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Transit-Oriented Development: An Approach to a Sustainable Development Locus: Jatinegara Station, East Jakarta

Tri Endangsih [1], Arif Kusumawanto[2], Dyah Titisari Widyastuti[3]
[1] Architecture study program, Budi Luhur University, South Jakarta;
[1] Doctoral Program in Architecture, Gadjah Mada University, Yogyakarta;
[2,3] Department of Architecture and Planning, Gadjah Mada University, Yogyakarta;

Abstract

The rapid rate of population growth is a critical problem worldwide. The increase in population causes many problems, especially in the provision of housing with limited land in urban areas. These problems cause disruption of the social environment and reduce the quality of the environment. Transit Oriented Development (TOD) is one of the alternative solutions in solving these problems, with the concept of city development that maximizes diverse and integrated land use by promoting healthy lifestyles through walking and cycling and maximizing the use of mass transportation modes. Therefore, this research was conducted with the aim of knowing the application of TOD development for planning to achieve a sustainable city. This study reveals how transit-oriented development design and policies help in achieving sustainable development despite having to maintain high density. With this research, it is hoped that it can provide input to local governments, especially the East Jakarta City Planning Service in the context of structuring and developing the Jatinegara station area.

Keywords: *TOD, Mass Transportation, Sustainable City*

INTRODUCTION

Starting in 2008 is a milestone where 50% of the world's population lives in urban areas, the increase in urban population from 30% in 1950 to 50% in 2007. This has also caused heavy pressure on urban areas and the occurrence of "urban sprawling" / horizontal urban development uncontrollable. And this is further predicted to produce mega cities or “Mega Cities” in developing countries (Tanuwidjaja, 2010). If population growth is not controlled, the need for these facilities will be even higher. Physical development is towards the maximum, while on the other hand the development of open space is towards the minimum, thus changing the face of the whole city. Land is ultimately the main resource of the city which is very critical, in addition to its increasingly very limited supply, its nature also does not allow it to be expanded.

Urban development that is not managed properly will tend to cause hereditary problems. These include traffic congestion, the growth of slums and urban poverty, the problem of crime, the decline in the quality of the urban environment, and the threat of disasters. It has become the current trend of market pressure and capitalism that moves very quickly, increasingly closing the movement of public space and residential space. The dynamics of a city with heterogeneity on the one hand is indeed good in its acceleration, but on the other hand the city is not only running fast but also livability. The city must also be able to prepare all the needs of its users and the existing infrastructure. Cities must offer the concepts of

Corresponding author
tri.endangsih@budiluhur.ac.id
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equity and sustainability so that future generations will not enjoy the chaotic dysfunctional cities (Sachdeva, 2012).

Based on the Jakarta report in 2020 figures, the population of the capital city of Jakarta, which has exceeded its limit, has reached 10 million (Badan Pusat Statistik Provinsi DKI Jakarta, 2017). This is because Jakarta as a center with a dense population will have an impact on: increasing demand for housing, increasing unemployment, congestion, air pollution, crime, and being the main cause of urban sprawl. Other problems include environmental degradation, an inefficient urban planning system, inadequate infrastructure provision, and an irregular transportation system. Congestion occurs not only because of the large number of motorized vehicles but also because the roads in Jakarta are only about 6 percent of the total area, while ideally it is around 15 percent.

Congestion has become a major issue in every city due to the imbalance between the supply and the need for transportation facilities and infrastructure (Nurdini et al., 2013). Transport and mobility are now centered on urban forms to facilitate sustainable transport solutions. One solution according to Reppogle 2006 in Mauliawati et al, 2014(Mauliawati et al., 2014) In the world of transportation, the concept of TOD (Transit Oriented Development) is known, which is a concept of transportation development that synergizes with spatial planning with the aim of shortening trips and making trips more efficient.

