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Circulation Development of Bayuangga Bus Terminal, Probolinggo City

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ABSTRACT

Bayuangga Terminal, the largest Type A passenger terminal in Probolinggo City, has seen a significant rise in passenger and bus traffic. Despite this growth, its circulation system remains inefficient and does not meet Type A terminal standards, hindering infrastructure development. This study focuses on improving transportation connectivity through architectural and spatial analysis of the terminal's circulation, where irregular intersections between bus and pedestrian corridors pose safety risks. Methods include literature review, field observations, and interviews with the Terminal's Technical Management Unit (UPT). Results highlight the critical safety issue caused by overlapping bus and passenger lanes. Recommendations involve separating pedestrian and vehicle lanes, redesigning bus routes, and upgrading passenger facilities. These interventions aim to optimize circulation, enhance user safety, and improve operational efficiency. Implementing these measures will help Bayuangga Terminal meet Type A standards and better serve its growing user base.

Keywords: Circulation Design, Transportation Connectivity, Pedestrian Safety, Terminal Architecture

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INTRODUCTION

Urban transportation infrastructure plays a vital role in enhancing regional mobility and accessibility, especially in rapidly growing cities such as Probolinggo (Simatupang & Santosa, 2020). Terminal Bayuangga, as a Type A terminal within the national transportation framework, is expected to function as a key node for intercity and interregional connectivity (Kementerian Perhubungan Republik Indonesia, 2018). However, despite its strategic classification, the terminal currently faces numerous operational challenges including inefficient circulation, limited user safety measures, and inadequate spatial design. These issues reflect broader systemic problems found in many secondary city terminals across Indonesia (Güllü, 2015; Setyawan, 2018).

One of the most pressing concerns is the lack of effective circulation systems that separate pedestrian flows from vehicular traffic. Research has emphasized the importance of clearly delineated circulation pathways to minimize conflicts and enhance safety in transport hubs (Wahyudi & Hartono, 2021; Handayani & Yuliana, 2019). In Bayuangga Terminal, circulation conflicts are intensified by poor spatial planning, where intersecting

paths between passengers and buses create safety hazards. Jiang et al. (2020) argue that an efficient terminal layout must consider user movement patterns, spatial relationships, and peak-hour congestion to deliver optimal performance. Unfortunately, such planning considerations are often absent in terminal development in mid-tier Indonesian cities.

Furthermore, inadequate infrastructure has compounded safety risks for users. Pedestrians must frequently traverse active bus lanes to reach platforms, exposing them to potential harm (Zegras & Bertini, 2008; Rahmawati et al., 2019). Observations from the Bayuangga Terminal reveal a lack of dedicated walkways, minimal signage, and poorly demarcated zones, undermining both operational efficiency and user experience (Putra & Santoso, 2020). As Nugroho et al. (2021) indicate, the absence of passenger-centric design significantly impairs terminal functionality.

Another core issue is the misalignment between terminal design and national development standards. Despite regulatory frameworks that outline spatial and safety requirements for Type A terminals (Kementerian Perhubungan Republik Indonesia, 1995, 2018), many facilities fail to meet these benchmarks. Previous studies, including those by Louf and Barthelemy (2019), show that mismatched infrastructure capacity and traffic flows are common in urban mobility systems, leading to chronic congestion and user dissatisfaction.

While terminal development has been discussed in policy and planning contexts (Setyawan, 2018; Simatupang & Santosa, 2020), few studies have explored architectural interventions as viable solutions. The architectural discipline offers unique insights into spatial configuration, user behavior, and built environment optimization that are essential for terminal revitalization (Ceder, 2016). Zhao et al. (2021) argue for sustainable and inclusive design strategies that prioritize safety, comfort, and operational effectiveness.

This study aims to address these gaps by focusing on architectural strategies to improve circulation at Bayuangga Terminal. The research question guiding this investigation is: How can architectural design improve circulation layout at Bayuangga Terminal to support transportation connectivity and fulfill Type A standards? The study will analyze existing terminal conditions, assess circulation inefficiencies, and propose spatial interventions that align with user needs and regulatory guidelines.

Ultimately, this research seeks to contribute to the broader discourse on urban terminal design by emphasizing the role of architecture in enhancing circulation, safety, and connectivity. By offering design-based solutions, the study hopes to inform future terminal development in similar urban contexts, promoting a safer and more efficient transportation network across Indonesia (Zhang et al., 2018; Arampatzis & Fragkos, 2023).

METHOD

This study utilized a qualitative research design aimed at exploring circulation and spatial inefficiencies at Bayuangga Terminal. Qualitative methods are suitable for obtaining contextual and in-depth understanding of environmental and behavioral conditions, as noted by Sugiyono (2013).

