

Secondary City and TOD Concept in the Light Rail Transit (LRT) Development to the Sustainable Transportation

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Secondary City and TOD Concept in the Light Rail Transit (LRT) Development to the Sustainable Transportation

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1. Introduction

Some developing countries, such as Indonesia, are developing a city of independent cities and even some metropolitan cities such as Jakarta, Surabaya, Medan and Semarang. The purpose of an independent city or satellite city is to overcome the population explosion in several big cities, according to the designation. Satellite cities are residential providers that have good access to industrial locations, while the people are still dependent on big cities. But with the ease of access to the big city, satellite cities are growing, many residents choose to live in satellite cities and work in big cities [1]. Along with the development of time in almost all major cities in Indonesia, the trend of the construction of apartments is carried out both in the city center and on the outskirts of the city, because of the increasing population development and the lack of land for housing. Problems that arise with the proliferation of apartment development actually have an impact on the movement of people from the suburbs to the city center, these conditions also impact congestion on several city networks from independent cities to the city center. [2] also in his paper said: that in the country developing lifestyle countries influence changes in travel patterns, so the cause of congestion is due to the high use of private vehicles, this is also supported by the statement of [3], that in several major cities in Indonesia such as Jakarta, Bandung, Surabaya and Semarang, air pollution from the transportation sector has reached 70% followed by the Industrial sector 20% and domestic 10%. Urban development often results in pressures on the environment, including congestion and air pollution, according to the world organization (WHO, 2006) more than 2 million sudden deaths each year are related to the effects of air pollution, both outdoor and indoor, and more than half of them occur in developing countries [3]. Indonesia is a developing country, that a mixed-use concept development will bring serious urban problems, and require very urgent handling, while in spatial planning specifically in Semarang city, TOD oriented use use development

has not been discussed. [4] an American urban designer and new urbanist, proposed the concept of TOD, but refers to the construction of high-density and mixed-use land centered on transit stations, usually train stations because in addition to its large carrying capacity the railway station has strong, permanent image, and it is more attractive to potential investors [5], otherwise bus stops do not have a strong, permanent image and are considered less attractive to investors, so will attract little investment and development. However, the TOD concept in the US before it was implemented successfully was an obstacle, because the TOD concept could not be applied to suburban-oriented out-of-order, whereas in the US suburbanization policy was automatically oriented. [6] in his paper said that the concept of TOD with Railways would reduce the external costs of Development.

LRT has begun to be built in several cities in Indonesia, namely in Jakarta, which is limited from the train station to Soekarno Hatta Airport and in the city of Palembang with the aim of succeeding the Asian Games, but not yet oriented to TOD. in investment, because shares will be offered to property investors on the development of mix use. Transit oriented development (TOD) aims to improve the development of mass transportation systems in big city cities and develop areas around TOD and minimize vehicle movement using private vehicles [4,5]. In addition, the TOD concept is also to suppress the development of sprawl. This study aims to address urban problems that are the trend of apartment construction and mix use development as well as congestion impacts as a result of the mix use development in developing countries, especially cities in Indonesia which have the concept of Satellite city / independent city by modeling LRT development with the TOD concept. Semarang as a study location has satellite cities with the development of sprawl in the periphery areas as shown in Figure 1 (a) and 1 (b), while the development of transportation infrastructure has also not been able to overcome the congestion indicated by the main road network $DS > 0.75$ seen in Figure 5.

2. Research Methods

This study uses a mixed method, namely descriptive exploratory method in collecting primary data in the form of sessioners in the study area of sub-urban service areas and urban LRT route plans, while quantitative methods are used in the collection of existing movement patterns and characteristics of the TOD concept area. The simulation method is used to model the potential of movement patterns with the TOD concept in LRT construction.

3. Results and discussion

3.1. Existing Condition of Study Area

Semarang is the capital city of the province of Central Java and is the fifth largest metropolitan city in Indonesia, has an area of 373.70 km² and the population of Semarang City until 2016 was recorded at 1,729,428 people (BPS Kota Semarang, 2017) with the largest population located in Pedurungan District, which is 175.77 people. The city of Semarang has a new city / secondary city, namely Mijen and Ngaliyan, which is located west of the city of Semarang with a higher growth of around 1.84 -3.04% per year, and the Tembalang area with a growth of 3.77% and kec. Banyumanik with a growth of 1.07% per year which is located in the South of Semarang City as shown in Figure 1 (a), 1 (b), but if seen from the density of sub-urban area buildings shown in Figure 2, the number of houses is highest in kec. Pedurungan 56,569 houses, followed by Kec. Tembalang 33,512 houses, kec. Banyumanik 23,446 houses, kec. Ngaliyan 26,662 houses, Kec.Mijen 14,221 and Kec. Gunungpati 14,499 houses. Differences in the growth of the number of houses and residents of the sub-urban area (Secondary City), due to the Kec. Tembalang has Diponegoro University and currently in 2018 the mix use starts to be built in the form of apartments and facilities. Likewise in kec. Gunungpati accelerates the growth of home buildings due to the Semarang State University, while in the district. Mijen and its position are close to the kec. Gunungpati is a new city of BSB City, apart from being a new city it has

