

A Post-Pandemic Architecture: Mandalika Bus Terminal Design with Locality Approaches

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Abstract. The spread of the COVID-19 virus since it first appeared in Wuhan (2019) to all regions of the world has had implications in various sectors and endangered people's lives. As a result, the entire world is under lockdown and travel is prohibited. Public transport as community commuting could increase the risk of virus transmission widely. Therefore, some new design ideas are approached to facilitate people mobility and to mitigate and hinder the spread of virus. This study aims to address the ongoing public health problem posed by the COVID-19 outbreak by designing a post-pandemic bus terminal in Mataram City, Indonesia, incorporating health protocols and physical distancing to prevent COVID cases. The study used architecture design methods by collecting some data onsite and offsite, analysing the data through site analysis and programming, and then proposing design concepts for the bus terminal. The results show a bus terminal building design that incorporates green elements, flexible furniture, signage to promote physical distancing and minimize the spread of COVID-19 and incorporates Sasak Architecture concepts, creating a distinctive, and visually appealing appearance. This study concludes that the design of a bus terminal building can play a crucial role in promoting physical distancing and minimizing the spread of COVID-19.

Keywords: COVID-19, bus terminal, public transportation, post-pandemic design

1. Introduction

The corona virus disease, first appearing in Wuhan, China in December 2019, has rapidly spread worldwide, posing significant threats to public health and economic development (Li et al., 2020). A public health emergency of international concern was then declared by the World Health Organization as a response (WHO, 2020). Lockdowns and travel ban impact around 3 billion individuals (WEF, 2020). It has impacted communal life and economic growth in many areas (An & Jia, 2020). Indonesia publicly declared its first COVID-19 case in March 2020, announcing an epidemic as a national disaster (Rahim, 2021). There is an increasing number of confirmed positive cases and the Indonesian government has issued a policy for an acceleration of COVID-19 management. The "outbreak" is one of the most important threats for global health from the World Health Organization perspective and remains a global public health issue (Hui et al., 2020).

Terminals are defined in Government Regulation No. 74 of 2014, as "a center of public transportation service to sort arrivals and departures". It is also a fundamental place for load/unload passengers and/or cargo and interchange between different transport modes. Public transportation is one of the collecting points among people and this aspect of course relates also with COVID-19 diffusion (Zheng et al., 2021). Before the COVID-19 pandemic, the use of public transportation in Indonesia, was operating normally without any concern to hygiene issues. However, when the COVID-19 pandemic struck, public transportation users' behavior changed dramatically. The public has become far more concerned about the possibility of virus transmission, particularly in enclosed and congested areas such as public transit. Health protocols such as mask wearing, physical distance, handwashing, and passenger capacity limits are tightly followed. The necessity of air, cleanliness, and free

movement has also grown considerably. The role of these hubs in the development of COVID-19 virus is of particular significance, as increasing connectivity and distance has been shown to lead to an increase in the risk of transmission (Jones et al., 2021). Terminal operations and public transportation, such as buses, are disrupted, leading to economic and tourism decline. As the transportation companies struggled due to Covid-19 impacts, they cut off some employees to minimise the expenses on workers' salaries (Anggraeni, 2021). They also found some ways to cope with covid 19 by promoting social distancing, buying online tickets, and facilitating hand sanitizers in the buses and hubs. However, designing the new layout for the terminal buildings is also necessary to prevent the spread of virus, by implementing several rules to cut off the virus transmission.

Mataram City is also strategically important for regional transport, as the Terminal Mandalika is the main hub for cross border and interprovincial buses. The Terminal Mandalika will also receive an allocation of IDR 27 billion for revitalization amidst the COVID-19 pandemic, a reflection of the pivotal role played by the terminal within the transportation infrastructure in the area. Even though there have been investments in the terminal, facilities are still scarce and the terminal is unable to cope with the growing demand of transportation services, especially from tourism. Its increasing numbers of local and foreign visitors have made evident the need for more space and for substantial upgrades to the existing layout of the terminal.