The research subjects comprised both the physical infrastructure of Bayuangga Terminal and its operational dynamics. Informants were selected from key stakeholders, including terminal management staff and officials from the Technical Management Unit (UPT), to gather relevant insights into terminal operations.

Data collection methods included literature review, direct field observation, and semi-structured interviews. The literature review helped identify terminal classification standards and spatial design strategies, drawing from academic studies and government regulations (Kementerian Perhubungan Republik Indonesia, 1995, 2018; Handayani & Yuliana, 2019; Ceder, 2016). Field observations were conducted to document user movement, identify bottlenecks, and map circulation routes. Interviews with terminal officials provided qualitative insights into recurring operational challenges and redevelopment efforts.

Data were analyzed using descriptive qualitative techniques, enabling a synthesis of findings across various data sources. Patterns related to circulation inefficiencies and user safety were triangulated from field notes, interview transcripts, and visual documentation. The results were used to develop design-oriented recommendations in alignment with Type A terminal standards (Putra & Santoso, 2020; Wahyudi & Hartono, 2021).

FINDING AND DISCUSSION

RESEARCH RESULT

Bayuangga Terminal is currently facing notable challenges in terms of circulation and user capacity. Observations and official reports reveal that both bus traffic and passenger volume have increased steadily, particularly following the easing of COVID-19 restrictions (Pemerintah Kota Probolinggo, 2009; Nugroho et al., 2021).

a) Increase in Passenger and Bus Volume

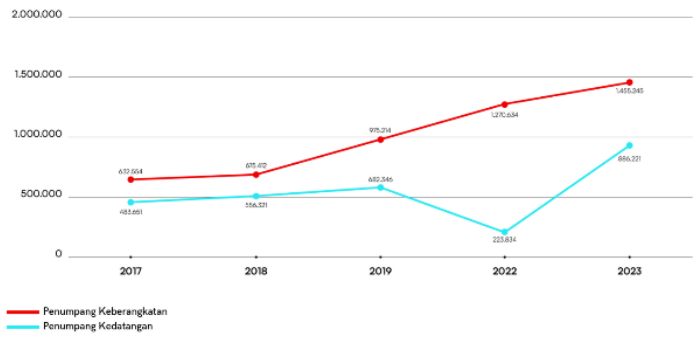

Figure 1 : Passenger Data Graph Arrivals and Departures of Bayuangga Terminal Type A Probolinggo City in 2017, 2018, 2019, 2022, and 2023

Surveys and UPT data indicate a steady rise in passenger activity from 2017 to 2023, with declines noted only during pandemic years. This surge has contributed to

congestion in departure areas and passenger waiting zones, especially during peak hours (Hasan & Ukkusuri, 2017).

b) Circulation Issues and Route Intersections

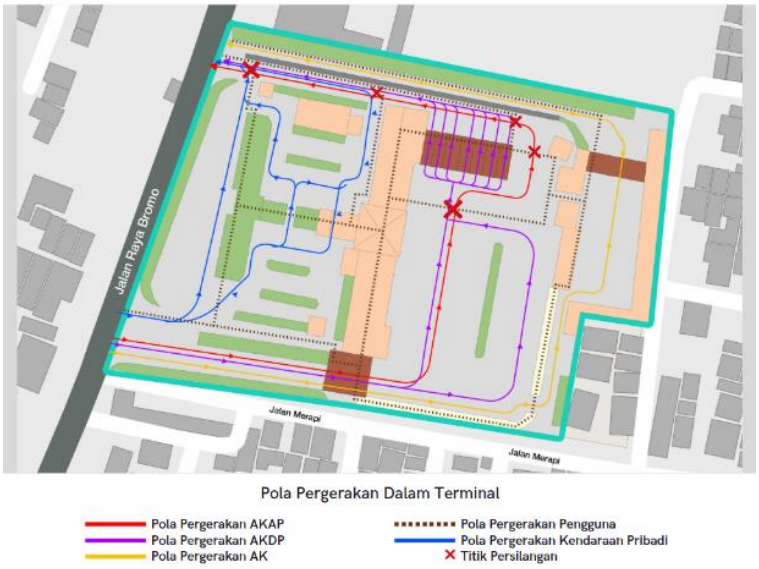

Figure 2 : Image of Existing Circulation Crossing at Bayuangga Terminal Type A, Probolinggo City 2017 - 2023

A major issue at Bayuangga Terminal is the intersection between pedestrian and bus routes. These conflicts mainly occur in the platform and departure lane areas, where passengers must cross active bus lanes to reach platforms or vehicles. The lack of designated pedestrian routes exacerbates this issue and creates unsafe conditions. Key circulation conflicts include:

1. Shared exit gate between private vehicles and AKAP/AKDP buses.
2. Horizontally arranged AKAP and AKDP departure platforms causing pedestrian-bus intersections.
3. Overflow of AKDP buses outside designated platforms, disrupting pedestrian circulation.
4. Pedestrian access to intercity departure areas that crosses arrival lanes of AKAP and AKDP buses.
5. Transport buildup at the AKAP and AKDP exit gates due to ongoing passenger loading activities.