Land use planning is considered to have an important role in overcoming the problem of land availability in urban areas, namely by applying the concept of a transit-oriented development area(Chen et al., 2014a);(Ma et al., 2018). Transit-Oriented Development (TOD) is a concept that combines land-use and transportation modes so that this concept can become a recommendation in efforts to develop sustainable urban areas (J Li and Huang, 2020);(Trepci et al., 2019). The presence of the TOD area concept in urban development provides various benefits such as reduced congestion rates, reduced air pollution increased energy use efficiency, and most importantly increased land-use efficiency in urban areas (Pojani and Stead, 2014). The concept of the TOD area is also able to create a cultural community for walking and cycling, as well as providing green open spaces (Hasibuan et al., 2014);(Vale, 2015). This happens because the TOD area has the principles of density, diversity, design, distance, and purpose (Jeffrey et al., 2019).

Land use planning is considered to have an important role in overcoming the problem of land availability in urban areas, namely by applying the concept of transit-oriented development areas (Chen et al., 2014b);(Ma et al., 2018). TOD is a concept that combines land use and transportation modes, so that this concept is able to become a recommendation in efforts to develop sustainable urban areas (Jianyi Li and Huang, 2020);(Pan et al., 2011);(Trepci et al., 2019).

In Jakarta, the TOD study focused on environmental carrying capacity and land use typology (Hasibuan et al., 2018);(Hasibuan et al., 2014). In Surabaya, the TOD study focuses on the area's function as a mitigation of greenhouse gases (Handayeni, 2014). In Depok, the study on TOD focuses on the actual conditions of the TOD index (Sulistyaningrum, S Sumabrata, 2018). However, studies on TOD are still not much in demand by academics in Indonesia, especially studies that focus on environmental models of TOD areas based on urban design. Therefore, this study will discuss the application of TOD principles in the context of modeling the Jatinegara station area.

LITERATURE REVIEW

Transit-Oriented Development (TOD) Concept

Transit-Oriented Development (TOD) is a planned design process for a community that fosters a user-friendly, compact, mixed, and pedestrian-friendly environment where development spreads

within a quarter mile to half a mile of a public transit station. A transit station can be a train station, bus stop, or bus terminal. The aim of designing TOD around public stations is to reduce dependence on private cars by encouraging the use of public transport. The TOD concept is widely used in developed countries to contain urban spread by filling developments in the suburbs. TOD size ranges from 50-100 hectares. TOD contains residential buildings, work centers and shopping centers around transit stops. TOD stations are surrounded by a relatively high density that gradually diminishes outward from the center. TOD has been recognized as a model for integrating land use with transport for the benefit of "smart growth" ((Calthorpe, 1993); (Cervero, 1998); (Renne and Wells, 2004)). Dittmar dan Ohland (2004) stated TOD is an important part of healthy growth and also involves regional economic development (Dittmar and Ohland, 2004). Bukowski et al. (2013) also defined TOD as "an environment located around a rail transit station that is within walking distance so as to provide a healthy lifestyle for its residents" in their study of the sustainability of TOD in Hong Kong.(Bukowski et al., 2013). They believe that a sustainable TOD should be able to meet all the needs of residents within walking distance of the nearest station or other stations.

TOD is considered one of the most sustainable forms of urban development because its "compact, mixed-use, pedestrian-friendly development centered around transit stations" encourages the use of public transport modes and reduces motor vehicle use. (Cervero et al., 2004). It is a concept that can help many government urban policies realize more sustainable outcomes, more specifically, it is a planning element that seeks to get public transport (trains, buses, or ships) that are more environmentally friendly and socially responsible for urban forms. (Black et al., 2016). TOD is also a type of modern movement in urban design that aims to stimulate street life and diversify urban landscapes (Cervero and Murakami, 2008).

