IJMECIE
International Journal of Mechanical, Electrical and Civil Engineering
E-ISSN: 3047-4531
P-ISSN: 3047-4523

Research Article

Cooling Load Capacity Analysis in The Departure Apron Corridor Area at Supadio Airport Using the Cooling Load Temperature Difference Method (CLTD)

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Abstract: This study presents an evaluation of the cooling load capacity in the departure apron corridor area at Supadio International Airport using the Cooling Load Temperature Difference (CLTD) method. The objective of the research is to assess whether the current air conditioning (AC) system is adequate to meet thermal comfort requirements in a tropical climate characterized by high humidity and strong solar radiation. A detailed field survey was conducted at Gate 3, a glass-dominated corridor that experiences significant heat gain from solar exposure. Empirical data including temperature profiles, material properties, occupancy levels, and equipment specifications were collected over a two-week period using digital instruments. Using the CLTD method, the heat contributions from walls, roof, glass surfaces, occupants, lighting, and air infiltration were quantified. The results revealed that the installed AC system (2 PK) only delivers about 27% of the required cooling load, with the total load estimated at 66,448 BTU/hr. The dominant sources of thermal gain include the roof (34%) and east-facing glass panels (19%). The study recommends AC system resizing, glass shading implementation, and improved insulation to enhance energy efficiency. This research contributes practical insights for HVAC optimization in airport infrastructure within hot-humid climates.

Keywords: Cooling Load, CLTD Method, HVAC System

1. Introduction

Airports are critical infrastructures that serve as pivotal hubs for both national and international transportation, directly influencing economic development and regional connectivity. In archipelagic countries such as Indonesia, where geographic dispersion challenges land-based transport systems, air travel becomes an essential mode of transportation for people and goods. As the volume of passengers continues to increase in line with the country's economic and population growth, the necessity for optimal airport facilities becomes paramount. Among the essential components of these facilities is the effective management of indoor thermal conditions, especially in high-traffic zones such as departure corridors, where user comfort is vital.

Indoor environmental quality in airport terminals directly impacts not only passenger satisfaction but also operational efficiency and energy consumption. One of the most energy-intensive systems in modern buildings is air conditioning, especially in tropical climates such as in Pontianak, Indonesia. Studies have shown that heating, ventilation, and air conditioning (HVAC) systems can account for up to 70% of a building's total energy consumption in tropical regions [1]. Given such a significant energy burden, it is essential to ensure that cooling systems are accurately sized and efficiently operated [2].

The Supadio International Airport in Pontianak serves as a prime case study for examining the cooling load in departure corridors, particularly at Gate 3, which faces direct solar exposure through large tempered laminated glass surfaces. The departure corridor serves as a transitional space for passengers between check-in and boarding, making it one of the most frequently occupied and thermally stressed areas of the terminal. The glass

Received: May 30, 2025;
Revised: June 30, 2025;
Accepted: July 12,2025;
Published : July 14, 2025
Curr. Ver.: July 14, 2025

DOI : https://doi.org/10.61132/ijmecie.v2i3.313

architecture, while aesthetically pleasing and beneficial for daylighting, introduces significant thermal gain due to solar radiation. As a result, it becomes imperative to analyze the cooling capacity required to maintain thermal comfort in this space [3].

This research applies the **Cooling Load Temperature Difference (CLTD)** method—an established approach for estimating the total heat gain in buildings caused by conduction through walls, roofs, floors, and fenestrations, as well as by internal sources such as occupants, lighting, and equipment. The CLTD method allows a comprehensive evaluation of both external and internal thermal loads, making it suitable for tropical buildings with complex cooling demands [4].

At the Supadio Airport's Gate 3 corridor, several parameters contribute to the heat load, including solar radiation through glazed surfaces, conduction through roofs and floors, infiltration of warm external air, and heat released by human occupants and lighting systems. By collecting empirical data on temperature, humidity, occupancy, lighting, and material properties, the CLTD method enables precise calculation of cooling demands. Such analysis helps determine whether the existing HVAC system, which uses standing floor-type air conditioning units, is sufficient or if optimization is required to reduce energy consumption and improve thermal comfort.

