Regency, East Kalimantan, is a Class III airport serving as a vital link between inland areas and growth centers such as Balikpapan. The airport serves the Melak–Balikpapan and Melak–Datah Dawai routes and is managed by the West Kutai Regency Government. Despite its important role, the airport currently only has a terminal building area of 325 m² with a capacity of 109 passengers per hour. This study aims to analyze projected passenger numbers until 2045 and calculate terminal space requirements to meet future demand. This study uses a quantitative approach with descriptive analysis and a simple linear regression model to project passenger growth. The results indicate a significant increase in passenger numbers, necessitating terminal expansion. Based on projections, the total terminal area required in 2045 is 2,454 m², with a projected peak-hour passenger count of 367. These findings indicate that the current terminal capacity is inadequate to accommodate future growth and requires infrastructure planning for further expansion.

Keywords: *terminal capacity, passenger projection, Melalan Airport, linear regression, air infrastructure planning*

1. INTRODUCTION

Air transportation in Indonesia plays a strategic role in strengthening inter-island connectivity, accelerating population mobility, and driving economic growth, tourism, and equitable development. As the world's largest archipelagic nation, its vast geographical distances make airplanes an effective mode of transportation for reaching remote areas. Melalan Airport, located in West Kutai Regency, East Kalimantan, is a Class III airport serving as a vital link between inland areas and growth centers such as Balikpapan. The airport serves the Melak–Balikpapan and Melak–Datah Dawai routes and serves as the main gateway for the movement of people and goods within the West Kutai region.

In recent years, increased regional economic activity and population growth have driven a surge in passengers at Melalan Airport. This growth has created a major problem in the form of potential congestion at the passenger terminal, particularly during peak hours. Existing terminal facilities are feared to be inadequate to meet minimum service standards if the trend of increasing passengers continues. Furthermore, there has been no comprehensive study on long-term projections of passenger terminal capacity requirements and development strategies. This situation could impact service quality, operational efficiency, and passenger safety.

To address these challenges, it is necessary to conduct a passenger growth projection study and analyze the required passenger terminal space. Such a study is not only beneficial for airport managers but also crucial for local governments and aviation stakeholders as a basis for making decisions about air infrastructure investments. The proposed solution to this problem is to analyze passenger growth trends using historical data and appropriate projection methods, then calculate the required terminal space by referring to airport technical standards. This way, terminal development can be designed to align with projected air traffic growth through 2045.

The objectives of this study are (1) to analyze projected passenger growth at Melalan Airport through 2045, and (2) to determine the required passenger

terminal space in accordance with service standards and airport regulations. The results of this study are expected to provide input for airport managers, local governments, and the Directorate General of Civil Aviation in developing effective and sustainable airport infrastructure development plans.

A theoretical study of passenger terminal capacity planning forms an important basis for this research. According to the International Civil Aviation Organization (ICAO), terminal planning must consider projected air traffic growth, airport operating patterns, and passenger comfort standards. Furthermore, the Directorate General of Civil Aviation, through airport technical regulations, establishes guidelines for calculating terminal capacity based on peak-hour passenger volume, facility area, and passenger circulation. Previous studies on regional airport terminal capacity analysis have shown that a mismatch between passenger growth and existing facilities can reduce service quality and increase operational costs. Therefore, long-term projection-based analysis is necessary to anticipate future needs and prevent operational bottlenecks.

In addition to providing solutions for Melalan Airport, this research is expected to contribute more broadly to the development of airport planning and air transportation management in Indonesia. The results of this study have the potential to serve as a reference for other Class III airports facing similar conditions: rapid passenger growth but limited facility capacity. Thus, this research not only addresses local issues but also provides strategic benefits in supporting national air connectivity and regional economic development.

Overall, this introduction underscores the urgency of comprehensive passenger terminal capacity planning. Using an approach based on passenger growth projections and airport technical standards, passenger terminal development is expected to meet service needs for decades to come. The research findings are also expected to strengthen coordination between airport management and other stakeholders to achieve reliable, efficient, and sustainable air transportation infrastructure in the interior of East Kalimantan.

2. METHOD

This research uses a quantitative approach with descriptive analysis methods to examine existing conditions and a simple linear regression model to project future passenger numbers. The data used in this study is secondary data in the form of passenger movements from 2015 to 2023, obtained from airport management.

The research stages are as follows:

1. Problem Identification: Identifying current terminal capacity issues.
2. Literature Review: Collecting data and theories related to terminal capacity analysis.
3. Data Collection: Collecting secondary data on passenger movements from 2015-2023.
4. Data Analysis: Conducting a simple linear regression analysis to project passenger numbers.
5. Terminal Area Requirement Calculation: Calculating the required terminal area based on passenger projections.
6. Conclusions and Recommendations: Summarizing the research results and providing recommendations.

