

PHYSICAL ANALYSIS CONDITIONS AROUND LEBAK BULUS MRT STATION IN SOUTH JAKARTA, INDONESIA

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ABSTRACT: Transit-oriented development (TOD) is one of the concepts of sustainable urban development in tackling congestion, environmental degradation and energy efficiency. In an effort to realize transit-oriented development, the government issued a transit-oriented development policy at every mass rapid transit (MRT) station in DKI Jakarta, one of which is Lebak Bulus MRT Station. In the concept of transit-oriented development, there are several criteria such as land use, mobility and infrastructure that support the function of the MRT station thus reducing dependence on private vehicles. The criteria are broken down into several indicators that are analyzed based on the characteristics of the existing area conditions. This study aims to determine the extent to which the area around Lebak Bulus MRT station can support the development policy of the TOD area. The research method used is quantitative method in the form of descriptive analysis by using Geographic Information System (GIS). The result of the research is an explanation and the concept of transit-oriented development concept in DKI Jakarta. The research conclusions and recommendations will focus on establishing transit-oriented development areas around Lebak Bulus MRT Station in accordance with government policies and TOD indicators.

Keywords: transit-oriented development, TOD indicator, Lebak Bulus MRT Station.

1. INTRODUCTION

Transit Oriented Development (TOD) is one of the concepts of sustainable urban development in overcome congestion, environmental damage and energy efficiency. This concept aims to overcome urban sprawl and divert dependence on the use of private vehicles [1]. Transit Oriented Development (TOD) is also a relatively new model of environmental development that has been conceptualized as urban development with a combination of nodes such as transit stations and places such as environments [2]. Through the provision of good and balanced transportation between mass transport and private vehicles can improve the efficiency of the urban economy [3].

As an effort to make it happen the government makes transit-oriented development policy at every MRT station in Jakarta Capital City. Transit-oriented development concept in Indonesia began to be developed in big cities. Transit-oriented development provisions in Indonesia shall be regulated in the Regulation of the Minister of Agriculture and Spatial [4]. Meanwhile, transit-oriented development in Jakarta Capital City is regulated in Jakarta Governor Regulation Number of 44/2017.

In both policies, transit-oriented development has 3 area typologies namely the area of development of TOD regions, TOD city area and neighborhood TOD area.

Transit-oriented development policy in the capital city of Jakarta there is several stages, the current TOD plan that was developed one of them is the TOD area of Lebak Bulus MRT Station in South Jakarta which is currently still in the preparation of the Urban Design Guide. Based on Jakarta Governor Regulation, TOD Lebak Bulus area is directed as TOD Regions with a regional service function.

However, this policy needs to be supported by the physical condition in the designated area. Although the preparation of the Lebak Bulus City Design Guideline is currently underway, it is necessary to conduct a study of the potential of the area around MRT Lebak Bulus Station, whether the physical characteristics of the area currently available, the area has the potential to be developed as a region-scale TOD based on the criteria transit-oriented development and can support government policy in the implementation of TOD area development around Lebak Bulus MRT Station.

2. LITERATURE REVIEW

Transit Oriented Development (TOD) is a community with mixed use in an average distance of 2,000 feet or approximately 600 meters from transit stop and commercial center. The TOD region, when applied on a regional scale, can provide a mixed network of environments that can help balance urban development with the suburbs by creating solid and centralized growth set around the regional transit system (Calthrope, 1993). Criteria of TOD area based on Calthrope, consist of Location and TOD type criteria, where TOD location is within 2.000 feet or approximately 600 meters with two types of TOD, urban TOD and neighborhoods TOD.

Land Use criteria where each TOD type must have a core commercial area with mixed-use be equipped a public area (open space or plaza), a core area of at least 10% of the total area of TOD. Housing density at Urban TOD approximately 15 units/acre or 15 units or 4,046 square meters, while the housing density at neighborhood TOD is approximately 10 units/acre or 10 units / 4,046 square meters.

Criteria for *Road and Circulation Network Systems*, designed to maximize pedestrian safety. The vehicle path is designed to narrow the vehicle speed. Traffic speed is not more than 15 mph or 24 km / h with a width of 8 - 10 feet or 2.4 meters - 3 meters.

Criteria for *Pedestrian and Bicycle Paths* must be located along with a road network connected to commercial areas and transit stations equipped with comfort, safety and security features in walking and cycling. The pedestrian track in the residential area has a width of 5 feet or 1.5 meters, and the commercial area has a pedestrian foot width of 10 feet or 3 meters.

