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Analysis of Elevator Waiting Time Performance in Four-Star Hotel Buildings: A Comparative Study in Kupang City

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Abstract. The increasing number of hotel visitors in Kupang has led to the development of several four-star hotels with multi-floor configurations that require effective elevator services. However, inadequate elevator performance can cause longer waiting times. This study aims to analyze the average waiting time of elevator users in three four-star hotels, namely Aston Kupang Hotel, Harper Kupang, and Sotis Hotel Kupang. The research applies a quantitative case study approach through field observations using video recording techniques at the elevator lobby area. Data collection was conducted during weekday and weekend periods across four different activity sessions to capture variations in user traffic. The collected data were analyzed using descriptive statistical methods to determine the average waiting time for each hotel and then compared with the service performance criteria stated in SNI 03-6573-2001. The results show that the average waiting time in all observed hotels exceeds the recommended standard of 30–50 seconds. Aston Kupang Hotel recorded the longest average waiting time, followed by Sotis Hotel Kupang, while Harper Kupang demonstrated relatively better performance. These findings indicate that building characteristics such as the number of floors, elevator capacity, and number of elevator units significantly influence elevator service efficiency.

Keywords: circulation system; elevator; hotel building; vertical transportation; waiting time

1. Introduction

Vertical transportation systems are essential components in multi-storey buildings because they support the mobility of occupants and influence the efficiency of building operations [1]. In contemporary urban buildings, elevators function not only as mechanical transport devices but also as part of the spatial circulation system that affects comfort, accessibility, and service performance [2]. Efficient elevator operation becomes increasingly important in buildings with a high number of floors and large user volumes, such as hotels, office towers, hospitals, and shopping centers. Inadequate elevator capacity or inefficient circulation planning can lead to congestion, increased waiting time, and reduced user satisfaction [3].

Hotels represent a building typology in which service efficiency and user comfort are closely interconnected. A hotel is generally defined as a commercial accommodation facility that provides lodging, food services, and other supporting facilities for travelers and visitors [4]. In hotel buildings, vertical transportation plays a crucial role because guests frequently move between guest rooms, public facilities, restaurants, and meeting areas. Therefore, the performance of elevator systems becomes a significant factor influencing the perceived quality of service [5]. When elevator waiting times are too long, guests may experience inconvenience that affects their overall satisfaction with the hotel environment.

The evaluation of elevator performance is commonly measured through several operational indicators, including handling capacity, travel time, and waiting time. Among these indicators, waiting time is considered one of the most important parameters because it directly reflects the efficiency of elevator service from the user's perspective [6]. Waiting time refers to the duration between the moment a user calls the elevator and the moment the elevator arrives and opens its doors. Studies on vertical transportation indicate that longer waiting times can reduce the perceived quality of indoor circulation and negatively affect user comfort in high-rise buildings [7].

In Indonesia, the design and performance of vertical transportation systems are regulated by the national standard SNI 03-6573-2001. This standard provides guidelines for elevator planning in buildings, including recommendations regarding elevator capacity, number of elevators, zoning systems, and service performance indicators. According to this standard, the acceptable average waiting time for elevators in hotel buildings generally ranges between 30 and 50 seconds, which is considered an adequate level of service for building users. If the waiting time exceeds this threshold, it may indicate inefficiencies in the vertical circulation system, such as insufficient elevator capacity, inadequate zoning strategies, or high user demand.

The rapid development of tourism and hospitality industries has increased the demand for efficient accommodation facilities in various urban areas. One example is Kupang, the capital city of East Nusa Tenggara, which has experienced a steady increase in tourist arrivals in recent years. Several four-star hotels in Kupang operate with different architectural configurations, building heights, and elevator capacities. Examples include Aston Kupang Hotel, Harper Kupang, and Sotis Hotel Kupang. Although these hotels share the same classification level, they vary in terms of the number of floors, elevator capacity, and operational characteristics. Such differences may influence elevator service performance, particularly in terms of waiting time experienced by guests in the lobby area. However, empirical studies examining elevator waiting time performance in hotel buildings, especially in secondary cities in Indonesia, remain limited.

Previous research has explored elevator efficiency in various building types, including hospitals, commercial buildings, and shopping centers, highlighting the relationship between elevator capacity and user comfort [8]. These studies emphasize that the number of elevators, passenger demand patterns, and building height significantly influence waiting time performance [9]. Nevertheless, research focusing specifically on hotel environments (where guest experience and service quality are critical) remains relatively scarce.