A simple linear regression model is used to predict future passenger numbers using the formula: $Y = a + bX$

a. Y is the dependent variable (number of passengers).

b. X is the independent variable (year).

c. a is a constant.

d. b is the regression coefficient.

Next, the projected peak passenger numbers (peak hours) will be used to calculate the terminal area requirements in accordance with the Directorate General of Civil Aviation Guidelines: Terminal Area (m^2) = (Peak Passenger Count × Standard Terminal Area) / Standard Terminal Capacity

a. The standard terminal area is set at 1.00 m^2/passenger.

b. The standard terminal capacity is 180 people/hour

3. RESULT AND DISCUSSION

a. Data Analysis and Passenger Forecasting

Analysis of passenger movement data at Melalan Airport from 2015 to 2023 shows a consistent growth trend. This data was then processed using a simple linear regression model to predict future passenger numbers. The results show a strong positive relationship between the year variable and the number of passengers, indicating that passenger movements are projected to continue increasing.

Based on the analysis, the projections for passenger numbers at Melalan Airport through 2045 are as follows:

a. The number of passengers in 2025 is projected to reach 172,639.
b. In 2035, the number of passengers is expected to increase to 237,962.
c. At its peak, in 2045, passenger movements are predicted to reach 303,286.

Data analysis shows that passenger numbers at Melalan Airport increased from 2020 to 2024, with an average growth rate of 18%. This data is used as a reference to predict passenger movements until 2045.

No.	Season	Come up	Depart	Total	Grow
1	2020	7.008	6.703	13.711	0%
2	2021	8.830	8.861	17.691	29%
3	2022	9.264	9.226	18.490	5%
4	2023	11.984	11.547	23.531	27%
5	2024	15.233	15.198	30.431	29%
Average Increase					18%

Table 1. Passenger Growth 2020-2025

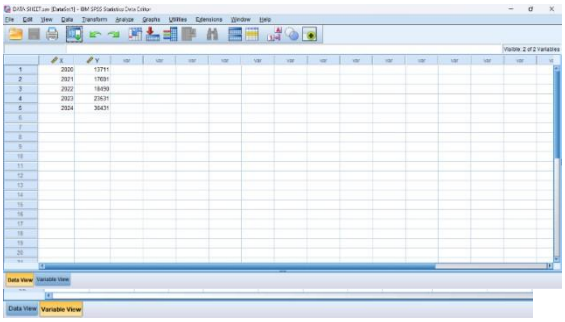

Figure 1. Input Variables X and Y
Source: Author's Editing, 2025

Forecasting Formula and Results: The method used for forecasting is simple linear regression. The linear regression equation model used is:

Y=a+bX

With the values of **a** and **b** calculated using the following formula:

$$a = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x^2)}$$

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

Forecast results show an increase in the number of passengers every year, and it is estimated that it will reach 282,334 passengers in 2045. This calculation is an important basis in determining future airport infrastructure needs.

b. Peak Time Passenger Forecasting

Based on the annual passenger projections, the next step is to calculate the number of passengers during peak hours, which is the primary reference for terminal capacity analysis. The calculations indicate that peak passenger numbers are projected to reach 367 people in 2045. Next, using the standards established by the Directorate General of Civil Aviation, the terminal area requirement is calculated using the formula:

$$PWS = \frac{Annual\ Passenger\ Count}{100} x\ Koef\ PWS$$

This section forecasts the number of passengers during peak hours (PWS) using the Minister of Transportation Regulation Number 41 of 2023.

Number of Pax/Year (Million)	Koefisien (%)	PWS
>30.000.000	0,035	>10.500
20.000.000 – 29.999.999	0,04	8.000-11.999
10.000.000 – 19.999.999	0,045	4.500-8.999
1.000.000 – 9.999.999	0,05	500-4.999
500.000 – 999.999	0,08	400-799
100.000 – 499.999	0,13	130-649
< 0,1	0,2	<200

Table 2. Typical Peak Hour Passenger
Source: PM 41 of 2023

Year	Total PNP	koef PWS	PWS
2020	13.711	0,2	27
2021	17.691	0,2	35
2022	18.490	0,2	37
2023	23.531	0,2	47
2024	30.431	0,2	61
2025	103.854	0,2	208
2026	207.702	0,2	415
2027	211.630	0,2	423
2028	215.558	0,2	431
2029	219.486	0,2	439
2030	223.414	0,2	447
2031	227.342	0,2	455
2032	231.270	0,2	463
2033	235.198	0,2	470
2034	239.126	0,2	478
2035	243.054	0,2	486
2036	246.982	0,2	494
2037	250.910	0,2	502
2038	254.838	0,2	510
2039	258.766	0,2	518
2040	262.694	0,2	525
2041	266.622	0,2	533
2042	270.550	0,2	541
2043	274.478	0,13	357
2044	278.406	0,13	362
2045	**282.334**	**0,13**	**367**

Table 3. Busy Time Passengers
Source: Author's processing, 2025

The results show that in 2045, the highest peak time passenger count is estimated to reach 367 people, with a

breakdown of 184 departing passengers and 183 arriving passengers.

c. Space Requirements Analysis

Given the analysis results indicating the inability of the existing terminal to accommodate future passenger growth, this study proposes a new terminal development plan. This plan is designed to achieve the required terminal area of 2,454 m² while also improving comfort and operational efficiency. This includes vital areas such as:

1. A larger check-in area to reduce queues.
2. A departure lounge that can accommodate peak passenger numbers.
3. Supporting facilities such as restrooms, prayer rooms, and adequate commercial areas.
4. A more efficient security checkpoint (SCP).