Based on Governor Regulation No. 67 of 2019 concerning the Development of the Tod Area, Transit Oriented Development (TOD), is the development of areas around transit points that are oriented towards the ease of movement and movement of people, increasing accessibility and connectivity of the area, assimilation of activities, utilization of dense land in the context of urban rejuvenation and increased use of Mass Public Transport. TOD area is an integrated area of mass public transportation that encourages the movement of pedestrians, cyclists, the use of mass public transportation and restrictions on motorized vehicles within a radius of 350 m (three hundred and fifty meters) to 700 m (seven hundred meters) and in the center of an area that has the principles of Transit Oriented Area, seen in figure 1:

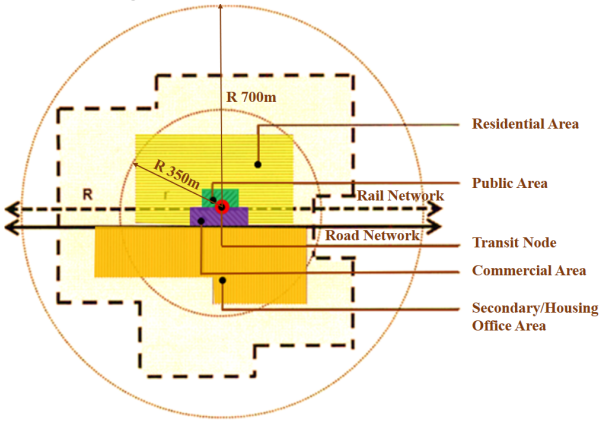

Figure 1. TOD Structure Area
Source: Based on Governor Regulation No. 67 of 2019 concerning the Development of the Tod Area

TOD Aspect:

Land use mix: Housing, employment, retail and service centers should be mixed in the planning area either horizontally (Figure 2) or vertically (Figure 3) in different or the same building. Residential areas are intended to mix different income groups and household types. Residential and community facilities, educational centers, recreational facilities close to transportation stations create a balanced environment. There should be sufficient open space and greenery for recreation and preservation of environmental quality.

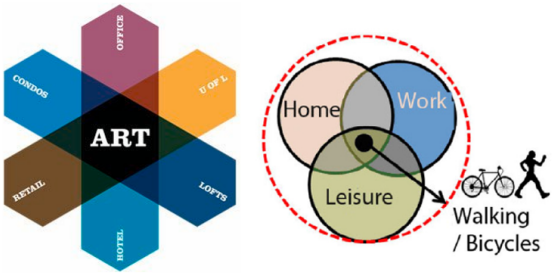

Figure 2. Horizontal mix up of land use
Source:(Liem and Prayitno, 2019)

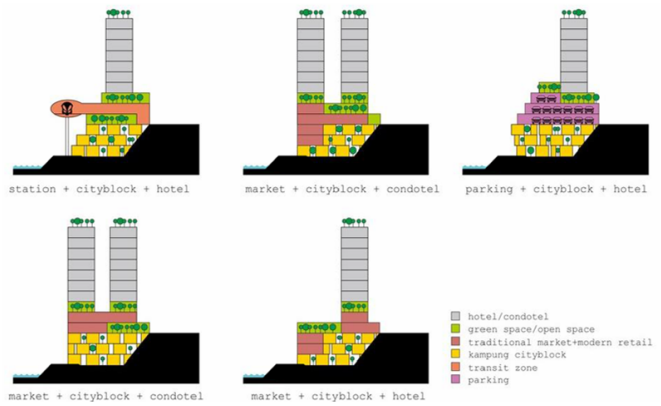

Fig 3: Vertical Mix-Up Of Land Uses And Stepping

Down At Upper Floors For Tall Building

RESEARCH METHOD

This research was conducted in the transit area of Jatinegara Station, East Jakarta. The transit area of Jatinegara Station is one area that is in a potential area, including; East Jakarta's trading center is the Jatinegara main market (Mester Market), agate trading center, animal market, and others. The area around the Jatinegara Station transit location in the 2030 DKI Jakarta RTRW is planned to be a secondary area for office, trade and service activities(Gubernur Provinsi Daerah Khusus Ibukota Jakarta, 2012).

The tools and materials used in this study are stationery and computers that are useful for the process of data collection and data analysis, as well as cameras used to document survey results in the area around Jatinegara Station. Other data needed are regional maps and administrative maps of the Jatinegara, Matraman, and Pulogadung sub-districts, East Jakarta, as well as the google earth application.