Based on these considerations, this study aims to analyze the average waiting time of elevator users in three four-star hotels in Kupang City. The study evaluates elevator service performance by measuring waiting times at the main lobby of each hotel and comparing the results with the performance standards outlined in SNI 03-6573-2001. By examining the differences in waiting time among the selected case studies, this research seeks to identify how building characteristics, such as building height, number of elevators, and elevator capacity, affect the efficiency of vertical transportation systems in hotel buildings.

2. Methods

This study employs a quantitative research approach with a case study method to analyze the performance of elevator waiting time in four-star hotel buildings. The quantitative approach was selected because the research focuses on measuring numerical data related to elevator waiting time and comparing the performance among several case study buildings. The case study method allows an in-depth investigation of vertical transportation performance within specific building contexts, enabling the identification of operational characteristics and differences among the observed hotels.

The research objects consist of three four-star hotels located in Kupang, namely Aston Kupang Hotel, Harper Kupang, and Sotis Hotel Kupang. These hotels were selected because they represent the main four-star hotel category in the city and have different architectural characteristics, such as building height, number of floors, and elevator capacity. The comparison among these buildings allows the evaluation of how vertical transportation systems operate under different building configurations.

2.1. Research Variables

The primary variable analyzed in this study is elevator waiting time, which refers to the duration between the moment a user presses the elevator call button and the moment the elevator arrives and opens its doors at the lobby floor. Waiting time is used as a key indicator to evaluate the efficiency of elevator service and the effectiveness of vertical circulation within the building.

Supporting variables considered in the analysis include the number of floors in the building, the number of passenger elevators, the elevator capacity (kg and maximum passengers) and user arrival patterns at different times of the day. These variables are important because they influence the operational performance of elevator systems in multi-storey buildings. The performance results are later compared with the service criteria provided in SNI 03-6573-2001, which recommends an average waiting time of approximately 30-50 seconds for hotel buildings.

2.2. Data Collection Method

The primary data in this research were collected using direct observation through video recording techniques. This method allows the researcher to capture real-time user behavior and elevator operation at the hotel lobby area without interfering with the activities of the building users. Video recording is categorized as non-participant observation, where the researcher does not interact directly with the subjects but records the activities occurring in the observation area.

The recording process focuses on the elevator lobby area because this location represents the main vertical circulation point where hotel guests request elevator service. The recorded data are then analyzed to determine the duration of waiting time experienced by elevator users. The time measurement begins when the elevator call button is pressed and ends when the elevator door opens at the lobby floor.

2.3. Observation Schedule

Data collection was conducted during two different types of days, namely weekday and weekend periods, in order to capture variations in hotel occupancy and visitor activities. Each hotel was observed during two separate days consisting of one weekday and one weekend day.

To represent different patterns of hotel activity throughout the day, observations were divided into four-time sessions:

- Breakfast period (08.00-10.00 WITA), when hotel guests typically move from guest rooms to the restaurant area.
- Check-in and check-out period (12.00-14.00 WITA), when guest arrivals and departures are most active.
- Afternoon leisure period (17.00-19.00 WITA), when guests move between rooms and recreational facilities.
- Evening period (20.00-22.00 WITA), when guests return to their rooms after dining or other evening activities.

Each observation session lasted two hours, allowing sufficient data to be collected for analyzing elevator service performance during different operational conditions.

2.4. Data Analysis Technique

The collected data were processed using descriptive statistical analysis to determine the average waiting time of elevator users in each hotel. Descriptive statistics are used to summarize raw observational data into numerical indicators that are easier to interpret. The average waiting time is calculated using the following formula:

$$WT = \frac{\sum ti}{n} \tag{1}$$

where WT is average waiting time (seconds), *ti* is waiting time of each observation, *n* is total number of observations.

The processed data were first organized and calculated using spreadsheet software to determine the average waiting time for each observation session. The results were then compared across the three case study hotels to identify differences in elevator performance. Finally, the calculated waiting times were evaluated against the performance criteria recommended in SNI 03-6573-2001 to determine whether the elevator systems meet the acceptable service standards for hotel buildings.

3. Results and Discussion

3.1. Characteristics of the Case Study Buildings

Understanding the physical and operational characteristics of the studied buildings is important in evaluating elevator performance. Building height, number of floors, number of elevators, and elevator capacity are key factors that influence vertical transportation efficiency in multi-storey buildings. In hotel buildings, these characteristics directly affect passenger demand patterns, elevator handling capacity, and ultimately the waiting time experienced by users.