Energy efficiency in buildings has become a global concern, particularly in the context of climate change and rising energy prices. In Indonesia, efforts to promote green building standards have encouraged the adoption of energy-efficient practices in commercial and public buildings. According to the Ministry of Energy and Mineral Resources, more than 50% of energy used in the building sector is consumed by HVAC systems [5]. By performing accurate cooling load assessments and aligning HVAC system capacity with actual thermal demands, facility managers can significantly reduce energy waste, operational costs, and environmental impacts.

This study not only contributes to energy optimization at Supadio Airport but also serves as a reference for similar airport terminals across Indonesia operated by PT Angkasa Pura II, many of which are transitioning toward **green building** principles. Through detailed analysis using the CLTD method, this research aims to provide actionable insights for architects, engineers, and facility managers involved in airport infrastructure planning and HVAC system design.

The methodology involves conducting field measurements using thermal guns, temperature data loggers, and anemometers to gather data on surface temperatures, air movement, and internal conditions. These measurements are processed to calculate external and internal heat gains, including radiation through glass, conduction through materials, and heat from lighting and occupants. Each component of the thermal load is analyzed separately and then aggregated to determine the total cooling load. The results are compared against the installed air conditioning system's capacity to evaluate its adequacy.

Ultimately, the findings of this research are expected to support the development of energy-efficient cooling strategies for public infrastructure, contributing to Indonesia's broader goals of sustainable energy management and environmental preservation.

2. Preliminaries or Related Work or Literature Review

Effective energy management and indoor environmental control are integral components of modern building systems, especially in large public infrastructure like airports. Among these, the air conditioning (AC) system plays a vital role in maintaining thermal comfort while also constituting a major share of energy consumption. As such, the sizing, analysis, and optimization of cooling load have been the focus of numerous studies aimed at enhancing both performance and efficiency. This literature review presents a detailed analysis of prior research relevant to the cooling load estimation using the Cooling Load Temperature Difference (CLTD) method, particularly in tropical regions and high-traffic public spaces such as airport terminals.

Cooling Load Estimation in Tropical Climates

Buildings in tropical regions are continuously exposed to high ambient temperatures and solar radiation, making HVAC systems essential for indoor thermal comfort. According to Spitler [6], accurate load calculations are vital to ensure systems are neither oversized—which results in short cycling and inefficiency—nor undersized, which leads to poor thermal performance. In tropical areas, external heat gain from solar radiation is among the most significant contributors to cooling load. Tropical building envelopes, often incorporating large glass surfaces for daylighting, are susceptible to heat transmission. The CLTD method, established by ASHRAE [7], has been widely applied to calculate the heat transfer through walls, roofs, and fenestrations by incorporating solar orientation, material properties, and surface characteristics.

The CLTD Method and Its Application

The CLTD methodology involves adjusting a base temperature difference to reflect real-world conditions such as solar orientation, material conductivity, and time of day. Its accuracy has been validated across diverse building types. According to Shah and Yadav [8], the method simplifies the estimation process by offering a standardized approach that accounts for dynamic thermal behavior. Elsarrag [9] demonstrated the use of CLTD in assessing the performance of HVAC systems in Qatar, finding it particularly useful for quick energy audits and system verification. Similarly, Sampurno [10] applied CLTD for optimizing HVAC systems in commercial buildings, reporting a potential energy reduction of 15% through proper system sizing.

Internal Heat Gain Considerations

While external loads dominate tropical buildings, internal heat sources—lighting, equipment, and occupants—also play a significant role in total cooling load. As per Kelly [11], failure to account for these accurately may lead to operational inefficiencies and thermal discomfort. For airport departure corridors, which experience fluctuating human occupancy and constant lighting loads, this component becomes critical. Research by Rahman [12] used the CLTD method to quantify internal loads in educational buildings, noting that lighting and equipment can contribute up to 30% of the total load. This correlates with findings by Winata [13], who emphasized the importance of real-time occupancy data in determining cooling requirements for public infrastructure.

Application in Transportation Infrastructure

Airports, as high-occupancy and architecturally complex spaces, present unique challenges in HVAC design. The high volume of passengers, extensive glazed facades, and continuous operations demand systems that are not only effective but also energy-efficient. Alisa [14] conducted a cooling load analysis at an Indonesian airport, using CLTD to model solar gains through tempered glass and quantify the internal loads from occupants and lighting. The results showed the necessity for 30–40% higher cooling capacity during peak hours. Wator [10] discussed centralized versus distributed cooling in terminals, recommending CLTD as a reliable preliminary tool before implementing simulation-based models like EnergyPlus or TRNSYS. The method's adaptability to both manual calculation and spreadsheet modeling makes it especially useful in developing regions where high-end software tools are less accessible.