These circulation challenges are consistent with findings by Rahmawati et al. (2019), who argue that poor route segregation reduces safety and spatial efficiency.

c) Analysis of Circulation Development Needs

To address these challenges, circulation development at Bayuangga Terminal is urgently needed. The increasing number of passengers and vehicles must be supported by a redesigned transportation system that is both efficient and safe. Proposed improvements include:

1. Separation of pedestrian and vehicle circulation routes.
2. Creation of special passenger zones.
3. Redesign of entry and exit flows to minimize congestion.

An improved internal traffic management system should also be applied. These measures may include restricted operation times for certain bus types, one-way circulation systems, and the use of information-based technology to organize terminal traffic more effectively. These changes align with international best practices in terminal design (Zhao et al., 2021; Jiang et al., 2020).

d) User Safety and Security

Ensuring pedestrian safety is critical to terminal design. Physical barriers, clear signage, and surveillance infrastructure should be implemented to improve safety outcomes (Zegras & Bertini, 2008; International Transport Forum, 2012).

DISCUSSION

The findings confirm that Bayuangga Terminal's circulation system is not adequately supporting its operational demands. The overlapping pathways between buses and pedestrians are the main contributors to inefficiency and user hazards (Wahyudi & Hartono, 2021; Rahmawati et al., 2019).

This study aligns with prior literature emphasizing the need for integrated spatial planning in transit terminals (Arampatzis & Fragkos, 2023). Louf and Barthelemy (2019) also argue that inefficiencies often result from imbalances between spatial layout and transport demand, a situation observable at Bayuangga.

From an architectural perspective, spatial design plays a pivotal role in shaping both user behavior and operational efficiency. Poor terminal design contributes to navigational confusion, reduced safety, and longer passenger dwell times. As Ceder (2016) notes, the integration of spatial logic and circulation flow is essential in the functional layout of public transportation nodes. In the case of Bayuangga Terminal, the architectural configuration fails to support the dynamic movement patterns of its users, leading to recurring congestion and safety issues.

Moreover, the use of passive design strategies and intuitive spatial organization can significantly enhance user experience. For instance, designing with natural visual cues, logical sequence of movement, and hierarchy of spaces can reduce reliance on signage and active supervision (Zhao et al., 2021). By applying these principles, Bayuangga Terminal could provide a more coherent and legible environment for its users.

Although the study relied on qualitative methods, the triangulation of field data and stakeholder interviews lends credibility to its findings. However, limitations exist: the absence of quantitative modeling (e.g., traffic simulations) and the focus on a single site may constrain generalizability (Zhang et al., 2018).

Moving forward, the design of Bayuangga Terminal should integrate dedicated pedestrian infrastructure, one-way traffic systems, and digital monitoring tools. The use of digital twin technology and real-time user analytics could help optimize terminal performance. Furthermore, collaboration between architects, urban planners, and transport engineers will be critical in implementing successful design interventions. Future research should incorporate cross-terminal comparisons and predictive modeling to enhance strategic planning (Eksioglu et al., 2009).

CONCLUSION

This study identifies critical circulation issues at Bayuangga Terminal, Probolinggo, and proposes architectural interventions to improve its efficiency and safety. The increasing number of buses and passengers has overwhelmed existing infrastructure, resulting in conflict-prone pathways and congestion.

Recommended measures include separation of transport modes, spatial reconfiguration of platforms, and the use of monitoring technology. These interventions are essential for aligning Bayuangga Terminal with national standards for Type A classification (Kementerian Perhubungan Republik Indonesia, 2018).

The findings underscore the role of architectural design in shaping safer and more functional transportation hubs. Implementation of the proposed strategies could significantly improve passenger experience and urban connectivity across similar Indonesian terminals. By integrating principles of spatial clarity, human-centered design, and technological innovation, the redevelopment of Bayuangga Terminal can serve as a model for future terminal projects.

Furthermore, this research contributes to the discourse on urban mobility infrastructure by highlighting how design-thinking approaches can resolve systemic inefficiencies in transit spaces. The study also opens pathways for future interdisciplinary collaborations and research involving traffic engineering, environmental psychology, and smart city technology. Ultimately, improving terminal circulation is not merely a logistical challenge but an architectural opportunity to elevate public space quality, safety, and inclusiveness in Indonesian urban settings.

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