The three case study objects in this research are located in Kupang and represent the main four-star hotel category in the city, namely Aston Kupang Hotel, Harper Kupang, and Sotis Hotel Kupang. Although these hotels have the same classification level, they differ in several architectural and operational aspects that potentially affect elevator service performance. Figure 1 shows the lift lobby area of each object studies where the 'waiting time' data collection was carried out.

Figure 1. Lift Lobby Area of Aston Hotel, Harper Hotel and Sotis Hotel

One of the most influential parameters is the number of floors. Buildings with a greater number of floors generally require more efficient elevator systems because the travel distance of elevator cars becomes longer and passenger demand tends to increase. Another important factor is the number of passenger elevators relative to the building height and number of rooms. Insufficient elevator provision can cause congestion during peak hours, particularly during breakfast time, check-in and check-out periods, and evening activities when many guests return to their rooms simultaneously.

In addition, elevator capacity plays a significant role in determining service efficiency. Elevators with larger passenger capacity can accommodate more users per trip, thereby reducing the queue length at the lobby area. However, capacity alone does not guarantee optimal performance because elevator dispatching strategy and traffic distribution also influence operational efficiency.

Table 1 presents the comparative characteristics of the three hotels that potentially influence elevator performance.

Table 1. Comparison of Building Characteristics Affecting Elevator Performance

Building Characteristics	Aston Kupang Hotel	Harper Kupang	Sotis Hotel Kupang
Building Type	City Hotel	City Hotel	Beachfront Hotel
Year of Opening	2014	2023	2015
Number of Floors	18 Floors	10 Floors	8 Floors
Number of Rooms	153 Rooms	176 Rooms	±120 Rooms
Passenger Elevators	3 Units	2 Units	2 Units
Service Elevator	1 Unit	1 Unit	1 Unit
Elevator Capacity	1000 kg (≈13 persons)	800 kg (≈11 persons)	1000 kg (≈13 persons)
Primary User Type	Business & MICE Guests	Government & Business Guests	Leisure & Tourism Guests

From the comparison above, it can be observed that Aston Kupang Hotel has the largest vertical scale, with 18 floors served by three passenger elevators. Although the number of elevators is higher than the other two hotels, the building height increases the vertical travel distance, which may contribute to longer waiting times during peak demand periods. In contrast, Harper Kupang has fewer floors, allowing elevator travel cycles to be completed more quickly, which contributes to relatively lower waiting time values. Meanwhile, Sotis Hotel Kupang has a moderate building height and similar elevator capacity to Aston Kupang, resulting in intermediate elevator performance.

These differences demonstrate that elevator performance is not determined by a single factor but by a combination of building characteristics such as building height, elevator quantity, and passenger demand patterns. Therefore, understanding the physical characteristics of each building is essential to explain the variations in elevator waiting time observed in this study.

3.2. Measured Waiting Time Performance

The results of the elevator waiting time measurements show that all three hotels exhibited average waiting times that exceed the recommended service level in the Indonesian elevator planning standard SNI 03-6573-2001. This standard suggests that the acceptable average waiting time for hotels should be in the range of 30-50 seconds under normal traffic conditions. However, the observed waiting time values in the studied hotels were found to be significantly higher, indicating potential inefficiencies in vertical transportation planning and operation.

The measured average waiting times were as follows: Hotel A recorded 70 seconds on weekdays and 78 seconds on weekends, Hotel B recorded 58 seconds on weekdays and 55 seconds on weekends, and Hotel C observed 62 seconds on weekdays and 68 seconds on weekends. These results reveal that none of the hotels met the benchmark for acceptable service waiting time outlined in the national standard.

Elevator waiting time is one of the most fundamental metrics in evaluating elevator performance, as it directly influences user comfort and satisfaction [10]. Previous studies in high-rise buildings indicate that waiting times significantly longer than service benchmarks often lead to congestion, increased travel delays, and reduced perceived service quality [4]. Moreover, the distribution of waiting times is influenced by building height, elevator capacity, and traffic patterns, which suggests that larger buildings with higher user volumes inherently encounter longer waiting times unless mitigated by adequate design strategies [7].

3.3. Impact of Building Configuration on Waiting Times

The differences in waiting time performance among the three hotels can be explained by variations in building characteristics. Hotels with more floors and fewer elevators per floor tend to exhibit longer waiting time during peak periods [11]. For instance, Hotel A, having more floors and higher occupancy rates, had the longest waiting times in both weekday and weekend observations. In contrast, Hotel B, with fewer floors and an adequate number of elevators relative to its size, showed comparatively lower waiting times.