This study aims to propose a recommendation in terminal building design with a post-pandemic approach after COVID-19. It examines the need for spatial improvements and upgraded infrastructure to accommodate the growing demands. Considering the new challenges posed by the pandemic, the study emphasizes the necessity for a post-pandemic design approach that prioritizes public health and safety while enhancing operational efficiency. Another important aspect of the terminal's transformation and in response to the local identity on building design, that would also work to provide a stronger sense of place for Lombok's cultural identity, is the use of indigenous design style for spaces to be flexible, sustainable, and socially distanced to keep it safe and functional in the post-pandemic world. This study adds to the knowledge of post- pandemic terminal building design standards for Indonesia, especially in Lombok which still has a few implementations. In this sense, increasing awareness and providing localized design guidelines can help foster a more resilient, safe, and health-oriented public infrastructure in a post- pandemic world.

2. Method

This design method was obtained by collecting data from both primary and secondary sources. Sketches, photographs, and interviews were conducted on the site. While secondary data could be obtained by reviewing literature studies such as books, local regulations, scientific writings, or other relevant writings. The data then informs an analysis of the site, space program, user needs and activities, and circulation patterns from which a design proposal is produced. From there the schematic design is developed into the design output.

3. Result and Discussion

3.1. Bus Terminal in Mataram City

Terminals are an important part of the transportation network because they are used as arrival and departure points for both passengers and goods. The terminal is one of the important elements in the transportation system that functions as a temporary stop, as a place of supervision, regulation, and operation of transportation flows that load goods and passengers (Purnomo M. F., 2021). Currently in Mataram City there is only one Type A bus terminal called 'Terminal Mandalika', in fact this terminal is the only main terminal on Lombok Island. This terminal is located on Jalan Sandubaya No. 1, Kel. Bertais, Kec. Sandubaya, Mataram City.

Terminal Mandalika is classified as a Type A passenger terminal serving 22 inter-city routes within the province and 15 inter-city routes between provinces. The existence of this terminal has an important role in the use of public transportation modes which have an impact on the efficiency of community travel and Regional Original Revenue.



Figure 3.1. Buildings in Terminal Mandalika (Author, 2023)

Terminal Mandalika has increased functionally quite rapidly in 2018. The condition of the buildings around Terminal Mandalika is generally a mix of commercial and residential structures. Many shops and eateries are located around the terminal area to serve the needs of passengers and visitors. Some buildings seem less maintained and some areas still look cluttered with illegal parking and street vendors, the surrounding infrastructure is fairly developed. The building at Terminal Mandalika mainly uses a pitched roof with spandex material, there are plenty of openings, and the dominant colours are white and blue. Even before pandemic, Terminal Mandalika has inadequate infrastructure conditions, lack of shadowed areas in terminals, and inefficient circulation of transportation modes, lead to the inconvenience of passengers or terminal users. In terms of facades, the design lacks elements of Sasak architecture.

Although there has been an improvement after the pandemic in the utilization of terminal, the quality of services provided has not met the standards, particularly in COVID-19 spread prevention. The role of Terminal Mandalika as a connecting hub with high frequency of user interaction, makes it high-risk area for virus transmission. Even, a study in Hubei stated that COVID 19 can spread from one people to nine throughout a single long-distance bus trip (Null & Smith, 2020). So, it would be naive to anticipate that people would happily return to mass public transportation without significant adjustments to the design and the infrastructure in public spaces to prevent further spread (Honey-Rosés et al., 2021).

3.2. Post-Pandemic Design Criteria and Strategies

COVID-19 first emerged in December 2019 and quickly spread around the world resulting in high mortality rates. The spread of the virus is not through the air, but through physical contact and the droplets (sneezing and coughing) of infected people (Navaratnam et al., 2022). To prevent the spread, the Indonesian government has implemented COVID-19 health protocols, including self-quarantine, safe distancing, and working from home, to combat the pandemic (Rahim, 2021). The conditions brought by the pandemic have changed the conception of ideals in environmental, urban, and architectural design. Several new design criteria have been established because of the spread of the COVID-19 virus, as the disease has triggered an urgency that affects social life and provides a new perspective on existing space standards, giving rise to new guidelines. The thing that is directly related to architectural issues is physical distancing. This creates a new space standard. According to the Centers for Disease Control and Prevention (CDC), everyone must maintain a distance of at least 6 feet or about 2 meters to minimize the spread of the COVID-19 virus (CDC, 2020).

The application of post pandemic design emphasizes design strategies that can prevent the spread of the COVID-19 virus. According to Mackenzie (2020) there are three important points

in the post- pandemic guidelines, including physically distanced, sanitization, and operational. Explanation of design criteria and strategies post-pandemic can be seen in Table 3.1.