Then the criteria of the *transit system* must be in accordance with the location characteristics, density and growth potential of the area, so that the transit system must be able to accommodate the maximum area limit of TOD area development. Transit stop is centrally located and adjacent to the core commercial area, then the transit station is equipped with easy accessibility and convenient for transit passengers, and accommodates year-round weather conditions.

Parking requirement criteria, parking capacity in the TOD area should be reduced to encourage a pedestrian-friendly environment. Parking location should not be adjacent to a transit station, then park and ride location and drop-off bus should not isolate pedestrian path from access to the station transit station. Then the cumulative parking is put

into place in commercial, retail, office and entertainment areas.

Florida TOD Guide Book, has several criteria for TOD areas such as where the concentration of TOD area development is within ¼ mile (400 m) radius called transit core with an area of about 125 Ha, then the radius distance up to ½ mile (800 m) from a transit station is marked by a reduction in intensity and density of land use is called a "*transit neighborhood*" with an area of 375 Ha, so on until a radius of 1 mile (1,600 m) is a "*transit supportive area*".

Transit cores and *transit neighborhoods* reflect a comfortable and safe walking area within 5 to 10 minutes of walking distance, then a transit supportive area marked by cycling activity [5]. The Florida TOD *framework* establishes 3 (TOD) types of Regional Centers, Community Centers and Neighborhood Centers. The division of TOD type aims to regulate the development and pattern of urban mobility in Florida, by differentiating each type of TOD based on the density and intensity of buildings, mixed usage, road network patterns, transportation mode services and parking lots.

In TOD Standard v3.0, the TOD development area has an area of ¼ mile - ½ mile or 400 m - 800 m in walking distance, with the central node area being a transit station. Some criteria based on TOD Standard, among others [6]:

Walk, building an environment that supports walking activities. *Cycle*, giving priority to non-motorized transportation network with the target network of cycling infrastructure is complete and safe. *Connect*, creates a congested network of roads and pedestrian paths with short route targets for walking and cycling, direct and varied.

Transit, puts development near a high-quality public transport network. With high-quality public transport targets accessible on foot as a TOD requirement, the furthest distance to public transport stations as far as 1,000 m or less for fast transit (mass rapid transit, light rail train and bus rapid transit) and 500 m or less for direct service (bus local).

Mix use, plan development with land use, mixed-income and demographics (use for settlements and non-settlements within the same block). *Densify*, optimize the space density and adjust the capacity of public transport.

Compact, build areas with short travel distance requirements. *Shift*, increasing mobility through parking arrangements and road usage policies with a reduction target of the infrastructure used for motor vehicles.

Development of TOD area in Indonesia, regulated in Regulation of the Minister of Agrarian Affairs and Spatial Number of 16/2017 with several criteria, namely *Delineation of region*, where TOD is within 400 m - 800 m from

transit station which is limited by physical boundaries such as road, river and so on which shows a unity of characteristics.

Mixed land use, Comparison of mixed space utilization and diversity in TOD area between housing and the other buildings that is 20% - 60% : 40% -80% for TOD Service Center City, 30% -60%: 40% -70% for TOD Sub City Center and 60% -80%: 20% -40% for TOD neighborhood scale. *Density area*, of TOD area based on occupancy, for TOD City Center with high density 20 - 75 units / 1000 square meters, for TOD Sub City Center with medium to high densities 12-38 units / 1.000 m2 and neighborhood TOD with medium density 15-20 units / 1,000 square meters.

Road pattern system has a block dimension of 70 - 130 m for City Center TOD, 70 - 200 m for TOD Sub Center and 70 - 270 m for TOD.

Parking restrictions, parking space at TOD Town Center, 1 parking/unit for housing, 1 parking / 100 square meters for non housing, 10% from the traveling area on the ground floor with the shared park. While parking is available at TOD Sub City Center for 1.5 parking/unit housing, 2 parking / 100 square meters for non housing, 15% from traveling area on the ground floor of building with shared parking pattern. Then at the TOD neighborhood, parking 2 housing parking/unit, 3 parking / 100 m2 for non residential, 20% from the width of the ground floor of the building with the use of shared parking.

Transit system, Transit system development at City Center TOD and Sub City TOD have the same transit system development that is heavy rail transit, light rail transit, bus rapid transit, local bus and ferry is possible. While the transit system on the neighborhood TOD that is light rail transit, bus rapid transit, local bus, bus feeder and the commuter line can serve the neighborhood TOD.

