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Design of Mixed-Use Area in *Leuwi Panjang* Bus Terminal Based on Transit-Oriented Development (TOD), Bandung City, Indonesia

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ABSTRACT

Leuwi Panjang Terminal of Bandung City is a terminal with an A-type category in the city of Bandung. This terminal is one of the proposed Transit Oriented Development in Bandung Urban Mobile Project 2031 programs. Listed in the BUMP 2031 program, the Leuwi Panjang Terminal area will be equipped as a public transportation transit, monorail. Based on the existing criteria, the Leuwi Panjang terminal doesn't fulfill the criteria as a Transit Oriented Development area, including inadequate facilities, the circulation systems that are not mutually integrated and the unavailability of signage makes visitors confused about their activity paths, and the stiffness of pedestrians and cyclists to move around in this area. This study discusses the architectural design recommendations of the TOD area that fill the TOD standards of the Leuwi Panjang Terminal. The method used is by conducting area studies, activity studies, and circulation studies. The study is analyzed and processed to produce a synthesis and application to the design to fulfill the TOD criteria and government regulations.

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1. INTRODUCTION

Humans have life needs such as primary needs (clothing, food, shelter) and secondary needs (shopping, recreation). But along with the times, the space to accommodate the necessities of life is decreasing, especially in urban areas. To meet these needs, we need a space that can accommodate several functions in one building. The design of mixed-use buildings can be one solution to overcome human needs in carrying out their activities (Arofah, et all., 2019) (Ghassani et al., 2020).
The design of the mixed-use building aims to provide a space that can meet human needs and provide comfort for users. This multifunctional building refers to the combination of several different functions in one building, for example, residential and commercial functions (Rahayu, et all., 2017), namely apartments and malls, and in the world of transportation such as bus terminals and stations. In designing this project, it is planned to create a mixed-use building that has three functions, namely bus terminal, LRT, and trade. Thus, the design of this mixed-use building makes it easier for humans to carry out activities in terms of mobility and terms economy (Kencanasari et al., 2020) (Permana et al., 2020) (Yazid et al., 2021).

The city of Bandung (Permana, A.Y., et al., 2020) (Permana, A.Y., and Wijaya, 2013) is now experiencing rapid development into a metropolitan city. Urban characteristics that make up the metropolis can be seen from various aspects, including the number of residents, economic activities, and the area built up. The migration of population (Permana, A.Y., et al., 2020) (Permana et al., 2013) from one area to another and economic growth in an area also affect the increase in terms of transportation (Susanti et al., 2018).

The Leuwi Panjang terminal area is one of the centers of community activities (Wijaya and Permana, 2018) in the city of Bandung. In this area, several areas function as trade and public transportation, namely bus terminals, and LRT. Leuwi Panjang Terminal is one of the terminals that have a type A category in the city ofBandung. This terminal is one of the proposed TOD areas in the BUMP (Bandung Urban Mobility Project) 2031 program. Included in the BUMP 2031 program, the Leuwi Panjang terminal area will also be equipped as a meeting place between LRT, BRT, AKDP, and public transportation lines.

Based on the existing criteria in the field, the Leuwi Panjang terminal area does not yet meet the criteria as a TOD area, including poor human and vehicle circulation systems because they are not integrated between areas and the absence of signage makes visitors confused to carry out their activities, lack of proper arrangement good and clean in this area, as well as inadequate facilities to support the continuity of activities in it. These are the reasons for choosing the project location for the design of a mixed-use building based on TOD for the smooth continuity of the activities of the people of Bandung City in the Leuwi Panjang terminal area (Setiawan et al., 2021).

This design is expected to produce a TOD-based Mixed-Use design that accommodates primary, secondary, and transportation needs for humans, with appropriate facilities and infrastructure according tostandards, to increase the attractiveness of the community to use public transportation. For this reason, this study aims to determine:

1. How can design facilities support all economic class groups?
2. How to design a mixed-use area based on TOD?
3. How to apply the integrated theme to the TOD-based Mixed-Use Area at the Leuwi Panjang Terminal,Bandung City?