Table 3.1. Post-Pandemic Design Guidelines (Author, 2025)

Post Pandemic Guidelines	Criteria	Design Strategies
Physically Distanced	<ul style="list-style-type: none"> - Maintain a distance of 6 feet (2 m) and apply physical distance when working. - Provide physical barriers where 6 feet are untenable. - Diversify pathways, flow, and access points to minimize physical contact. - Restricting visitors access to the employee workspaces. - Limit users physical contact in the shared space (e.g., waiting room, workspaces) 	<ul style="list-style-type: none"> - Increased mobility space per person to maintain physical distance. - Added both permanent and non-permanent partitions. - Implement one-way traffic and differentiate in and out access for users. - Added prohibitive signage access for users to increase vigilance. - Provide flexible waiting areas and dynamic seating arrangements.
Sanitization	<ul style="list-style-type: none"> - Clean and disinfect frequently used areas and equipment. - Provide hand washing facilities or alcohol-based hand cleansing products. - Providing touchless system control. 	<ul style="list-style-type: none"> - Using materials that are easy to clean and anti-bacterial. - Provide a sanitation area. - Implement a touchless system.
Operational	<ul style="list-style-type: none"> - Checking for COVID-19 symptoms and taking a temperature check before visitors enter the building. - Wearing a mask or other personal protective equipment (PPE). - Offering a flexible work environment. - Maintain cleanliness. - Implement automated air infiltration and ventilation controls to minimise exposure to hazards. - Promote new protocol operations before arrival. 	<ul style="list-style-type: none"> - Provide a thermal scanner camera for temperature check at entrances. - Increased awareness about health protocols and cleanliness. - Create flexible and safe workspaces. - Implement an effective automated control and ventilation system.

3.3. Implementation of Post-Pandemic Design in Bus Terminal

The new health protocols should be applied in daily life in almost all cities in Indonesia. Therefore, post-pandemic design can be interpreted as an architectural design concept that develops and adapts to adjust to post-pandemic conditions (Han et al., 2022). There are several adaptations that can be applied to public spaces, such as changes in the layout of public spaces, providing the ideal distance between people for sitting positions, normalize the provision of hand washing stations and hand sanitizers (Mackenzie, 2020). From post-pandemic design criteria, there are several strategies that can be applied to bus terminal design.

Before the pandemic, terminal designs generally overlooked health aspects such as personal space, natural ventilation, and sanitation protocols, resulting in crowded spaces with unclear circulation paths. However, after the COVID-19 pandemic, public awareness of health-oriented design increased significantly, leading to the implementation of one-way traffic system, permanent/non-permanent partitions, flexible seating plan, and the provision of sanitization, as well as improved ventilation system (Mackenzie, 2020). Terminal indoor spaces pose the highest risk for virus transmission due to limited air circulation and the high frequency of user's physical contact. Therefore, this terminal design focuses on indoor spaces as the main strategy to reduce the risk of virus transmission, create safer, more flexible, and health-responsive spaces for the future.

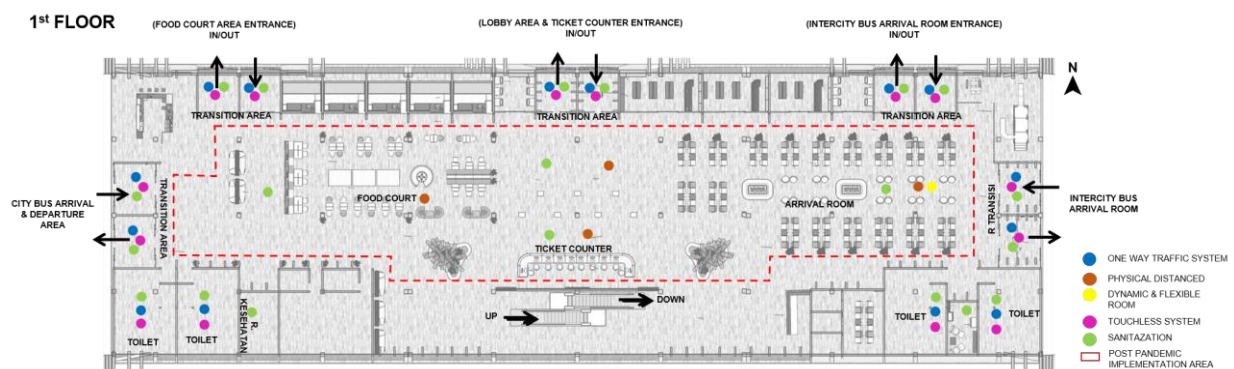


Figure 3.2. Bus Terminal 1st Floor Plan (Author, 2025)