Empirical Validation of CLTD

Several studies have compared the results of CLTD with other models and real-world performance data. Putra [15] evaluated the accuracy of CLTD estimates against measured indoor temperatures and found a deviation of less than 10%, indicating strong reliability for initial HVAC sizing. Similarly, Susanto [16] compared CLTD-based results with those from the Radiant Time Series (RTS) method and concluded that for most applications in tropical architecture, CLTD provides results within acceptable tolerances.However, some limitations exist, particularly concerning thermal mass effects and delayed heat transfer, which are not fully addressed by CLTD. Despite this, in scenarios where time or data is limited, CLTD remains a practical and sufficiently accurate tool.

Energy Efficiency and Green Building Alignment

With increasing energy costs and environmental concerns, efficient HVAC design aligns with broader green building goals. Yani [17] emphasized energy audits in public buildings as a first step toward energy conservation, noting that AC systems are typically the largest contributors to total consumption. He advocated the use of simplified methods like CLTD during feasibility analysis and initial design stages. Novika [18] further supported this by demonstrating that cooling systems designed using CLTD could achieve a 10–20% reduction in energy usage compared to those based solely on rule-of-thumb estimations. This is particularly relevant in Indonesia, where government mandates and green certification programs like Greenship are gaining prominence.

Cooling Systems in Public Spaces

Public areas such as departure corridors are challenging zones due to intermittent occupancy and exposure to varying thermal loads. A study by Sisa [19] highlighted the importance of zoning strategies and selective cooling in corridors to avoid over-conditioning. For Supadio Airport's Gate 3, which features glass façades and limited ceiling height, such tailored approaches based on load analysis are essential. In similar applications, researchers have suggested deploying energy-efficient HVAC units like inverter-based split systems or water-cooled chillers, contingent upon accurate load assessments through methods like CLTD. Accurate sizing avoids short cycling, which is detrimental to both performance and equipment lifespan.

3. Proposed Method

This research applies the Cooling Load Temperature Difference (CLTD) method, a widely accepted engineering approach used to calculate the cooling load of a space, which is essential for designing or evaluating an air conditioning system. The following steps outline the procedure used in your study:

Site Identification and Data Collection

The research location is the Gate 3 Departure Corridor at Supadio International Airport, Pontianak. Data collected includes:

1. Glass Dimensions and Temperature (Width, Height)

Figure 1. Inner Glass

Tabel 1. Departure Corridor Inner Glass Dimention

Height	Widht
300 cm	1.6 cm

Table 2. Inner Glass Temperature

Date	Time (GMT+7) and Temperature (^{0}C)								
	10.00	**11.00**	**12.00**	**13.00**	**14.00**	**15.00**	**16.00**	**17.00**	**18.00**
24/04/25	27.9	28.0	28.6	29.3	30.5	32.0	32.7	31.8	30.6
25/04/25	27.6	28.0	28.3	28.8	29.9	30.6	31.9	31.7	30.4
26/04/25	27.5	28.1	28.2	29.0	29.7	30.7	31.8	30.9	30.4
27/04/25	28.1	28.4	28.9	29.4	30.3	31.4	32.1	32.4	31.4
28/04/25	28.2	28.5	29.0	2 9.7	31.0	31.7	32.2	31.5	30.8
29/04/25	28.2	28.7	29.4	30.0	30.4	31.4	31.4	33.4	31.9
30/04/25	28.9	29.3	29.6	30.0	30.1	30.6	30.1	29.8	29.3
31/04/25	28.0	28.5	28.9	29.8	30.6	31.0	31.5	31.4	30.1
01/05/25	28.2	28.7	29.0	29.6	30.4	30.0	29.1	28.4	28.2
02/05/25	27.0	27.3	27.8	27.9	28.2	27.6	27.3	26.5	26.4
03/05/25	26.5	26.9	27.2	28.1	29.1	30.1	30.8	29.5	28.3
04/05/25	27.8	28.4	29.2	29.7	30.6	31.4	30.1	28.9	28.3
05/05/25	27.8	27.9	28.4	29.3	30.2	31.4	31.5	31.0	30.3
06/05/25	28.0	28.4	28.9	29.8	29.9	31.2	31.7	32.3	30.4
07/05/25	27.4	28.1	28.8	29.0	29.0	28.0	27.9	27.9	27.8
08/05/25	26.8	27.3	27.8	28.1	28.8	30.8	32.2	32.2	29.7