3. STUDY AREA

Lebak Bulus TOD area is partly located in Kelurahan Pondok Pinang Kebayoran Lama Subdistrict and some others are located in Lebak Bulus Village, Cilandak Subdistrict, South Jakarta. The study area is located at a radius of 400 meters from the current Lebak Bulus MRT station which is currently not operationalized. Lebak Bulus MRT Station is the center (nodes) while the 400-meter radius is the development of TOD (places) which is the core area of TOD.

Land use in the area of a radius of 400 meters from the MRT station is dominated by the functions of housing, offices and trade and services. As for the transportation area is served by the primary arterial road network system (R.A. Kartini road, Pasar Jumat road and Ciputat Raya road), then access to enter the inner-city toll road connected by the R.A. Kartini road.

Then there is a Transjakarta bus shalter located opposite the MRT Station and Inter-City Inter- Provincial bus terminal located on Pasar Jumat road, so the radius of 400 meters from Lebak Bulus MRT Station is served by rail transportation mode, Transjakarta bus rapid transit, and inter-city inter-provincial bus.

4. METHODOLOGY

In this study, researchers used visual observation methods at the study site by observing the characteristics of the area, the function of land use, the condition of the road network and the availability of transportation facilities and infrastructure. Every observation made, the researcher refers to the criteria and indicators of TOD area development based on the literature study and the prevailing laws and regulations in Indonesia.

Then to strengthen the result of visual

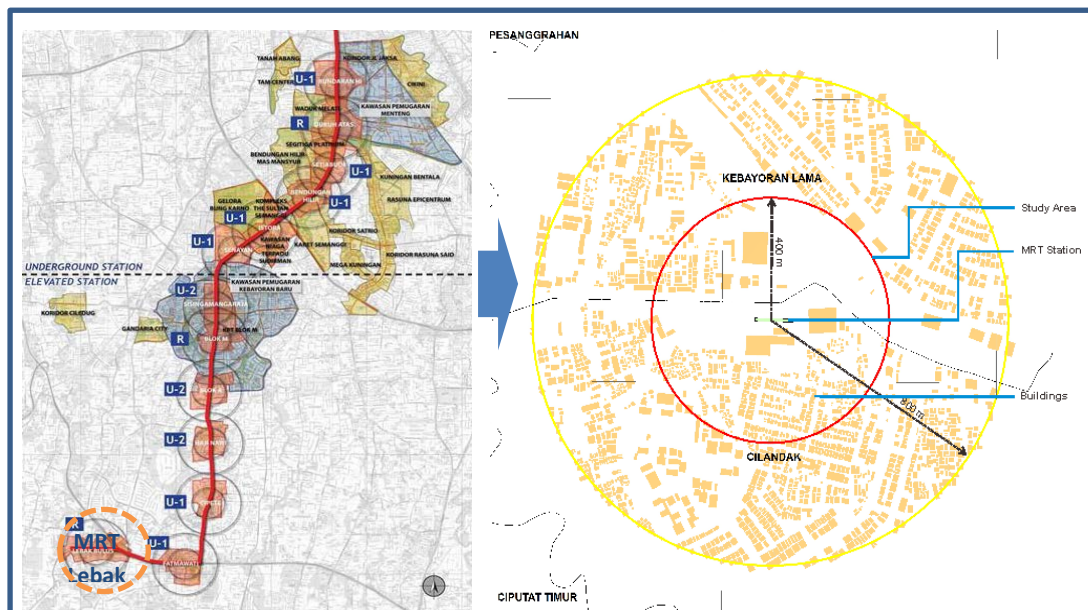


Fig. 1 Location of Study Area

observation, the researcher performs spatial analysis by using the Geography Information System (GIS) program. The use of this program aims to determine the level of density and density of buildings. As for calculating the density of the building the researchers used the ratio of the number of building units in every 1.000 square meters with the formula:

$$\text{Density building} = \frac{\text{Building Units} \times 1.000}{\text{Area-wide} (m^2)}$$

5. DISCUSSION

Physical descriptive analysis of the study area focuses on the analysis of land use in the area of 400 m from Lebak Bulus MRT station, which revealed that there are several TOD criteria and indicators that have been met and which have not been met according to the TOD area.