The design responses to the post-pandemic condition on the 1st floor of the main terminal building can be seen in Figure 3.2. The ground floor integrates facilities that are public and service areas like transition rooms, ticket counters, arrival rooms, food courts, children play rooms, atm centre, electrical mechanical rooms, retail, prayer rooms, bathrooms, lactation rooms, information rooms, health rooms, and security rooms. The commercial/service space located on the ground floor of the terminal.

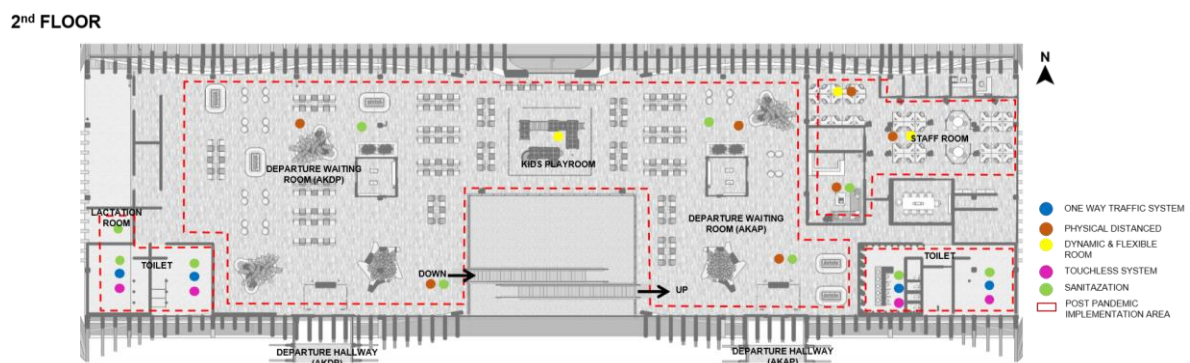


Figure 3.3. Bus Terminal 2nd Floor Plan (Author, 2025)

However, the terminal does provide public and private space on the 2nd Floor (Figure 3.3). Access to terminal 2nd Floor is more restricted than the 1st floor. The second floor is off-limits unless you have a bus ticket or work for the terminal administration. This restriction is imposed to prevent terminal users from contracting the virus. On the second floor, the terminal has a roof for bus departures, waiting room, platform, restroom, lactation and prayer room, children's play room, smoking room, and management office.

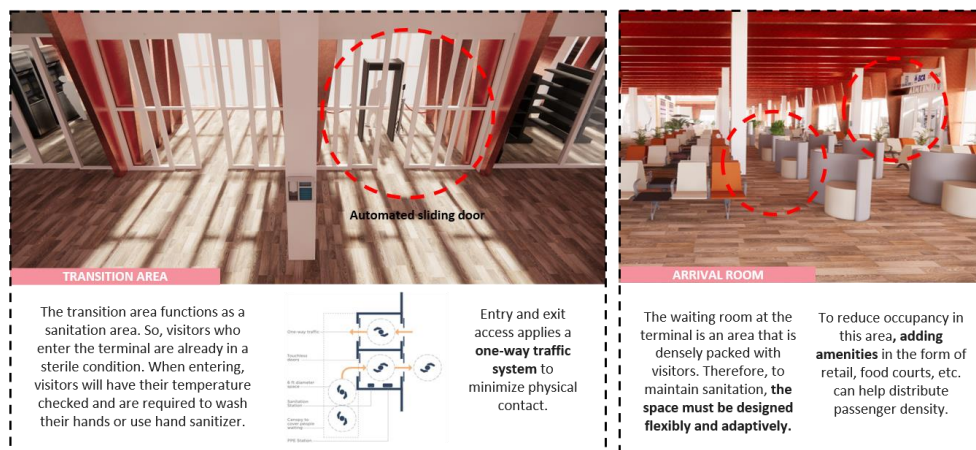


Figure 3.4. Transition Area and Arrival Room (Author, 2025)

There should be clarity on which is the entry and which is the exit point for visitors to reduce contact and make traffic flow more efficient (Figure 3.4). The design incorporates a one-way traffic system for the doors – each lane is either for entry or exit. In order to further improve this system, there are two doors per lane, creating a gap in between. This space is a sort of transition area, it is a space with sanitary amenities to maintain sanitary conditions and limit possible contamination. Sanitation is even harder in the terminal's crowded waiting room. This space needs to be a flexible and adaptive space. Elements such as modular seating tables, modular pop-up stores, stands to avoid the concentration of passengers in specific areas where comfort and sanitation are compromised.