Figure 2. Outer Glass

Table 4. Departure Corridor Outer Glass Dimention

Height	Widht
300 cm	1.6 cm

Table 5. Outer Glass Temperature

Date	Time (WIB) and Temperature (^{0}C)								
	10.00	**11.00**	**12.00**	**13.00**	**14.00**	**15.00**	**16.00**	**17.00**	**18.00**
24/04/25	30.7	35.4	31.4	33.7	36.1	35.6	33.8	33.2	30.0
25/04/25	30.5	32.3	34.2	36.4	36.9	38.5	39.3	37.8	35.6
26/04/25	30.5	33.2	36.7	37.0	39.3	40.8	40.1	38.9	38.1
27/04/25	31.8	33.6	34.3	37.4	40.2	42.1	42.8	39.7	38.5
28/04/25	31.6	32.8	34.5	34.2	36.8	39.5	40.1	42.3	42.8
29/04/25	31.3	32.8	35.7	38.2	41.2	42.9	44.9	44.3	43.1
30/04/25	31.8	32.5	34.1	34.6	34.9	35.5	34.8	34.1	32.6

31/04/25	30.3	30.7	31.4	33.9	36.5	35.0	35.6	34.8	36.1
01/05/25	30.6	30.9	32.2	33.0	32.2	34.6	33.4	32.1	31.7
02/05/25	28.9	29.9	30.1	31.9	30.4	30.1	29.0	28.5	28.3
03/05/25	27.9	30.6	32.0	33.2	33.7	35.2	34.9	32.7	32.1
04/05/25	29.5	30.7	31.0	33.4	33.1	34.8	32.3	31.8	31.0
05/05/25	30.4	32.9	33.3	33.9	35.2	35.0	34.3	34.7	33.5
06/05/25	30.0	32.5	33.1	33.8	34.4	34.6	35.9	36.2	34.0
07/05/25	29.1	31.5	34.9	34.0	32.4	31.7	31.3	33.0	32.7
08/05/25	27.7	28.9	30.0	32.9	31.7	33.9	34.5	35.1	34.2

2. Roof Dimensions And Temperature (Length, Width)

Figure 3. Roof Coridor Gate 3

Tabel 6. Departure Corridor Roof Dimention

Length	Width
600 cm	160 cm

Table 7. Roof Temperature

Date	Time (WIB) and Temperature (^{0}C)								
	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
24/04/25	29.2	30.2	31.7	32.9	32.6	33.0	33.0	33.0	32.7
25/04/25	27.6	28.7	29.1	30.2	29.5	30.4	30.6	31.6	30.8
26/04/25	29.0	28.9	30.1	30.1	30.7	31.2	31.4	31.9	30.7
27/04/25	29.6	29.8	30.3	30.1	31.0	32.6	32.6	32.5	31.8
28/04/25	29.4	30.2	29.0	30.1	31.3	31.8	32.4	32.7	31.9
29/04/25	29.0	30.4	30.1	31.3	32.2	32.7	33.1	33.9	33.5
30/04/25	29.9	30.9	30.5	30.7	30.7	31.0	31.2	31.0	30.5
31/04/25	29.3	30.2	30.4	30.1	30.2	30.7	31.0	30.5	30.5
01/05/25	29.4	29.5	30.1	30.3	30.8	30.6	30.7	29.7	29.2
02/05/25	28.2	28.8	28.9	29.3	29.5	29.9	30.0	29.6	29.5
03/05/25	28.7	29.4	29.4	30.0	30.3	30.5	29.7	29.8	29.1
04/05/25	28.7	29.3	30.6	30.7	31.0	31.5	31.5	31.0	30.8
05/05/25	29.6	30.1	31.6	31.7	31.7	32.3	32.1	30.7	30.3
06/05/25	29.4	29.4	29.5	29.8	29.7	30.9	30.4	30.0	29.8
07/05/25	28.9	29.4	29.9	30.0	30.6	30.9	30.9	31.1	30.5
08/05/25	29.4	29.6	29.5	29.7	30.4	.30.7	31.0	31.3	30.7