also developed into a tourist area. While the development of the toll road transportation infrastructure in the city of Semarang, namely toll roads section a, b, and c facilitate the movement of residents from satellite / secondary cities city to the city center and vice versa. This condition is supported by the results of the existing traffic conditions survey, which experienced congestion in almost all road networks linking the suburbs to the city center.

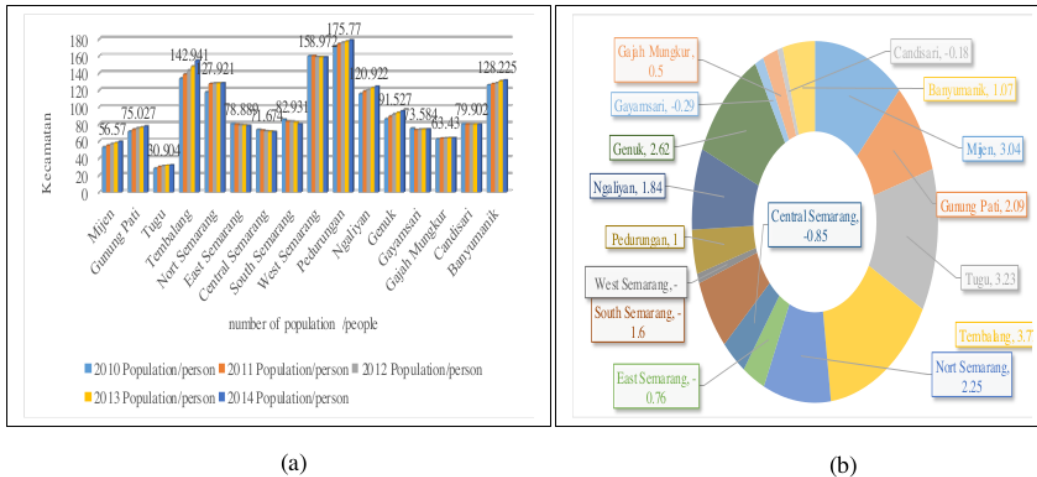


Figure. 1 (a), 1 (b) Population Growth of Semarang City and Secondary City Th 2010-2014

Source: Semarang City Statistic Center, 2015

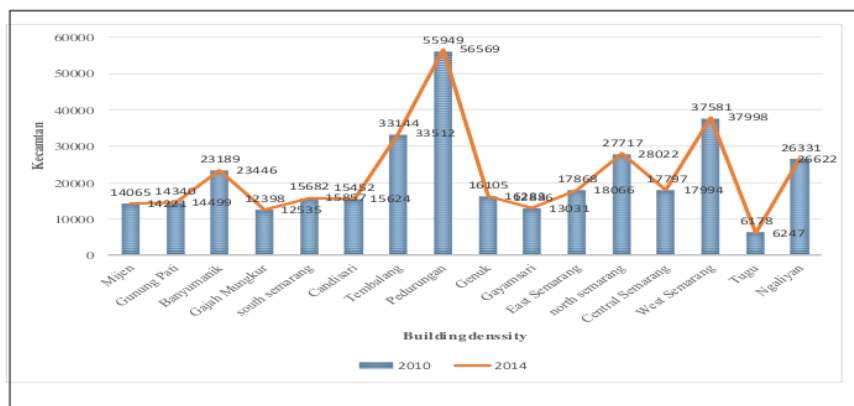


Figure. 2 Graph of Density of House Buildings, Semarang City in 2010 - 2014

Source: Semarang City Statistic Center, 2015

Semarang as a study location in the use of space for apartments and mix use buildings refers to Law No. 20 of 2011 concerning Flats. Article 3 states the purpose of the implementation or utilization of flats, namely:

Ensuring the realization of livable and affordable flats in a healthy, safe, harmonious and sustainable environment: 1) Creating integrated settlements to build economic, social and cultural resilience; 2) Improve the efficiency and effectiveness of space and land use, and provide green open space in urban areas; 3) Creating a complete and harmonious and balanced settlement area by taking into account the principles of sustainable and environmentally sound development; Reducing area and preventing the emergence of housing and slums; Directing the development of urban areas that are harmonious, balanced, efficient and productive.