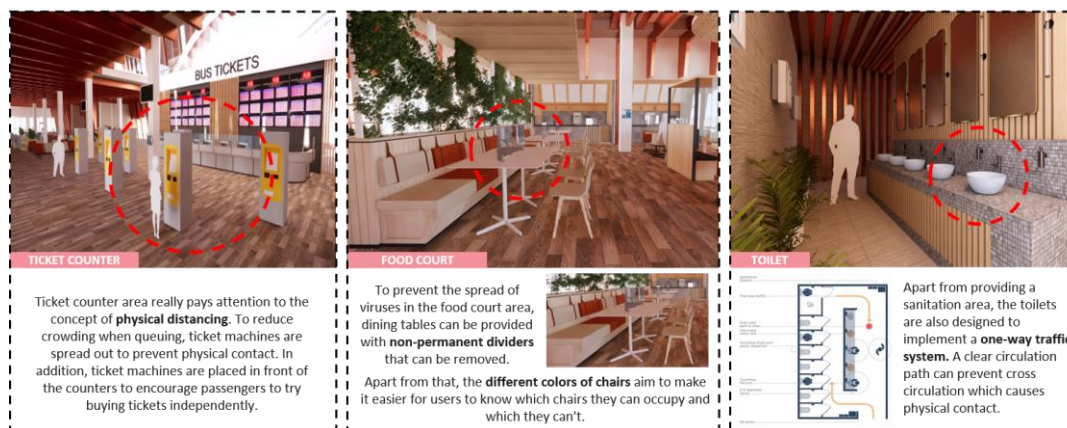


Figure 3.5. Ticket Counter, food Court, and Toilet (Author, 2025)

The design of the terminal focuses on promoting physical distancing and minimizing crowding to prevent the spread of viruses. The actual ticket counter has been strategically designed in order to enable the purchase of tickets independently and to minimize contact (Figure 3.5). In the food court non-permanent dividers between the dining tables serve to lessen the transmission of the virus and there are color-coded chairs to indicate which chairs are available for use. Also, the bathrooms are laid out in a single directional flow, with well-defined paths for circulation, in order to minimize cross-traffic and any physical interaction, increasing safety even further. Another way of implementing a touchless system could be in the public restrooms, with automatic hand sanitizer dispensers or touchless sink taps.

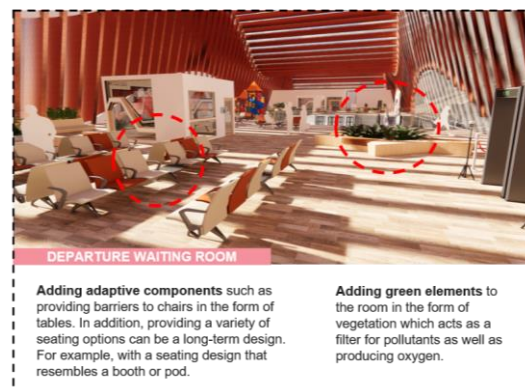


Figure 3.6. Departure Waiting Room (Author, 2025)

Next, the addition of adaptive components, such as seat dividers in the form of tables, can create space for placing items or bags, thereby providing more room for circulation (Figure 3.6). Dynamic arrangements in which people face each other can also include larger groups. So, buildings are constantly filled with visitors, and daily staff, maintaining high levels of indoor air quality is a main priority. Thousands of other airborne pathogens apart from the COVID-19 virus can create health problems. Low indoor air quality can lead to reduced staff productivity and higher risk for virus transmission. For this reason, we need to strive for better circulation of air to improve indoor air quality and eliminate viruses, germs, and pollutants. Integrating elements of nature, or greening spaces, is one of the strategies that has been found to improve air quality. Besides, voids can also promote air exchange and circulation.