Literature Review:
Transit-Oriented Development (TOD)

Transit-Oriented Development (TOD) is one of the methods of city development, the city adopts a mixed spatial layout and utilizes mass transportation such as bus/BRT lines, city trains (MRT), light rail (LRT) and is equipped with a pedestrian and bicycle network. A TOD neighborhood generally has a central area with transit stations or stopping stations (train stations, metro stations, bus terminals, and other public transportation stops) surrounded by infrastructure that supports community activities such as residences, offices, and shopping. TOD is designed to create a more-lively city space oriented towards

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pedestrians and public transportation users, and this TOD area provides a space of comfort and safety for pedestrians, bicycle users, and public transportation users for easy access to the places they want to go. TOD Principles (Figure1):

1. Walk (Users can move around on foot actively, safely, and comfortably in the area).
2. Cycle (Users can move around by cycling actively and comfortably in the TOD Area).
3. Connect (The pedestrian circulation route must go directly to the location and not too far away).
4. Transit (Switching modes of transportation with short and easily accessible routes).
5. Mix (The balance of complementary activities in the area (a mix of bus terminals, LRT, and trade)activities is not far to be accessed on foot).
6. Densify (Cities must not only be able to accommodate large numbers of people and their activitiesbut also be able to support the highly desirable lifestyles. Overcrowding within 500m of the transitstation).
7. Compact (a. The TOD Development location is in or next to an urban area, and b. Supported bymany public types of transport that serve multiple purposes).
8. Shift (Reducing needs such as parking spaces for private transportation so that people switch to public transportation).

Figure 1. TOD. Principle Source: TOD Standard, ITDP
Source: TOD Standard, ITDP

Bus station

According to Bahar (2010), the bus terminal is one component of the transportation system that functions as a temporary stop for public transportation to pick up and drop off passengers or goods and functions as a transfer from one mode of transportation to another.

Light Rail Transit (LRT)

LRT is a rail-based mass transportation technology with a smaller area coverage, this technology has

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been widely used to serve transportation needs with high carrying capacity and service characteristics that are considered suitable for urban areas (Davies,1989). LRT has also been implemented in various big cities in the world, LRT was built to overcome traffic congestion in the city of Bandung which continues to grow day by day. With the LRT, it is hoped that it will reduce people who use private vehicles for transportation. The people of Bandung City and immigrants can take advantage of the available public transportation modes (Azalia, 2019)(Forilma and Pamungkas, 2016)(Ernawati, 2010).

Trading

Trade is a transaction of goods and services or both which is one of the livelihoods of the people in the Leuwi Panjang terminal area. In this area, several trading points are not well organized. The design of this mixed- use building will provide one area that functions for trade to make the trade sector in this area more organized and easily accessible by visitors.

2. RESEARCH METHODS

2.1 Methods

This study uses a method in the form of primary data Hanafi. (2017) from a field survey to know the existing conditions and the potential of the site that can support this design (Haryati, 2012). In addition, there are also secondary data obtained from the results of a literature study related to the TOD-based Mixed-Use Building design.

2.2 Design Location

Leuwi Panjang terminal area with a land area of ± 38,000 m², with the existing function as a Bus and Commercial Terminal. A mixed-use design plan that functions as a BRT, LRT, and Commercial Trading Terminal. The site selection in the Leuwi Panjang terminal area is adjusted to the BUMP 2031 program which will also be planned as a TOD area (figure2).

Figure 2. Design Location
Source: Personal Documents, 2021

3. Results and Discussions

3.1 Existing data

Based on the results of the survey the Leuwi Panjang terminal area with the existing function as a Bus and Commercial Terminal. This area will be developed into a BRT, LRT, and Commercial Trading Terminal following the Bandung Urban Mobility Project (BUMP) 2031 program plan (Ghassani et al., 2020). The existing data can be seen in the table 1.