Regional regulations governing the use of space for apartments are the Semarang City Regional Regulation No. 14 of 2011 concerning the Semarang City Spatial Plan for 2011-2031. Article 119 paragraph (3) states the general provisions of zoning regulations in residential areas as referred to in paragraph (1) letter b. Housing development with vertical buildings (flats / apartments) carried out in the downtown area (BWK I, BWK II and BWK III) can be seen in Figure 4. Semarang Mayor Regulation No. 9 of 2015 concerning Semarang City Local Government Work Plan (RKPD) 2016 Page II.132. The use of space for residential, trading and service areas is carried out in the downtown area (Central Business Distric / CBD). Development of settlement activities in this region is carried out vertically with the pattern of flats / apartments / condominiums. According to Marlita (2008) Purba (2017), apartments are buildings that contain several residential groups, in the form of flat houses or terraced tenements which are realized to overcome housing problems due to the density of occupancy rates and limited land at affordable prices in urban areas. It can be seen from the policy of settlement and apartment development as well as the mix use development that is being developed, especially in the city of Study, namely the city of Semarang as stated in the Semarang Mayor Regulation No. 9 of 2015 concerning the Semarang City Regional Government Work Plan (RKPD) in 2016, that mix use development was centered in the center of Semarang. However, the apartments have been built and are being built in Semarang, namely: Best Western Star Hotel located on Jalan MT Haryono, Candiland Apartement located on Jalan Diponegoro, Sentraland Apartement located on Jalan Ki Mangun Sarkoro, MG Suites located at Jalan Gajah Mada, Paltrow City Apartment in Jalan Prof. Soedharto (suburb) The Akavia Mansion on Jalan Prof. Dr. Hamka (Suburb) Louis Kienne located on Jalan Ahmad Yani (city center) Marquis de Lafayette located on Jalan Pemuda seen in figure 5 and 6. It seems that the program implemented by the Semarang city government is not in accordance with the reality in the field, because the mix use construction is centered in the city center namely BWK I, II and BWK III (Figure 3), while currently the development of mix use is rampant in the outskirts of Semarang city.

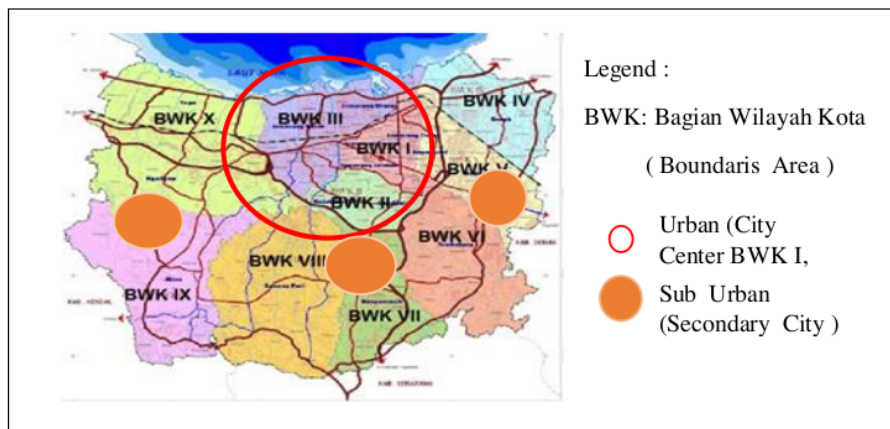
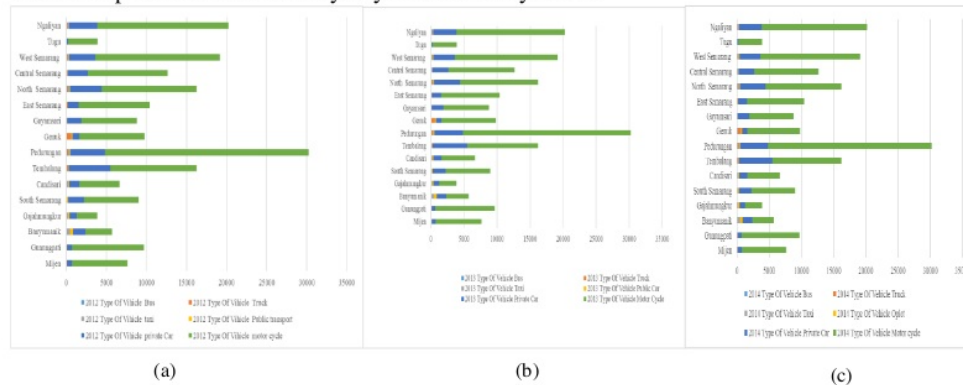