5.1 Land Use

In the land use criteria, among others, the use of mixed land, where there are several functions of commercial activities, offices, housing, and shopping centers. For the analysis of mixed-use, the author only identified between the use of residential and non-residential land, where in the radius of 400 m from Lebak Bulus MRT station the use of mixture is still dominated by housing activities. While the density of buildings in this area, based on the results of spatial analysis using GIS only has a density of 1.7 units / 1000 square meters, where the density of TOD region scale should have a density of 20 - 75 units / 1000 square meters. For the intensity of the building, this area has a maximum height of the building based on the Aviation Safety Operation Area according to the Letter of Command of the TNI AU 1 No.B / 1700-09 / 21/05 / Halim dated December 16, 2011 altitude lebak bulus 110 meters or around 27 floors.

5.2 Mobility

On mobility criteria in the area of 400 m from Lebak Bulus MRT station, there is much-connected access in this area, that is Pasar Jumat road, RA. Kartini road connected with Ir. H. Juanda road and Metro road as primary arterial road and secondary artery. Then in this area, there are busway transit shelters (bus rapid transit) corridor 8 which serves the trip Lebak Bulus - Harmoni. There is also an inter-city bus terminal between provinces that supports trips outside Jakarta. It is more impressed that the construction

of the Lebak Bulus MRT Station has been operated to support the movement in Jakarta.



Fig. 2. (1) Mixed land use and (2) Building density

5.3 Infrastructure

The availability of TOD's supporting infrastructure is largely available, but the quality and quantity are inadequate. For pedestrian paths are available, but the width of the line is only 1 meter, while the TOD standard for the pedestrian path is 1.5 meters. Based on visual observation, the availability of pedestrian is not available along the road, only on some roads and lack of supporting facilities of pedestrian facilities. While the availability of bicycle cycles in the area of 400 m from Lebak Bulus MRT station, is still not available. See table 1.

Table 1. Analysis of Physical Area Character

Criteria	Indicators	TOD Lebak Bulus Area Radius (400 m) from MRT Station	Explanation
Land Use	Density	Building density at 400 m radius of 1.7 units / 1,000 m ²	Can be developed more intensively for commercial areas such as shopping centers, restaurants, entertainment centers and so on with the concept of vertical buildings in order to create a dense area or meeting.
	Building Intesitas	The height of the building is limited by Aviation Safety Operation Area according to the Letter of Command of the TNI AU 1 No.B / 1700-09 / 21/05 / Halim dated December 16, 2011 altitude 110 meters	The vertical development pattern has the potential to be developed up to 27 floors as there are stipulations on building height limits based on the Aviation Safety Operation Area
	Mixed Use	Area of radius of 400 m is dominated by residential, office, trade and services functions	Potential to develop mixed use function
Mobility	Radius from MRT Station	Within a radius of 400 m from MRT Station	as the core area of TOD
	Accessibility	There are many accesses connected to St. MRT is Pasar Jumat road, RA. Kartini road, Ir. H. Juanda road, Metro Pondok Indah road There is St. MRT, bus station and Bus Way Corridor 8 (lebak bulus - Harmoni)	There needs to be a separation path for bicycle users.
	Service Mode	There is an MRT station, bus station, and busway corridor 8 (lebak bulus – Harmoni)	A connectivity system between the MRT station, the bus terminal and the BRT (bus rapid transit) shalter should be made.
Infrastructure	Road Network	Arterial road networks and collectors are dominated by motorcycle	Motor vehicle restrictions are required, to prioritize walking activities in the TOD area
	Pedestrian and Bicycle Paths	Pedestrian path already exist only non-continuous and not connected to building blocks No bicycle lane in particular / separate	Pedestrian construction is required along the road in this area, as well as adequate pedestrian width and the addition of comfort features on foot, such as greening, chairs, lamps and other instruments
	Parking	The parking system is not integrated and is still scattered on each building (not yet centralized)	It requires the construction of centralized parking with limited capacity to encourage walking activity and use of public transport.

6. CONCLUSION AND RECOMMENDATIONS

This paper has evaluated the physical characteristics of a radius of 400 meters from Lebak Bulus MRT Station against TOD area criteria and indicators based on several kinds of literature. It is generally found that the physical area of Lebak Bulus MRT Station has the criteria that can be developed as TOD area, there are only some unfulfilled indicators such as building density, building height, bicycle path availability, pedestrian facilities and connectivity between MRT Station, BRT shalter and inter-city bus station. While the indicators of mixed land use, building intensity and service mode now have the potential as a TOD area.