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Table 1. Existing data

No.	*Guideline Walk*	Standard	Existing
1.	Pedestrian Infrastructure is Available and complete	Main facilities: a. Pedestrian paths; b. Crossing, which consists of: • Plant crossing; • The crossing is not a plotin the form of the overpass (bridge) and underpass (tunnel)	 • There is no special access or platform for bus passengers, so passengers have to get off theroad at random to get on the bus. • There is no special access that aims to change modes • There is a sidewalk that has been misused as an area for selling street vendors.
		Pedestrian Facilities for Disabled: a. Passing place b. Guide Lane (Warning and steering Block)	 • The waiting room area and the area adjacent to the terminal (bus parking) do not have a passing place or guide lane for the disabled.  • Meanwhile, in areas leading to commercial trade, there are already guidelines for people with disabilities.

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		Supporting facilities: a. Signs and Markings b. Illumination lamp c. Shade safety fence d. GreenLine e. Seating f. Trash	 There are already road markings in the bus parking area. • There are no parking information signs and parking markings resulting in some motorbikes beingparked carelessly  • There are only a few parts of the green area that are contained in pots in the management area. • There is already a green open space in the Leuwi Panjang Terminal, it's just that it's not well maintained so there's a lot of garbage scattered about. • There is a fence as a barrier between the road and the green area, but there are no trash cans and seats.
2.	Active andlive pedestrian infrastructure	The standard size of space forpedestrian paths	 There is a sidewalk with a width of 1.5 m equipped with a roof and trees as shade.
3.	The pedestrian infrastructure is comfortable and the temperature ismaintained	Has pedestrian shadevegetation	

Source: Documents, 2021

The division of land use is obtained from the grouping of activities that will be carried out in it. The Private Zone is devoted to space for all activities of the terminal and station management office, all activities related to the manager both in terms of mode regulation and administration of all modes are discussed and managed by the manager. This public zone, which is a zone where visitors, users, or passengers can carry out activities that support the mobility of their activities using public transportation, including spaces such as rooms for purchasing tickets for transportation modes, departure waiting rooms, and other spaces such as prayer rooms, toilets, health services, trade, and others(Wisesa, 2021)(Ghassani et al., 2020).

The semi-public zone is devoted to people who will carry out activities using transportation. In this zone,there are areas such as parking for visitors, users, and passengers, bus parking areas, departure areas for AKDP, AKAP, BRT, DAMRI, taxis, and city transport buses, as well as LRT departure areas. In addition, this zone also provides a supporting area for passengers who will use transportation such as online taxis and online motorcycle taxis. The Service Zone is devoted to spaces that require maintenance for the entire area,including being the point of origin for water utilities, electricity utilities, and garbage utilities (figure3).

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Figure 3. The Concept of Zoning
Source: Personal Documents, 2021

3.1 Zoning Design Concept

The activity accommodation in the Leuwi Panjang terminal mixed-use area is intended to accommodate all activities that occur at the Leuwi Panjang terminal without grouping based on economic level aspects. Middle-lower and upper-middle-class people will still be able to carry out activities within the same zoning. The concept of zoning division is shown in the figure 4.