In the extant literature, elevator performance analysis underscores that elevator system design (including number and capacity of elevators) directly affects vertical transportation efficiency and user experience [12]. Studies using traffic simulation models demonstrate that increasing elevator capacity and optimizing dispatching strategies can significantly reduce waiting times, especially during peak demand periods [13]. These findings are aligned with our empirical data, showing that configurations with higher handling capacity and balanced passenger flow management yield better waiting time performance.

3.4. Comparison with International Elevator Performance Research

Comparative research on elevator traffic flow has shown that elevator performance can be significantly optimized through strategic planning and configuration decisions. For example, intensive simulation studies demonstrate that mixed-capacity or all-large-capacity elevator systems can influence waiting time performance depending on traffic conditions and user demand patterns [9]. Specifically, in the Ak-Keme Hotel simulation study, elevator configurations with all-large-capacity systems showed reduced average waiting time and minimized longest waiting instances compared to mixed-capacity configurations, highlighting the importance of capacity planning in vertical transportation [9].

In addition, research conducted in the urban residential context of Jakarta also supports the notion that elevator performance (especially waiting time and round-trip time) is heavily dependent on appropriate elevator planning, including the number of elevator units and their service cycles [14]. These findings corroborate the requirement that elevator design parameters must be tailored not only to building height but also to expected traffic patterns and peak usage times to ensure effective vertical mobility.

Table 2 below summarize the average elevator waiting times measured at the lobby of each hotel during weekday and weekend periods.

Table 2. The Average of Waiting TimeRadja_Production

Hotel	Weekday WT (s)	Weekend WT (s)	Avg WT (s)
Aston Kupang	70	78	74
Harper Kupang	58	55	56.5
Sotis Kupang	62	68	65

3.5. Implications for Hotel Vertical Transportation Design

The results from the studied hotels in this research indicate a clear need to reconsider elevator design and service planning for high-demand hospitality environments. Longer waiting times than recommended standards may negatively affect user comfort and perceived quality of service. Prior studies show that perceived waiting time can exacerbate user stress and dissatisfaction, which in turn impacts overall satisfaction with building services, especially in hospitality settings where user experience is paramount [15].

From a design perspective, vertical transportation systems in hotels should integrate advanced elevator control strategies, such as destination dispatching or adaptive scheduling algorithms, that are proven to lower waiting time and even energy consumption under variable traffic conditions. Such strategies have been reported to improve system performance in high-rise buildings through more balanced passenger distribution and responsiveness to dynamic demand patterns.

4. Conclusions

This study analyzed the elevator waiting time performance in three four-star hotel buildings located in Kupang, namely Aston Kupang Hotel, Harper Kupang, and Sotis Hotel Kupang. The analysis focused on evaluating elevator service efficiency based on the average waiting time experienced by users at the lobby area during different operational periods.

The results show that the average waiting time of elevator users in all three hotels exceeds the recommended service level defined in SNI 03-6573-2001. The longest waiting time was observed in Aston Kupang Hotel with an average waiting time of approximately 74 seconds, followed by Sotis Hotel Kupang with an average of about 65 seconds, while Harper Kupang recorded the lowest average waiting time of approximately 56.5 seconds. These values indicate that the elevator service performance in the studied hotels does not fully meet the recommended standard of 30–50 seconds for hotel buildings.

The findings also demonstrate that building characteristics significantly influence elevator waiting time performance. Factors such as the number of floors, number of elevator units, and elevator capacity contribute to differences in waiting time across the three case studies. Buildings with greater height and higher user demand tend to experience longer waiting times, particularly when the number of elevators is not proportional to the building scale and occupancy level.

This research contributes to the understanding of vertical transportation performance in hospitality buildings by providing empirical data on elevator waiting time in four-star hotels. The results highlight the importance of integrating proper elevator planning and traffic analysis in hotel design to ensure efficient vertical circulation and improve user comfort. In practical terms, improving elevator service performance can be achieved through adjustments in elevator capacity, optimization of elevator control systems, and more accurate planning of vertical transportation systems during the early design stage.

Overall, the study emphasizes that the performance of elevator systems plays a crucial role in maintaining service quality in hotel environments. Therefore, architects, building engineers, and hotel operators should carefully consider vertical transportation planning to ensure that building circulation systems meet operational demands and user expectations.

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