Main data

1) Primary data, the collection is done by conducting a survey on the vegetated area, as well as conducting interviews with the community around the research area.
2) Secondary Data were obtained from various agencies and literature studies, including:
   a) Administrative Map of Jatinegara, Matraman, and Pulo Gadung Regencies.
   b) Standard of green open space area, obtained from literature study.
   c) Total population, population density and area are obtained from the Central Statistics Agency (BPS) in Jatinegara, Matraman, and Pulo Gadung Districts, East Jakarta Municipality.
   d) City Development Plan Map, Regional Spatial Plan Map, and City Spatial Detail Plan Map

Analysis and Calculation

Analysis of the calculation of TOD area, total population, number of workers, basic building coefficient, coefficient of total building area for planning the intensity of space utilization. TOD spatial structure planning and spatial use intensity refer to the Regulation of the Governor of the Capital Province of DKI Jakarta(Gubernur Provinsi Daerah Khusus Ibukota Jakarta, 2019).

FINDINGS AND DISCUSSION

Sustainable Development in the context of Transit-Oriented Development

Cervero (1996) shows that mixed density and land use contribute to reduced car ownership, shorter trips and travel distances and lower average vehicles traveled per person. Cervero found that a 3% increase in the share of transit and ride-hailing fell with each 10% increase in floor space allocated to retail commercial purposes. These results can also reduce CO2 emissions and reduce energy consumption. In addition, Dorsey & Mulder (2013) stated that livability is related to the provision of open space, access to public services, clean air, better mobility; efficiency is achieved through mixed use building planning, pedestrian friendly land use; flexibility and choice of opportunity are closely related to TOD's diversity dimensions: more choice in terms of housing, shopping, and mobility than the suburban development model. The benefits of TOD on the environment, reduced social and economic separation have made TOD the concept of sustainable development. Table 1. below summarizes the benefits of TOD, as follows:

Table 1. TOD Benefits in a Sustainable Context

Economic Benefits	Social Benefit	Environment Benefit
Housing affordability	Increased physical activity	Reducing CO2 emisi emissions
Peningkatan nilai real estate	Community identity	Reduce energy consumption

Economic Benefits	**Social Benefit**	**Environment Benefit**
Real estate value increase	Shorter round-trip distance	Air Quality Improvement
Reducing household spending on transportation costs	Mobility, housing and community options	Reduce congestion
Reducing the cost of spending on infrastructure	Urban revitalization	Reconstruction
Increase in transit passengers	Attention to preservation outdoor	Improved quality of life for residents
	Improve public safety	Sustainability

Source: (Dorsey and Mulder, 2013); (Dorsey, 2016)

Sustainability in patterns and infrastructure of spatial development of urban forms that support shorter journeys, and alternative modes of transportation (E.Reusser et al., 2008). As mentioned earlier, TOD encourages development (facilities, houses, etc.) near public transport infrastructure, by providing environmentally friendly accessibility. In addition, a comparison between Table 1 (TOD Benefits) and Figure 5 (Four important factors of transport system sustainability) conveys the close relationship between TOD results and sustainability principles.

TOD and accessibility, other concepts focused on sustainable livability. The main difference between TOD and Livability is the local component, livability being a community level strategy for economic growth, increased transportation options, accessibility, pollution control, public health, and social justice. (The National Association of Regional Councils, 2012). Livability is a concept related to sustainable transportation as well as to TOD. The livability principle according to the U.S. Department of Transportation: U.S. DOT, the U.S. Environmental Protection Agency: U.S.EPA and the U.S. Department of Housing and Urban Development: U.S. HUD, 2009 is to provide more transportation options, expand equitable and affordable housing options, increase economic competitiveness, support existing communities, coordinate and improve policies and investments, community and environmental value.