Based on the results of the analysis that has been done, to make the radius area of 400 meters from Lebak Bulus MRT Station as a TOD area service area there are some recommendations that are:

1. Building density indicator can be increased with vertical development pattern, increasing the intensity of building through local government policy, so that land parcels can be reduced and the number of building units in each block can be more and more compact.
2. Increasing the intensity of buildings can be optimized according to the provisions of the Area of Flight Operations Safety up to 110 meters or 27 floors. This can be used as an

incentive and disincentive from the Local Government of the region to encourage the creation of TOD area.

3. Pedestrian and bicycle path system can be made through urban design guide line by increasing the widening of pedestrian, greening, a seat on a certain spot and other equipment supporting safety and comfort for pedestrians. As for the bike path can take advantage of some of the road used by the vehicle (lane division), so the road capacity for the vehicle is reduced to reduce the speed of the vehicle.
4. To support the function of shifting modes in this area, it is necessary to connect facilities between MRT Station, Shalter Busway (BRT) and inter-city bus terminal, so that the connectivity of movement in TOD area around MRT Lebak Bulus. For recommendations can be seen in table 2.

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Table 2. Potential Areas Around Lebak Bulus MRT Station to Become a TOD Region

Criteria	Indicators	Regional Potential
Land Use	Density	<ul style="list-style-type: none"> ▪ Increase in population density by 630 people/ha ▪ Increase in occupancy density by 11 unit/1,000 m2
	Intensity	In commercial buildings can be increased 5-6 floors to 26-27 floors
	Mixed Use	Need to increase diversity in non-residential functions (mixed areas) with percentages of 30% : 70% up to 40% : 60%
Mobility	Transit Center Area	The area of 400 meter radius from the Lebak Bulus MRT Station can be use as a TOD area with typology as the city regional center
	Accessibility	Enhanced systems that are integrated between centers of movement (MRT station, BRT shelter, Inter-city Bus Terminals and city transportation)
	Service Mode	Increased terminal capacity and shelter for city transportation
Infrastructure	Road Network	<ul style="list-style-type: none"> ▪ Improvement of City Arterial Road (Kartini road 4 meter - 43 meter and Metro Pondok Indah road 3 meter - 42 meter) ▪ Increased Road Collector Primer (Pasar Jumat road 13 meter - 17 meter)
	Pedestrian and Bicycle Paths	Continuous improvement and construction of pedestrian / pedestrian lanes connected to residential, office, trade and transit nodes
	Parking	Parking restrictions on each building and construction of cumulative parking in mixed function buildings

8. REFERENCES

- [1] Calthorpe, Peter (1993). *The New American Metropolis*. New York, NY: Princeton Architectural Press.
- [2] Kamruzzaman, Baker, Washington, Turrell, (2013). Advance transit-oriented development typology: a case study in Brisbane, Australia. *Journal of Transport Geography*. Published by Elsevier Ltd.
- [3] Carlton, Ian. (2007). *Histories of Transit-Oriented Development: Perspectives on the Development of the TOD concept*. University of California, Berkeley.
- [4] Ministry of agrarian and spatial planning BPN (2017). *transit-oriented development guidelines. Regulation of the Minister of Agriculture and Spatial BPN, Republic of Indonesia No.16 / 2017*.
- [5] Busha, Michael., Brunot, Marlene., DeLaney, Kim., Fett, Steven., Gianniotis, Anthea., Hatton, Wynsum., Hutton, Christen., Little, Dana., Sabol, Eloine (2012). *Florida TOD Guide Book*. Florida Departement of Transportation.
- [6] Institute for Transportation and Development Policy (2017). *TOD Standard*, 3rd ed. New York.
- [7] V. Sohoni, Mariam Thomas and Khrisna Rao (2017). *Application of The Concept of Transit Oriented Development to a Suburban Neighborhood*. *Transportation Research Procedia*. Published by Elsevier B.V.
- [8] Newman, P., Kenworthy, J.R.(1996). *The Land Use-Transport Connection: An overview Land Use Policy*.
- [9] Braswel II, Daniel, Allen. (2013). *Transit Oriented Development, An Urban Design Assessment of Transit Stations in Atlanta*. Faculty of the School of Cityand Regional Planning, Georgia Institute of Technology.
- [10] Curtis, C., Renne, J.L., Bertolini, L., (2009). *Transit Oriented Development : Making It Happen*. Ashgate e-Book Publishing, Farnham, UK.

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