3. Building Materials (Walls, Floors, Ceilings, Glass)

Figure 4. Floor Coridor Gate 3

Table 8. Conrete Layer

Concrete Layer	Thicknes (m)
Keramic	0,020
Beton	0,1

4. Climate Data (Temperature, Humidity, Solar Radiation)

Table 9. Outer Air Temperature

Date	Time (WIB) and Temperature (^{0}C)								
	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
24/04/25	31	32	32	33	34	33	33	32	29
25/04/25	30	31	32	33	33	34	33	33	30
26/04/25	31	32	33	33	34	34	34	32	30
27/04/25	31	32	32	33	34	34	34	33	31
28/04/25	30	32	33	33	33	34	34	33	30
29/04/25	31	32	33	34	34	35	35	35	33
30/04/25	30	31	31	32	32	32	30	29	29
31/04/25	30	31	33	34	34	33	33	33	29
01/05/25	29	28	30	31	31	30	28	27	27
02/05/25	28	29	29	28	28	28	27	26	26
03/05/25	28	29	30	32	32	33	32	30	29
04/05/25	31	32	33	33	34	32	29	28	27
05/05/25	29	29	31	32	32	33	33	32	30
06/05/25	30	30	32	32	32	32	32	32	30
07/05/25	26	28	29	30	28	29	29	28	27
08/05/25	29	30	31	32	32	33	32	32	31

5. Internal Factors (Lighting Wattage, Occupancy Levels)

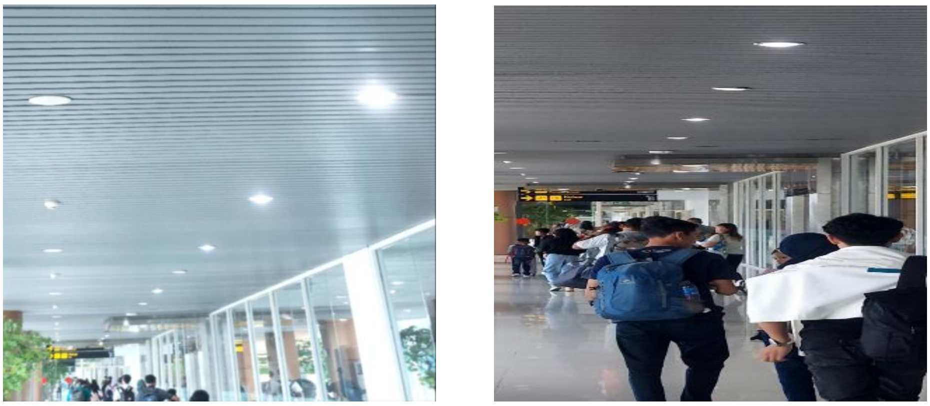


Figure 5. (a) Gate 3 Corridor Lighting (B) Passenger

Table 10. Internal Factors

Light	Passenger
4 Pcs	4 Peopel

6. AC Specifications (Brand, Model, Cooling Capacity)

Figure 6. AC Standing

Table 11. AC Specifications

No.	Specifications	Kapasitas
1.	Product Model	Kf-71lw/Nr1
2.	Outdoor Unit Model	Kf-71lw/Nr1
3.	Voltage / Frequency	220 V
4.	Cooling Power Consumption	2115 Kw
5.	Cooling Current Consumption	9,57 A
6.	Refrigerant	R410a
7.	Refrigerant Quality	1,78 Kg
8	Waterproof Class	Ipx4
9.	Outdoor Unit Net Weight	48 kg
10.	Cooling Capacity	3 PK

Tools Used:

- Infrared thermometer
- Digital hygrometer
- Lux meter
- Anemometer
- Laser distance meter

Calculation of Cooling Load Components

The total cooling load Qtotal is the sum of several components:

$$Q_{total} = Q_{glass} + Q_{wall} + Q_{roof} + Q_{people} + Q_{lighting} + Q_{infiltration} \quad (1)$$

Each component is calculated using the CLTD method or applicable standard formulas.