The concept of livability has a healthy local component, more focused on "community experiences in a particular place". In contrast, a sustainable strategy is high-level, focusing on “how to sustain society without harming the environment” (National Association of Regional Councils' Livability Literature Review 18: A Synthesis of Current Practices, 2012). These characteristics are influenced by the time and place of the emergence of local politics. , trends in perceived quality of life, and preferences of people living in certain contexts (Miller, 2013). The built environment must reflect shared expectations because it is developed to be more permanent, comfortable and enjoyable. The following figure describes the relationship between sustainability-human quality of life- quality of space and human quality - TOD - the concept of accessibility:

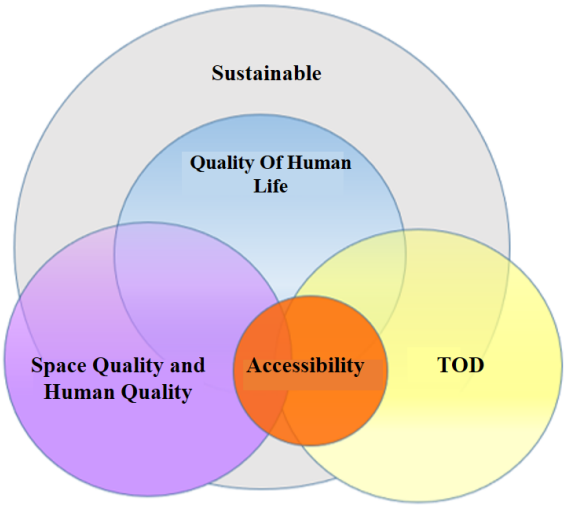

Figure 4. Relationship Between Sustainability-Human Quality of Life-Quality of Space and Human Quality-TOD-Accessibility Concept

Source: (E.Reusser et al., 2008) dan (Miller, 2013)

Quality public spaces, neighborhoods, cities, or regions can be improved by involving the community in planning, transforming, and improving the surrounding environment. Emphasizing the importance of community involvement is a characteristic that is applied during planning to achieve a better quality of space and quality of human life. Regional spatial development focuses on providing affordable housing, economic development and transportation options (National Association of Regional Councils' Livability Literature Review 18: A Synthesis of Current Practices, 2012). It is a multi-disciplinary approach to public space, helping planners, designers, engineers to consider community-driven development (Porada, 2013).

Land Use Intensity

In sustainable area planning according to Ewing and Cervero in Mitra, Raktim (2007) there are three (3) types of settlements, namely traditional settlements, Planned Unit Developments (PUD) and Hybrids (Mixed)(Ewing and Cervero, 2001). The diversity of functions in community settlements has given rise to various forms and types of settlements that are adapted to social, economic, and residential environmental conditions, and are important aspects that can be utilized in consolidation efforts.(Liem and Prayitno, 2019). Hybrid architecture finds its meaning through the diversity and unique relationships between activities (Derome-masse, 2015). To achieve the diversity of land use and various building functions, vertical hybrid forms can be applied (vertical buildings with various functions vertically) or horizontal hybrid forms with horizontal arrangement of areas for various functions.

In terms of structuring the area, the concept of hybrid architecture is in line with the principles of TOD and sustainable settlements, namely; By planning the area must be compact, pedestrian is comfortable and land use is mixed, the variety of housing types so as to form diversification, public, social and economic facilities must be integrated with housing, and the provision of transportation

as an alternative option for private vehicles. This statement is in accordance with the opinion of Cho, et al (2016).(I. Cho et al., 2016), in their theory of spatial hybrid urban space. The spatial hybrid city model is reflected through structural complexity, technological innovation, and contextual relationships with the surrounding environment that form new spatial conditions for access, connectivity, physical flexibility, and innovative public use. From the results of observations, the existing condition in one block consists of functions that are limited to between 2-3 building functions. To achieve a variety of functions with good intensity of space utilization in one block, there can be more than 3 building functions. Examples of plans for implementing the hybrid space concept are as follows:

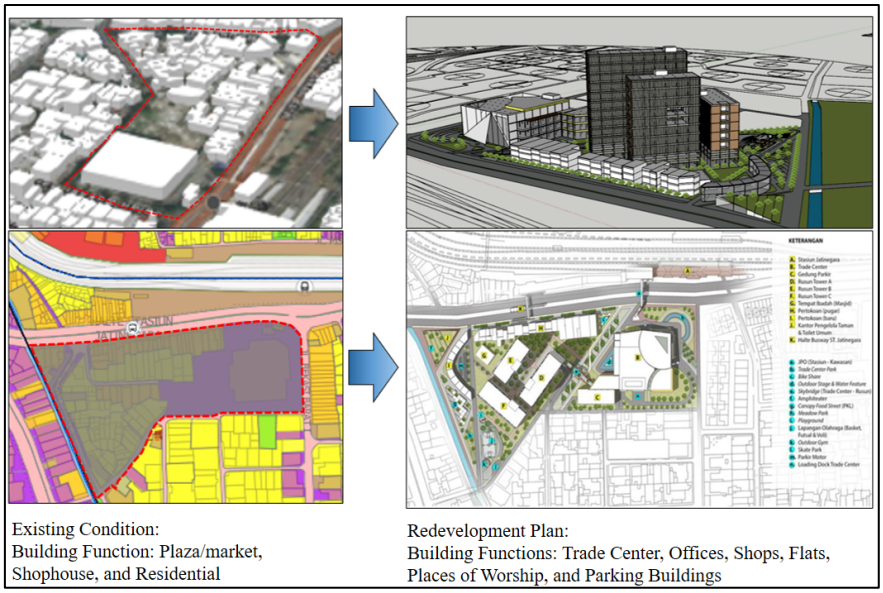

Figure 5. Example of a Planning Area Building Function Plan

Source: Researcher Analysis, 2021

Figure 5, explains the results of the observation of the existing condition in block 2 which has 3 building functions (Plaza/market, Shop House, and Housing). In order to apply the concept of hybrid space to form a compact TOD area by redevelopment site. Redevelopment site by developing a variety of building functions, forming vertical buildings to meet the provisions of KDB, KLB, and KDH as an effort to implement a compact city form. This development aims to bring each function closer together in one block, so that people are comfortable and safe for walking and cycling.

The purpose of TOD area planning is to achieve a sustainable city, it is important to form a city that is able to improve in terms of economic, social and environmental quality aspects. The typology of sustainable cities is: 1) Neotraditional Development, Audirac 1994 in (Hasan et al., 2015) , 2) *Urban Containment*(Woo, 2007), 3) *Compact City*(Calthorpe, 1993)*;* Neuman 2005 in (Laskara, 2018)), 4) *Eco City*(Kenworthy, 2006). Of the four (4) city typologies that are in accordance with the TOD principle and hybrid architecture, the compact city type is the form of a city with a small urban radius, high density and mixed land use. A design strategy that encourages people to prefer walking, and riding a bicycle or take public transportation instead of taking a

private car. The criteria for achieving sustainable city design are to: 1) Land use mix between housing, trade, services and public facilities in a compact area; 2) A balance between private and public spaces to enhance the identity and value of the area; 3) Establish a peaceful society, encourage walkability and increase comfort; 4) The use of traditional urban and regional patterns as future models. Based on the discussion of the principles of the TOD concept and the principle of a sustainable city, the inputs for planning a sustainable settlement model are as follows:

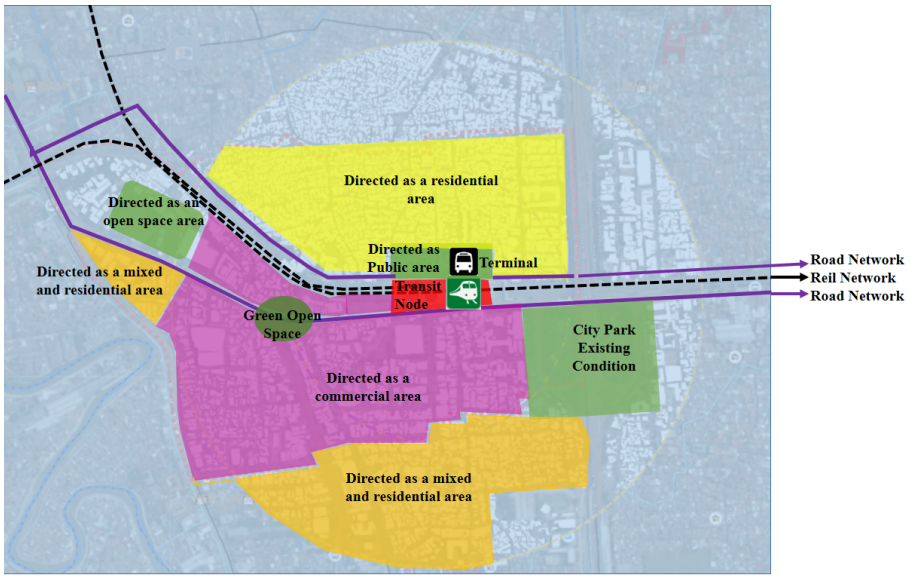

Figure 6. Regional Planning Scheme

Source: Researcher Analysis, 2021

The picture above shows the site redevelopment plan based on the transit area development guidelines. A map of the redevelopment site plan is needed to create an area model with a variety of building functions and the arrangement of the area's supporting facilities infrastructure. With this planning scheme, it can contribute to the sustainability of the city.

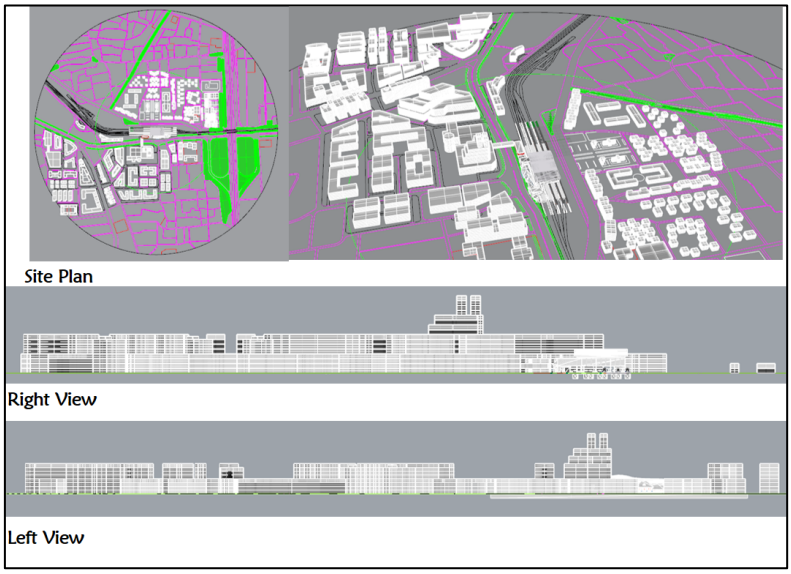

Figure 7. Building Mass Arrangement Plan

Source: Researcher Analysis, 2021

CONCLUSION

The development of transit-oriented areas or Transit Oriented Development (TOD) is one solution to transportation and environmental problems in urban areas, especially big cities, especially in DKI Jakarta. TOD was developed in order to overcome congestion problems through the integration of the mass transportation network system, in addition TOD also aims to reduce the use of private vehicles while encouraging people to walk and use public transportation. TOD is the best solution to meet high density development by providing the services needed to support it. The TOD design criteria suggest the path to sustainable development in terms of affordability, social equity, economic viability and ecological balance. To meet the increasing demand for housing in the city of Jakarta, TOD can be a successful planning approach by providing high density housing near transit stations. The mixed use development pattern in the TOD area is expected to provide various kinds of activities or space designations such as offices, housing, commercial business areas, green open spaces that can be connected and integrated with each other, besides that the essence of TOD is also an effort to encourage, facilitate and prioritize the provision of public facilities that prioritize accessibility for residents of the area as well as users of mass transportation modes which is realized by providing pedestrian paths that provide comfort in walking. It is also easier for the community to reach the desired location because transportation has been integrated with each other and in the end the efficiency of the spatial structure and sustainable urban development can be realized properly.

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