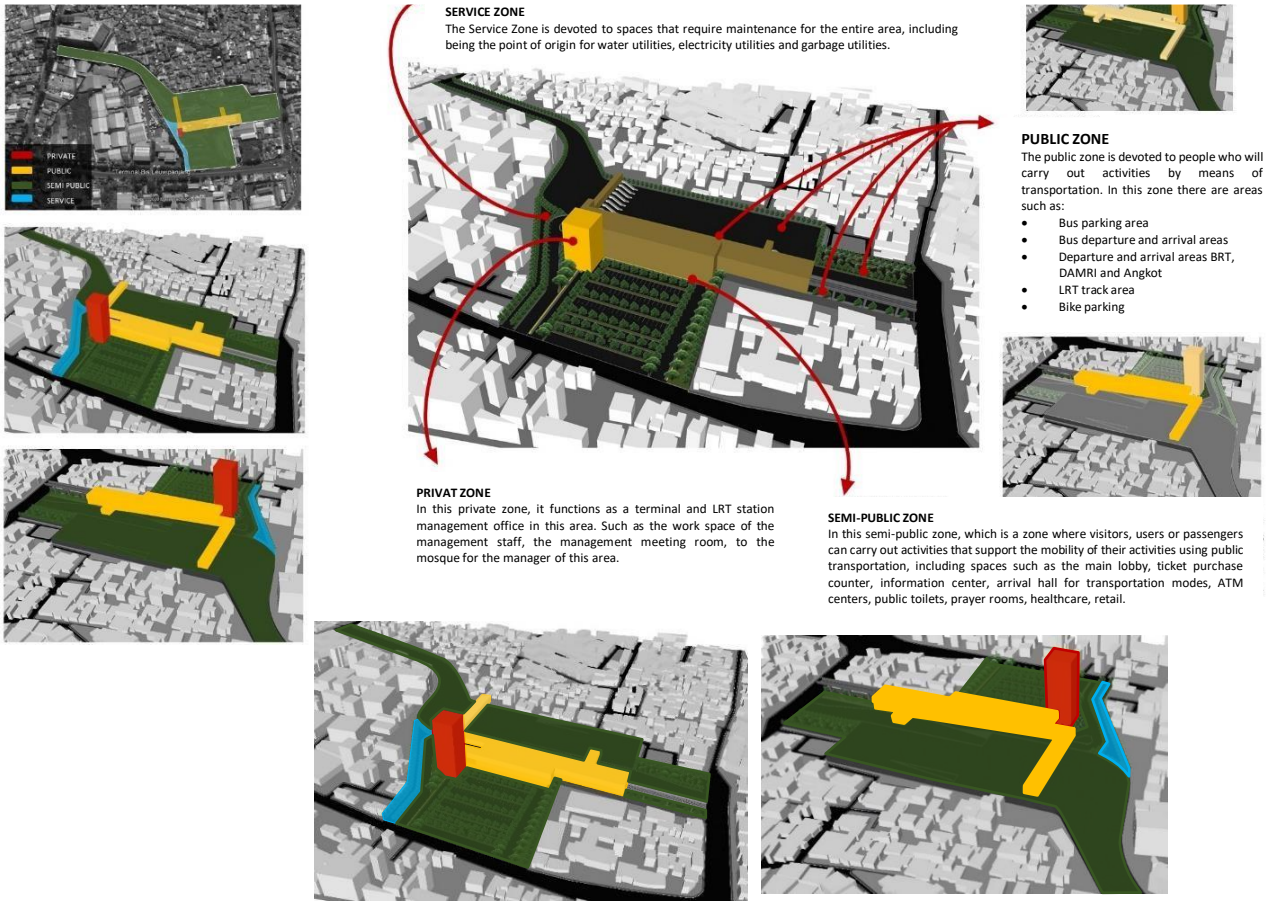

Figure 4. The Concept of Zoning
Source: Documents, 2021

In Figure 4 the buildings are placed facing north and south, with the aim of not being exposed to direct sunlight which can cause glare in the room. That way the building will get bright sunlight (not sunlight).

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The zoning division in the Leuwi Panjang terminal mixed-use area is divided into four, namely:

a. Private Zone (The Private Zone is devoted to space for all activities of the terminal and station management office, all activities related to the manager both in terms of mode regulation and administration of all modes arediscussed and managed by the manager).
b. Public Zone (This public zone, which is a zone where visitors, users, or passengers can carry out activities that support the mobility of their activities using public transportation, including spaces such as rooms for purchasing tickets for transportation modes, departure waiting rooms, and other spaces such as prayer rooms, toilets, health services, trade, and others).
c. Semi-Public Zone (The semi-public zone is devoted to people who will carry out activities using transportation. In this zone, there are areas such as parking for visitors, users, and passengers, bus parking areas, departure areas for AKDP, AKAP, BRT, DAMRI, taxis, and *angkot* buses, as well as LRT departure areas. In addition, this zone also provides a supporting area for passengers who will use transportation such as online taxis and online motorcycle taxis).
d. Service Zone (The Service Zone is devoted to spaces that require maintenance for the entire area, including being the point of origin for water utilities, electricity utilities, and garbage utilities).