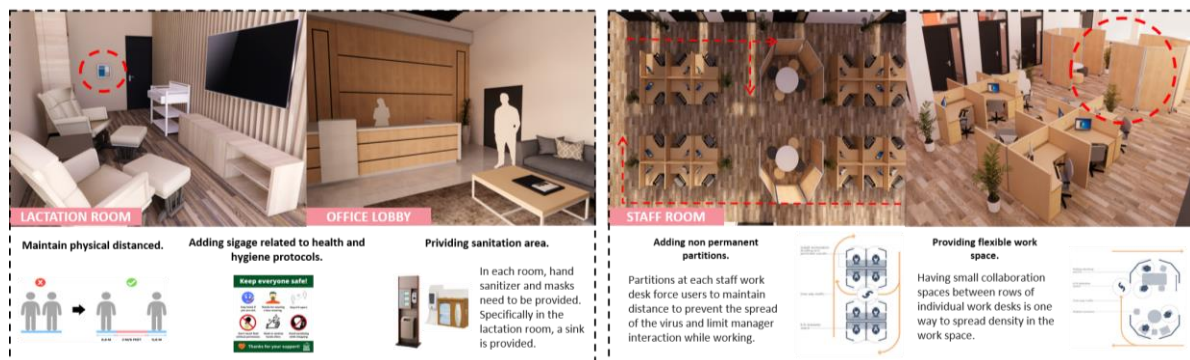


Figure 3.7. Lactation Room, Office Lobby, and Staff Room (Author, 2025)

Additionally, to help prevent crowding in more confined spaces like the lactation room or office lobby (Figure 3.7), visitors should be alerted with distance signage and other reminders to help safeguard these areas. Furthermore, additional signage regarding adherence to health protocols and cleanliness concerning virus containment needs to be addressed. The workspace itself, in addition, needs to be prepared to easily adapt to potential temporarily imposed restrictions in the future. Design solutions within these parameters may include selections of furniture and equipment, overall space layout, circulation, and adjustable collaborative work areas. Circulation in the staff room is organized to define a single circulation route, which helps streamline movement for the staff circulation and results in smooth organized movement. Different colours and patterns on the floor can be used to outline or highlight prominent pathways and make them orderly and visible that enhance organization within the space. Through the use of permanent and non-permanent partitions, users are compelled to avoid physical interactions. The use of non-permanent panels combined with movable chairs provides users with flexible spacing over time.

Post-pandemic design refers to an architectural approach that adapts to the unique challenges posed by the COVID-19 pandemic and similar global health crises, focusing on creating safer, more hygienic, and adaptable public spaces like bus terminals. It prioritized on physical distancing, enhanced sanitation, and contingent use of spaces to limit the spread of viruses and safeguard public health and functional spaces in the face of new realities (Mackenzie, 2020). As Mackenzie (2020) outlines these three considerations in post-pandemic design are physical distancing, sanitization, and operational. These three components are all incorporated in this terminal design. Physical distancing implementation such as a one-way traffic system, flexible seating, provision of a variety of amenities for varying user densities, and a permanent/non-permanent partition. Sanitization is handled by the installation of hand-sanitizer stations, touchless toilet fixtures and clean transition zones. Operational aspect is done through the provision of a thermal scanning camera for temperature checks at the entrances, signage of the new health protocols, and creating flexible and safe spaces for work.

In addition, Navaratnam et al. (2022) emphasized the importance of reducing direct contact as well as airborne transmission in public places. In answer to that, touchless systems (automatic ticket machines, hand sanitizer dispensers) and public/restricted space separation have all been incorporated into the design. This re-signifies the terminal as a health-oriented space, again, for users, but also for a psychological sense of security for passengers and employees after the pandemic.

Perhaps the most pertinent factor in post-pandemic terminal design is the consideration of physical distancing and crowd control, which serves to create enough distance between user to reduce the opportunities for transmission of certain viruses. Passenger flow management for distancing and de-crowding is the primary area of concern which is done with modular seating, touchless systems, one-way traffic patterns, and clear signage. All of these elements are to ensure that the terminal continues to provide safety and efficiency for all user and employees in a time of uncertainty about future health crises. In addition to these, other elements can support the versatility required in terminal design, such as temporary divider, movable partitions, and adjustable seating arrangements. While the primary design elements serve to maintain levels of safety and comfort, the other elements provide for long term flexibility and sustainability, enabling rails terminals to better cope with future public health situations.