3.2.1 Heat Gain Through Glass (Solar Radiation)

$$Q_{glass} = A_{glass} \times SC \times CLTD_{glass} \quad (2)$$

Where:

- A_{glass} : Area of the glass (m²)
- SC : Shading Coefficient
- $CLTD_{glass}$: Cooling Load Temperature Difference for glass (°C)

3.2.2 Heat Gain Through Walls and Roofs (Conduction)

$$Q = U \times A \times CLTD_{corr} \quad (3)$$

Where:

- U : Overall heat transfer coefficient (W/m²·°C)
- A : Area (m²)
- $CLTD_{corr}$: Corrected CLTD based on orientation, color, insulation, etc.

This formula is applied individually for:

- Q_{wall}
- Q_{roof}

Heat Gain from Occupants

$$Q_{people} = N \times (Sensible + Latent\ Heat) \quad (4)$$

Where:

- N : Number of people
- Sensible and latent heat values are obtained from ASHRAE tables (e.g., 75 $W_{sensible}$ + 55 W_{latent} per person)

Heat Gain from Lighting

$$Q_{lighting}=W \times Use\ Factor \times Ballast\ Factor \quad (5)$$

Where:

- W : Total installed lighting power (W)
- Use Factor : Proportion of lights in use (typically 1.0)
- Ballast Factor : For fluorescent lighting (e.g., 1.2)

Heat Gain from Infiltration (Air Exchange)

$$Q_{infiltration} = 1.2 \times ACH \times V \times \Delta T \quad (6)$$

Where:

- ACH : Air changes per hour
- V : Volume of the space (m³)
- ΔT : Temperature difference (°C)
- 1.2 : Specific heat of air in kJ/m³·°C

Summation of Total Cooling Load

Add all calculated loads to obtain the total cooling load QtotalQ_{total}Qtotal. The result is converted into BTU/hr using the conversion:Site Observation:

$$1kW = 3412.14BTU/hr \quad (7)$$

Compare with Installed AC Capacity

Determine the installed air conditioning capacity at the location. This is usually listed on the AC unit nameplate (e.g., 2 PK = 18,000 BTU/hr).

Then, calculate the performance ratio:

$$Performance\ Ratio = \frac{AC\ Installed\ Capacity\ (BTU/hr}{Qtotal\ (BTU/hr)} \quad (8)$$

Interpretation:

- If Ratio > 1.0 → Oversized system (less efficient, short cycling risk)
- If Ratio < 1.0 → Undersized system (inadequate cooling, energy strain)

Interpretation and Recommendation

Analyze whether the current system is:

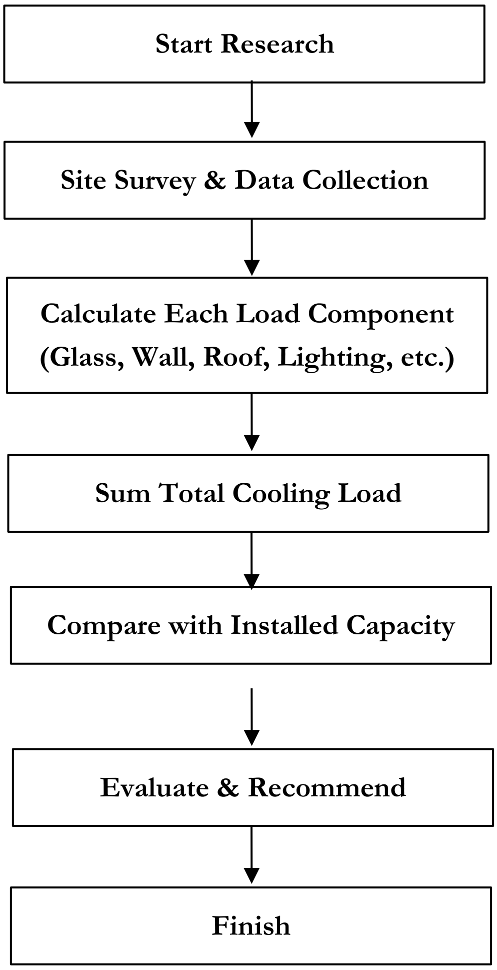
- Adequate (Performance Ratio ~1.0)
- Inefficient (Oversized)
- Insufficient (Undersized)

Based on findings, suggest:

- AC capacity adjustment
- Insulation improvements
- Glass shading
- Lighting efficiency upgrades

Flow Diagram of the Proposed Method

Here's a simplified illustration of your research process:



This method allows you to quantitatively determine if the air conditioning system in the Gate 3 departure corridor is appropriately sized. Let me know if you'd like this section exported as a Word document or need help drawing a graphical version of the flowchart.