3.2 The concept of laying and shaping the building

The laying of the building is placed facing south and north to avoid direct sunlight which can create glare. The facade of the building is applied with a double skin to minimize glare from sunlight, so users will not feel dazzled when in the room. The sky bridge area is intentionally not blocked by a wall, but only a glass railing that is used as a barrier to maximize the circulation of wind and incoming light, because this part of the area is not too long an area occupied by users (figure 5)

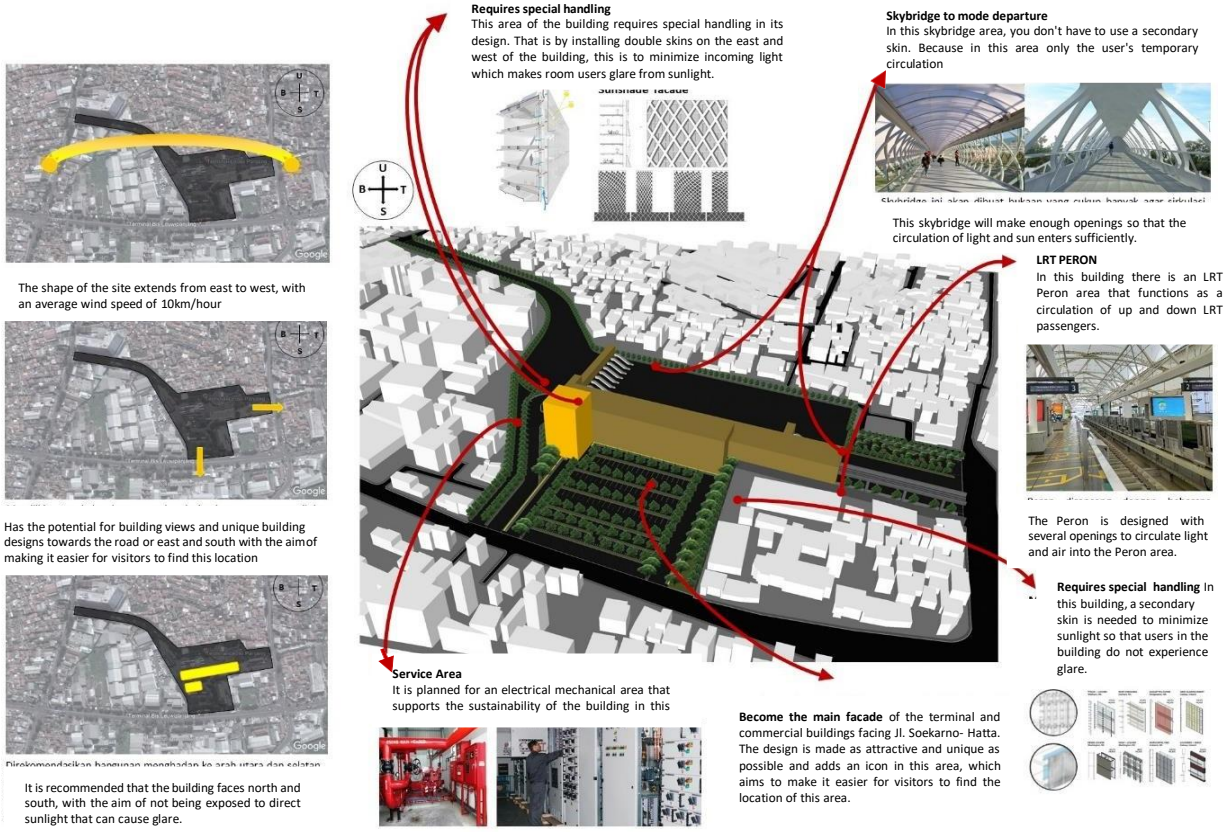

Figure 5. The concept of placement and the shape of the building
Source: Documents, 2021

Based on Figure 8, the potential of land with site conditions that extends from east to west, with an average wind speed of 10km/hour. This condition has the potential to view the building towards the road or east and south to make it easier for visitors to find this location. At the same time, determining the direction of the building facing north and south, with the aim of not being exposed to direct sunlight

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which can cause glare in the room. That way the building will get bright sunlight (not sunlight) (Ghassani et al., 2020).