Figure. 3 Semarang City Study Location with BWK Distribution (City Area / boundary area).
Source: <http://dppad.jatengprov.go.id>

In Figure 4 (a), (b), (c) also seen the development of the number of vehicles in the city of Semarang from 2012 to 2014 dominated by private vehicles in the form of motorcycle and four wheels, traffic jams are also supported by the results of the existing degree of Saturation calculation the primary and secondary road networks in the city of Semarang averaged > 0.75 which indicates that the city of Semarang has congestion problems in the condition of 2017 (Figure 5), which is now the rise of mixed use development in the secondary city and in the city center.



Source: Semarang in Figures, 2015

Figure. 4 Growth of the number of vehicles in the city of Semarang in 2012-2014

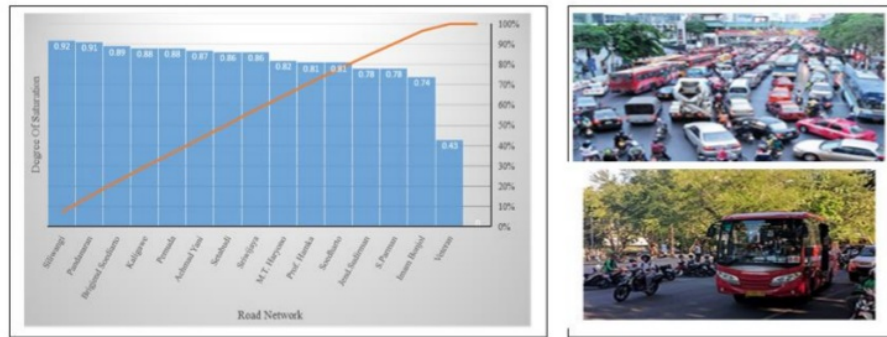


Figure. 5 Existing Conditions of Semarang City Main Road indicated by degree of Saturation (DS) in 2017

It can be seen that with the development of apartment development in the city of Semarang both in the city center and in the secondary city, it has an impact on serious transportation problems, namely almost all major networks in the city of Semarang from the suburbs to the city center with a congestion index of Degree of Saturation > 0.75 exceeding that required in PKJI 2017, shown in Figure 5.

3.2. Development of LRT Development Model with TOD Concept on Urban and Satellite Cities
 3.2.1. TOD Development Principles

TOD-oriented development, is an effort to overcome transportation problems by getting used to using public transportation and suppressing sprawl development. The success of TOD oriented mix-use

development has several requirements, including the fulfillment of 5D: high building-oriented density, mobility efficiency, pedestrian, network interconnection, open space as a place for social interaction of the transit point environment. While Semarang City shows sprawl sub urban development, shown in Figure 6 (a) and Table 1, that all 3 suburbs are in the city of Semarang Kec. Pedurungan, Kec. Tembalang, Kec. Banyumal; Kec. Ngaliyan and Mijen are fulfilled as a transit oriented LRT development model (TOD).

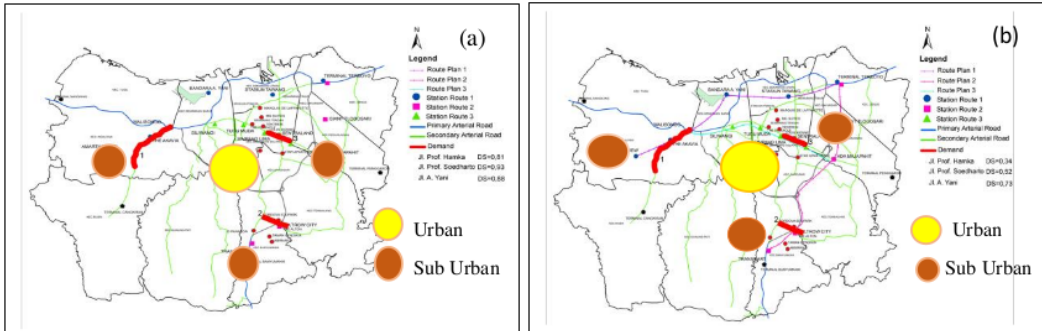


Figure. 6 (a) Travel Pattern Before Development of LRT Development Model with TOD Concept in Satellite City

Figure. 6 (b) Potential Movement Pattern After Development of LRT Development Model with TOD Concept

Source: RUTRK Semarang City BAPEDA TK I, improved Source :Ismiyati Ismiyati, et al, 2018
Ismiyati Ismiyati et al, 2018.