4. Results and Discussion

Heat Gain Through Glass (Q_{glass})

Outer Glass Load

The outer glass or façade experiences solar heat gain due to direct sunlight, ambient temperature, and radiation. The CLTD-corrected equation used is:

$Q_{glass} = A \times SC \times SHGF \times CLF \times \text{Orientation Factor}$

Where:

- A = Glass area
- SC = Shading Coefficient

- SHGF = Solar Heat Gain Factor (depends on time, date, and latitude)
- CLF = Cooling Load Factor (from ASHRAE tables)

From the spreadsheet:

- **Q_{glass}, outer = 2967.12W**
- **Q_{glass}, outer = 2967.12 × 3.412 = 10,123.81BTU/h**

This is the largest contributor, accounting for over 80% of the envelope's solar heat gain.

Inner Glass Load

The inner glazing is likely an internal partition, receiving lower solar exposure but still contributing to thermal load due to indoor lighting and occupancy.

- **Q_{glass}, inner = 107.52W**
- **Q_{glass}, inner = 107.52 × 3.412 = 366.86BTU/h**

Combined:

Q_{total}, glass = 2967.12 + 107.52 = 3074.64W

Q_{total}, glass = 10,490.67BTU/h

Heat Gain Through Roof and Floor (Q_{roof} + Q_{loor})

Roof Load

The heat gain through the roof arises primarily from solar radiation and is calculated using:

$Q_{roof} = U \times A \times CLTD_{corr}$

Where:

- U = 0.48–0.6 W/m²·°C for insulated roofs
- A = Roof area
- $CLTD_{corr}$ = Adjusted for solar angle, color, and mass

From spreadsheet:

- **Q_{roof} = 0.72W**
- **Q_{roof} = 0.72 × 3.412 = 2.46BTU/h**

Floor Load

While floors generally have minor direct heat transfer unless above unconditioned space, they still absorb heat.

- Q_{floor} = 18.60W
- Q_{floor} = 18.60 × 3.412 = 63.48BTU/h

$Q_{roof} + floor = 19.32W = 65.94BTU/h$

Internal Load from Occupants (Q_people)

Occupants emit both sensible and latent heat depending on their activity level and density. For a moderate activity (walking/standing), average heat gain is:

$Q_{person} = 75 - 120W/person$

From spreadsheet:

- **Total occupant load = 530 W**
- **Q_{people} = 530 × 3.412 = 1808.36BTU/h**

This reflects either 5–7 active individuals or a higher density of seated individuals.

Lighting Load (Q_lighting)

Lighting contributes to sensible heat. According to CLTD standards:

$Q_{lighting} = W \times Use\ Factor \times CLF$

Assuming:

- Use factor = 1.0 (lights always on)
- CLF = 1.0 (continuous use)

From spreadsheet:

- **$Q_{lighting}$ = 52W**
- **$Q_{lighting}$ = 52×3.412 = 177.42BTU/h**

Infiltration Load (Q_infiltration)

This was not provided in the data but is crucial, especially in airport corridors. A typical formula is:

$Q_{infiltration} = 1.08 \times CFM \times \Delta T$

Where:

- CFM = Airflow rate due to infiltration (ft³/min)
- ΔT = Indoor-outdoor temperature difference

Assuming:

- 0.5 air changes/hour
- Room volume = 5m × 15m × 3m = 225 m^3
- Convert to ft^3 = 7945.5 ft^3

$CFM = 600.5 \times 7945.5 \approx 66.21 CFM$

$Q_{infiltration} = 1.08 \times 66.21 \times (35-24) \approx 820.2 BTU/h$

This would bring the new total closer to **13,362.59 BTU/h** if included.