3.3 Vehicle Accessibility and Mobility Concept

The urban transportation system consists of various activities such as work, school, sports, shopping, and visiting that take place on a plot of land (offices, factories, shops, houses, and others). This piece of land is commonly referred to as land use. To meet their needs, humans travel between these land uses using a transportation network system. This gives rise to the movement of people, vehicles, and goods.

The movement of people, vehicles, and goods causes various kinds of interactions. There are interactions between workers and their place of work, between housewives and the market, between students and schools, between factories, and the location of raw materials and markets. Almost all interactions require travel and therefore result in the movement of traffic flows (Arofah et al., 2019).

Figure 6. Analysis of Public Transportation Vehicle Accessibility
Source: Documents, 2021

Base on the concept of accessibility and mobility (figure 6) of private and public vehicles is divided into 3 levels. At the first level, there is a parking area for private vehicles, both motorbikes or cars for visitors or managers, access to arrivals and departures of city transportation, access to bus arrivals and bus departures. On the second level, there is an area with a flyover intended for pick-up or drop-off from visitors. The third level is devoted to the LRT transportation route.

3.4 Preliminary Design

The following is the concept of the mixed-use area for the Leuwi Panjang Bus terminal based on TOD. The concept of integrated design is the basis of the assimilation of several functions into a unified whole (figure 7).

Figure 7. Above: Leuwi Panjang Bus Terminal exterior design; Below: Interior design of Leuwi Panjang Bus Terminal
Source: Documents, 2021

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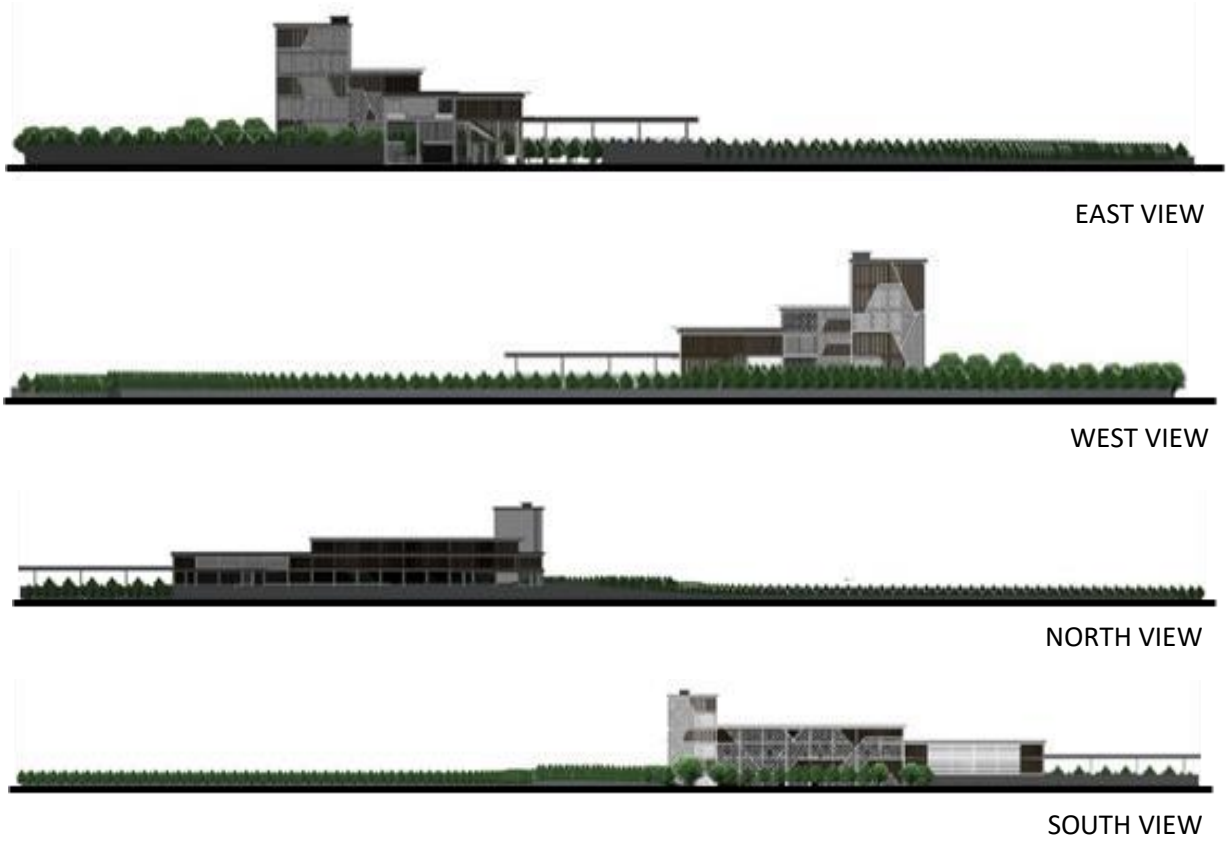