3.4. Local Context in the Bus Terminal Design

The building of the bus terminal is commercial and is focused on providing services to customers. In that light, circulation within the building is a significant consideration in the successful functioning of the bus terminal. The building is influenced by the traditional lumbung roof shape from Lombok culture. This building type is known for its steeply pitched roofs and unique configuration, which instils feelings of community, shelter, and congregation of people. It asserts the terminal role as a space where passengers come together and traverse through, offering flexibility and community gathering space. The design evolved to develop a trapezoidal shape as the initial shape of the building to introduce the symbolic roof pitch of the lumbung. And from the existing forms the overall structure becomes a working mass of buildable area and adaptable space that provides a practical area for the bus terminal. As the forms evolved, the relationship of these shapes in both culture and function allows for each shaped space to foster passenger movement and experiences while providing a design ethos that echoes local identity and history. This allows for traditional influences combined with modern interaction and purpose to inspire a lively atmosphere for a transitional space that centres on welcoming passengers. The massing design also evolved with the repetition of this idea of forms, with transitions formed by changes shapes resulting in a cohesive organizations of building ideas. The building form transformation of the main terminal building can be seen in Figure 3.8.

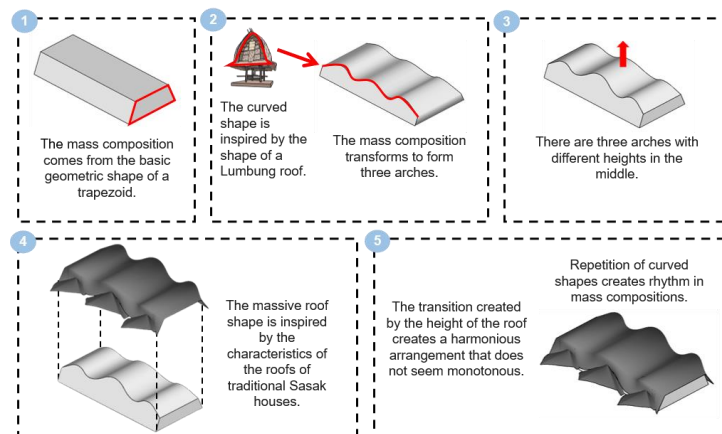


Figure 3.8. Building Form Transformation, (Author, 2025)

The exterior design of the building embodies the principles of Sasak Architecture, a design form selected to reinforce local wisdom and build a unique identity for the terminal. This design form occupies an essential part of the terminal area, allowing the terminal to forge its identity, while respecting the cultural significance of the Sasak people. The proposed building design is a wide-span structure, as the terminal is primarily a public facility. The wide-span configuration provides flexible, open spaces developing the overall experience for a very high volume of passengers and terminal activities. The wide span choice of configuration ensures that the overall requirements of the terminal functional needs could be successfully built, while still retaining openness with functionality.

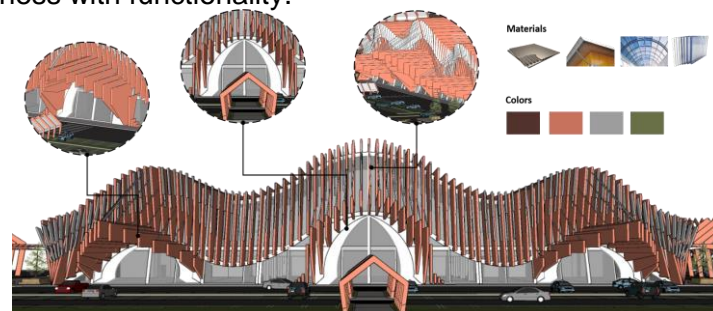


Figure 3.9. Bus Terminal Facade Design (Author, 2025)

In terms of structure, the roof is composed of a steel framed arrangement, reminiscent of a flowing wave, creating a cohesive rhythmic statement. In addition, the roof serves to shade against the sun's heat, preventing the sun radiance from entering the building space directly. The facade reflects a combination of patterns and colour variations that are purposeful instead of monotonous, creating beautiful aesthetics. The natural colours reference the traditional Sasak house colours, which strengthen the building's relation to indigenous customs.