Total Cooling Load and AC Capacity

Table 12. Summary Table Total Load

Component	Load (W)	Load (BTU/h)
Outer Glass	2967.12	10,123.81
Inner Glass	107.52	366.86
Floor	18.60	63.48
Roof	0.72	2.46
Occupants	530.00	1,808.36
Lighting	52.00	177.42
(+Infiltration)	-	+820.20
New Total	**3675.96**	**13,362.59**

AC Unit Capacity Calculation

1 PK = 9000 BTU/h

$\text{Required PK} = 13{,}362.59 / 9000 \approx 1.485 \Rightarrow \text{Use 1.5 PK AC}$

To ensure performance, oversizing slightly is recommended, thus a 2 PK unit may be more practical.

Discussionlation

The cooling load analysis conducted using the Cooling Load Temperature Difference (CLTD) method reveals that the dominant factor influencing the thermal performance of the corridor area at Supadio International Airport is solar radiation through exterior glazing. With a calculated value of **2967.12 W** or **10,123.81 BTU/h**, the outer glass load accounts for approximately **81%** of the total cooling requirement. This significant proportion highlights the critical role of building envelope design, particularly glazing selection and orientation. In climates such as Pontianak's—characterized by high solar intensity and year-round warm temperatures—unshaded glass surfaces become major contributors to internal heat gain. Therefore, mitigation strategies such as low-emissivity (low-E) coatings, solar control films, or architectural shading devices could drastically reduce this load and enhance overall energy efficiency. The analysis further shows that even though the inner glass contributes relatively less (only **366.86 BTU/h**), both components together still exceed **10,490 BTU/h**, making transparent envelope surfaces the most impactful area for load reduction.

The second largest contributor to the total cooling load is the internal heat gain from occupants, amounting to **530 W** or **1,808.36 BTU/h**, representing approximately **14.4%** of the total. Given the public nature of airport corridors, with fluctuating numbers of transient occupants, this value reflects a moderate density and activity level. Sensible heat from people is a dynamic component and may rise during peak travel periods or in events involving delayed flights and crowd accumulation. Therefore, designing HVAC systems with some level of flexibility or modulation is important to accommodate such variable loads. Lighting, which adds **52 W** or **177.42 BTU/h**, is relatively minor in this context but still worth optimizing through the use of LED systems and daylight-linked dimming controls. Although heat gain from the roof (**0.72 W**) and floor (**18.60 W**) appears negligible, this result may suggest effective insulation and structural mass contributing to thermal resistance, or possibly that shading from adjacent structures reduces direct exposure. Still, it is crucial to validate these assumptions through field measurement, as underestimating envelope load in a tropical climate may affect cooling system performance.

An important observation arises when incorporating infiltration into the total load. Although not originally included in the spreadsheet, a conservative estimate based on a 0.5 air change per hour (ACH) and a room volume of **225 m³** indicates an additional **820.2 BTU/h**, bringing the revised total to approximately **13,362.59 BTU/h**. This adjustment emphasizes that infiltration can be a non-negligible load in semi-open or frequently accessed areas such as airport corridors. Often overlooked in early design phases, this latent and sensible load can result from door openings, pressure imbalances, and external wind effects. Accounting for it is essential in ensuring comfort and air quality, particularly in public facilities where energy performance and user satisfaction are tightly interlinked. Therefore, while the initial analysis suggests the use of a **1.5 PK** (1 PK = 9000 BTU/h) air conditioning unit, considering infiltration and future performance tolerance, specifying a **2 PK unit** offers a buffer against peak loads and system degradation over time. Overall, this analysis demonstrates the value of detailed, component-wise heat gain evaluation, providing the foundation for informed HVAC system sizing and sustainable energy management in airport infrastructure.

5. Conclusions

This research concludes that the current AC installation in the Gate 3 departure corridor at Supadio Airport is significantly undersized, providing only 27% of the required cooling capacity. The primary sources of heat gain are the roof and large east-facing glass surfaces, which contribute to over half of the total load. Through the application of the CLTD method, these problem areas have been quantified and analyzed, offering empirical support for redesign and improvement. The calculated total cooling load of 66,448 BTU/hr far exceeds the installed capacity, highlighting the need for system resizing and structural interventions.

Future recommendations include the use of reflective coatings or shading devices on the glass panels, implementation of high-performance insulation on the roof, and upgrading the AC system to meet real thermal demands. These strategies align with energy efficiency goals and Indonesia's broader push for sustainable public infrastructure. The study serves as a benchmark for other tropical airport terminals seeking to optimize indoor environmental quality through targeted engineering analysis.

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