Figure 8. The Concept of the Situation of Leuwi Panjang Terminal

INFORMATION:
1. Entrance Bus AKDP/AKAP, BRT/DAMRI
2. TAXI Entrance, Angkot, and Delivery
3. Exit Taxi, Angkot, and Delivery
4. Entrance Manager and visitors
5. Management Car Parking Area
6. Visitor Car Parking Area
7. Taxi Parking Area
8. Motorcycle Parking Area
9. Online Ojek Drop Off Area
10. Park and Bike Parking Area
11. Bus Departure Parking Area
12. Exit Manager and Visitors
13. Exit Bus AKDP/AKAP, BRT/DAMRI

A. Building Management
B. Terminal Main Building
C. Skybridge Bus Departure
D. Skybridge Bus Arrival
E. LRT Platform Area
F. LRT Rail

Figure 9. TOD Master Plan

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Based on Figures 7, 8, and 9, the mixing of several functions to become a unified whole in an area or region. Creating interrelated or connected space functions with easy accessibility for the smooth running ofactivities. This is aimed at creating spaces arranged sequentially from their functions or patterns of activities and user activities, creating user comfort and safety with the availability of facilities that support all groups,a clear, easy and accessible circulation and accessibility system for all people to be able to access. shorten movement and time, implement a clear information system, there are no empty spaces that are cornered or dead-end, and a pedestrian-oriented road network that is directly related to the destination location.

4. CONCLUSIONS

The design of the Mixed-Use Building area at the TOD-based Leuwi Panjang terminal was designed based on the Bandung City Bandung Urban Mobility Project (BUMP) 2031 program. The area which has a high level of vehicle density is one of the proposals for the BUMP 2031 Bandung City program which will be used as a TOD area. The main function of this area is to accommodate public transportation for the surrounding community or immigrants, to become a transit node or meeting point between bus, light rail, city transportation, taxi, and online transportation modes. There is also a parking area or bicycle rental for people who want to use bicycles. The second function in this area is the office for managing the bus terminal and LRT station. Another function of this area is to accommodate trade or commercial activities such as food and clothing souvenirs typical of the city of Bandung.

In this design, the theme of integrated design is applied, which means assimilation of several functions to become a unified whole in an area or region. Creating interrelated or connected space functions with easy accessibility for the smooth running of activities in it. In addition, the application of this theme is intended to facilitate movement patternsand shorten user activity time and make it easier for visitors or users to find areas based on commodities.

The design of the Mixed-use Building at the TOD-based Leuwi Panjang terminal is hoped that the public can take advantage of public transportation properly which can reduce vehicle density in the surrounding area and the city of Bandung.

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