This development plan aims not only to meet the terminal's physical needs but also to improve the overall quality of service, in line with the government's vision of developing a modern and sustainable air transportation infrastructure.

The space requirements analysis was conducted based on a projection of 367 peak-time passengers in 2045. The calculation refers to the SKEP/77/2005 standard. The formula is as follows:

Number of Transfer Passengers = PWS x 20%
Number of Transfer Passengers = 367 x 20%
= 74 passengers

Passenger Data	**Total (person)**
Departing Passengers Busy	184
Arriving Passengers Busy	184
Transfer Passengers Busy	74

Table 4. Busy Transfer Passengers
Source: Author's processing, 2025

d. Passenger Flow

The passenger flow in the planned space expansion of Melalan Airport, West Kutai, is not expected to undergo significant changes by 2045. This is based on the consideration that the flow implemented at the existing terminal is sufficient to provide adequate access for passengers to utilize the facilities provided by the airport management.

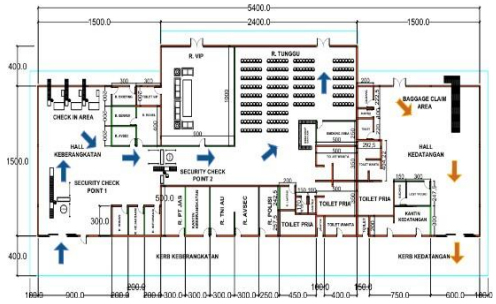

Figure 2. Existing Passenger Flow at the Departure Terminal. Source: Author's processing, 2025

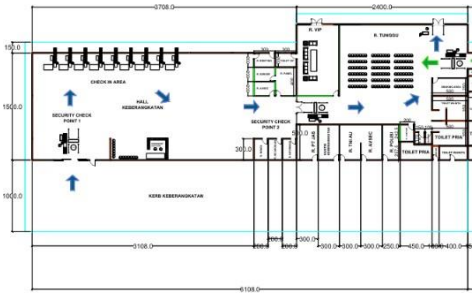

Figure 3. Planned Passenger Flow at the Departure Terminal. Source: Author's processing, 2025

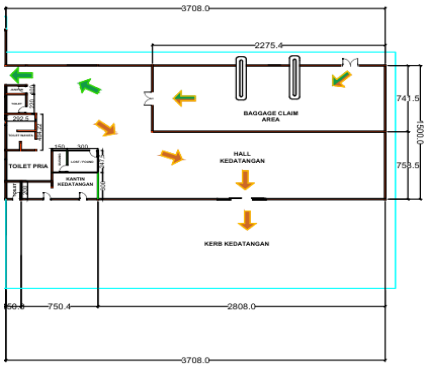

Figure 4. Planned Passenger Flow at Arrival Terminal. Source: Author's processing, 2025

Passenger movement description:

1. Departure: Passengers enter through the main gate, pass through Security Checkpoint 1 (SCP 1), proceed to the check-in counter for document verification and boarding pass printing, then proceed to SCP 2 before entering the departure lounge.
2. Arrival: After disembarking, passengers walk through the arrivals hall to the main gate. They then enter the arrivals hall to collect their baggage at the baggage claim area before proceeding through baggage screening and exiting.

4. CONCLUSION

Conclusion

This study concludes that passenger traffic at Melalan Airport will experience significant growth, projected to reach 367 passengers during peak hours by 2045.

Capacity analysis indicates that the current passenger terminal, with an area of 325 m², will be inadequate to accommodate this number of passengers. Calculations indicate that the required terminal area by 2045 is 2,454 m².

These findings underscore the urgent need for planning and development of terminal infrastructure at Melalan Airport. Strategic action is needed to ensure the airport continues to function optimally and support local economic growth. The study's primary recommendation is that airport management, in collaboration with the local government, immediately implement a terminal expansion plan to prevent future capacity shortages and ensure high-quality service for air transportation users.

Recommendation

Going forward, airport management is expected to continue developing and expanding the terminal sustainably, adapting to projected passenger growth. This development requires sufficient land availability to ensure optimal terminal expansion.

Further research is expected to plan the design and structure of the terminal development at Melalan Airport, West Kutai, East Kalimantan, to ensure that the airport development meets the needs of the passenger terminal's capacity standards.

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