3.2.2. The results of the LRT Development Model Development Simulation with the TOD concept on Urban and Sub Urban.

Exploration Results with a questionnaire conducted at the Semarang City study location, and after being tested for validity and reliability, the instrument was used as a basis for simulating the LRT development model with the TOD concept in Urban and sub-urban areas. The simulation results with the LRT development model with the TOD concept in the city of Semarang as the study city, namely in urban and sub-urban areas showed a change in travel pattern indicated by the degree of saturation (DS <0.75) smaller than the value before the TOD model was applied with LRT visible in Figures 6 (a) and 6 (b) The development of the LRT development model with the TOD concept changes the habits of sub-urban communities using public transport, and increases pedestrians, besides that the development of this model will control the development of sprawl in sub-urban areas and make cities low pollution towards sustainable transportation is shown in Figure 6 (b) and Table 1 (Simulation Results).

Table 1. Simulation of changes in the Travel Pattern of the LRT Development Model with the TOD Concept in the Secondary City Region

Lokasi Transit TOD	Urban and Environmental Criteria	Distance to the Shelter Plan	Trans Semarang corridor (BRT)	Traffic Conditions Before the development of TOD	Results of Traffic Conditions Simulation after TOD development
Mix Use area	Suburban -Apartemen - central business - Residential Area - Shopping center - tourist attraction	Shelter: -Amartha View Apartment -The Akavia Apartment Distance to : -BSB City Semarang: 4,6 km -IAIN Walisongo: 1,7	Trans Semarang Koridor IV (Stasiun Tawang – Cangkiran Terminal)	Jl. Prof. Hamka Degree Of Saturation (DS) = 0,81	Prof. Hamka street -DS = 0,34
Kec. Tembalang and Kec. Banyumanik -Paltrow City Apartment -The Alton Apartment -Abimanyu Apartment -Cordova Edupark - Diponegoro University Campus Tembalang -Politeknik Negeri Semarang -Poltekkes Semarang -Transmart Setiabudi -Ada Setiabudi -Banyumanik Terminal -Sukun Terminal Population Density: -Kec. Tembalang: 4.394 people /km ² -Kec. Banyumanik: 6.072 people/km ²	Suburban -Apartemen - education center -Shopping Center -Residential Area - health center - trading center	Shelter: -Paltrow City Apartment - Setiabudi Transmart Distance to: -The Alton Apartment: 350 m -Abimanyu Apartment: 1,4 km -Cordova Edupark: 750 m -Diponegoro University Campus: 850 m -Politeknik Negeri Semarang: 500 m -Poltekkes Semarang: 650 m -Ada Setiabudi: 900 m - Banyumanik Terminal : 700 m -Terminal Sukun: 700 m	-Trans Semarang II Corridor (Sisemut terminal – Terboyo Terminal) -Trans Semarang VI corridor (Diponegoro University– university of Negeri Semarang)	Prof. Soedharto street. -DS = 0,93	Prof. Soedharto street -DS = 0,52

Kec.Pedurungan	Suburban	Shelter:	-Trans Semarang I	Ahmad Yani	Ahmad Yani
-Giant Tlogosari	- Residential area	-Giant Tlogosari	Corridore	-DS = 0,88	Street
-Semarang	- residential	Distance To:	(Mangkang		-DS = 0,53
-Ada Majapahit	- Shopping center	- Semarang	Terminal –		
-Lotte Mart	- trading center	University = 1,4	Penggaron		
Majapahit	- Home industry	km	Terminal)		
-Superindo		- Sun Rise Hotel,			
Majapahit		Soekarno Hatta			
Population Density		Street			
-Kec. Pedurungan:		- Ada Majapahit =			
9,439 people/km ²		3,7 km			
		- Dalu Hotel,			
		Majapahit Street			
		- Lotte Mart			
		Majapahit Street=			
		2 km			
		- Superindo			
		Majapahit = 120 m			
		- Superindo Jl.			
		Soekarno Hatta			

4. Conclusion

The results of research conducted in the city of Semarang as an urban sample that has satellite cities in developing countries such as Indonesia, shows that the development of the LRT development model with the TOD concept will be successful towards sustainable transportation. The simulation results also show a change in the pattern of travel behavior from private vehicles to public transportation, this condition is indicated by the degree of saturation <0.75, which means that traffic at the sub urban / secondary city transit points is smooth (table 1) and the community starts changing lifestyles using a private vehicle turns into a public transportation user community. The results of the study recommend that the LRT development model with the TOD concept can be applied to cities that have satellite cities, as well as controlling the development of sprawl to the suburbs, which has never been discussed in urban areas in developing countries.

5. Acknowledgement

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