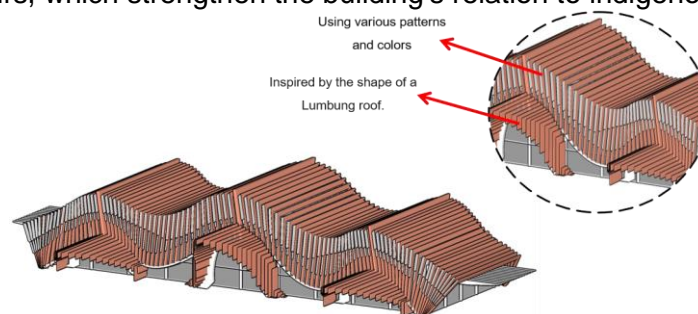


Figure 3.10. Bus Terminal Facade Design (Author, 2025)

The design of the facade for the main building will be prominent enough for the facade to become the focal point for the bus terminal area. The most visible aspect of the bus terminal is the difference in height between the bus terminal roof and the canopy that protects the entrance and exit of the bus terminal. Elements that take from the Sasak traditional house are used in the entrance and exit areas of this terminal, such as the roof shape of the lumbung. The curves and patterns of the entrance and exit areas create an impression that is not rigid and dynamic, and the total experience creates a balance that is visually appealing.

By integrating local cultural elements, the terminal's facade fosters a strong sense of place and identity. As Rapoport (1969) argues that architectural elements like decoration and form is an important factor in establishing an attachment to a place, especially if it adequately reflects their own cultural traditions and cultural symbols. To include traditional Sasak barns in a bus terminal is not just an aesthetic choice, it is intentional cultural expression. The lumbung implies a reference to the social history of Sasak, connection to agricultural history of Sasak as a community, and point of translation between ordinary, tradition, and tidying up lofty needs of the present and future.

This is in line with Kevin Lynch (1960) concept of "imageability," where unique buildings assist people to navigate and make emotional connections around the urban landscape. The terminal works not only as a public node or a transit hub, but also as a public unit of culture. While not all buildings need to keep local priorities in the design, civic buildings that incorporate terminals with high levels of symbolism, orientation, and identity are warranted due to either ethical or experiential reasons.

Moreover, considering local contexts in the design of the bus terminal provides the opportunity to engage in a shared memory practice between the terminal and the region's cultural and environmental heritage. The lumbung roof form that symbolizes co-operative building and agriculture is an essential part of the design, representing the region's tradition of coming together in a common purpose. The lumbung roof form also communicates with local cultural aspects that involve elements of shelter and grouping, while allowing for the terminal to act as a place of convergence for travellers. Climate responsive sun protection strategies, with the incorporation of large eaves and sun shading are important aspects of the façade design, guaranteeing energy-efficient solutions. Community involvement in the design process not only safeguards cultural traditions but also produces a space where travellers can tangibly experience the region's identity, positioning the terminal as a genuine cultural hub.

4. Conclusion

Based on the description that has been explained, it can be concluded that the COVID-19 pandemic has significantly impact to the terminal bus design. Post-pandemic design focuses on strategies to prevent the spread of the virus, emphasizing physical distance, sanitization, and operational aspects. Because of this, more and more spaces are considered with a different approach. While many strategies can be employed, some that specifically address the issues created by the pandemic for Terminal Mandalika include spacing in congested areas, one-way circulatory traffic to reduce physical interactions, flexible configurations for furniture, touchless system, better air circulation, partitions that are permanent or temporary, sanitation zones, and others all glorify the shift of design architecture toward public health.

Furthermore, because of the incorporation of Sasak Architecture into the terminal's design, cultural significance and local identity are integrated as well, for example by transforming the lumbung roof to local community sheltering architecture. This approach integrates the terminal's relation not merely to the passengers' functional requirements but also to the heritage and traditions of the area. The incorporation of local toned colours, traditional

materials, and sun-shading approaches fosters climate-appropriate energy efficiency while further reinforcing the building's connection to the region's culture. As such, the revitalized Terminal Mandalika will be more culturally responsive while also providing more efficient and safer travel enabling spaces. These design strategies also provision long-term responsiveness to future public health needs. This design emphasizes the need to blend local heritage and contemporary utility to foster a space that the community will find useful but also significant.

In summary, while the design seeks to address public health matters and heritage, there are limitations inherent in the design of issues including space limitations, maintenance, and the feasibility of installing every feature on the budget. This research contributes to detail knowledge of post-pandemic terminal building design standards in Indonesia and particularly Lombok, where implementation is still limited. As such, there is the potential for future work as more research takes place to determine how effectively design-based solutions can promote physical distancing and minimize the spread of COVID-19.

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