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Article

Creating Added Value for Urban Transit in Developing Country: A Case Study of Transit-Oriented Development Project

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Abstract. Transit-Oriented Development (TOD) is an approach of regional development in which there is a concept of integration between land, transportation, environment, and use. However, as a new idea in Indonesia, the development of TOD cannot be found yet. the TOD project for Jakarta LRT is the first idea for TOD implementation in Indonesia. From the results of the initial evaluation, it was found that the prepared TOD design of Jakarta LRT still refers to the development of conventional apartment buildings. The implication of this practice is that the benefits of TOD are not utilized, and regional development will not be in line with expectations. This research aims to improve the function of the project while fulfilling the characteristics of TOD by producing alternative designs that have added value. To achieve this goal, Value Engineering studies are used as the methods. After the benchmarking with case studies are done, the process of developing the existing TOD design is then carried out. As a result, the design of the conceptual development of TOD for Jakarta LRT is proposed as an alternative to the conventional property development, in which the benefits of TOD implementation can be obtained.

Keywords: Transit-oriented development, value engineering, property.

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1. Introduction

The life of urban dwellers cannot be separated from travelling activity moving them from their residence to their place of activity and vice versa. If the majority chooses to use private vehicles, hence tho increasing number of trips will also increase fuel energy use, pollutant emissions, and cause traffic congestion as well. This will cause a negative impact on the quality of life in the city [1].

The development of the Jakarta LRT is one of the Government's efforts, through Presidential Regulation No. 98 of 2015, in addressing Jakarta's congestion problem that keeps adversely affecting the economic and social activities of the capital. Congestion is caused by the fact that private motorized vehicles are still the most preferred type of public transportation modes in Jakarta. This is supported by the data showing that the users of the Jabodetabek KRL commuter train connecting Jakarta to its satellite cities are only 1.01 million people per day, while the number of registered Jabodetabek residents is 31.7 million. In other words, only 3% of its population uses the commuter train per day. In contrast to Singapore, MRT transportation users reach around 55% of the total population.

The effective use of public transportation will provide more sustainable benefits both in terms of transportation and urban planning. One approach to regional development in which there is the concept of integration of land-transportation-environment use is Transit-Oriented Development (TOD) [2]. TOD is the development of an area around the station or transit stop within a radius that is in walking distance area (approximately 500-800 meters) with at least the characteristics that include mixed-use, medium to high density, and pedestrian-friendly [3]. Thus, TOD is an approach that can help reduce the dependence on privately owned motorized vehicles, particularly by promoting transit or active transportation (cycle or walking) as their transportation mode. In addition to it, along with diverse land use and high density and proximity to transit stations, the TOD area, according to its typology, can attract visitors from other regions so that it can increase revenue from transit operations. Therefore, TOD is considered as an effective approach carried out to maximize returns on investment in infrastructure projects [4].

Robert Cervero & Kara Kockelman observed that there are three main criteria that influence transportation patterns for the built environment, which is known as "3D", referring to density, diversity, and design [3]. It was found that built environments with density characteristics, land-use diversity, and pedestrian-oriented designs generally can reduce trip rates and encourage non-auto travel in statistically significant ways. Moreover, Ewing & Cervero [5] developed this criteria by adding destination accessibility and distance to transit, hence it was called "5D".

There are slight differences in the focus of developing TOD in the world nowadays. American countries tend to develop TOD by re-concentrating urban development around the transit station. Meanwhile European countries re-developed existing areas around the station. Furthermore, Asia views TOD as a formula for the corridor of mass public transportation connecting the development of mega-urban areas, since the strategy to connect the development of dense urban areas around the station area is the main key [6]. But as a new idea in Indonesia, the development of TOD cannot be casually found yet. However, the development of TOD projects for Jakarta LRT is the first notion of TOD development in Indonesia. In line with the realization of the development of the Jakarta LRT, the potential for the implementation of TOD is starting to feel relevant to be implemented (the Jakarta LRT Route can be seen in Fig. 1.)

From the results of the initial evaluation carried out in the literature study, the documents of feasibility study and other TOD project precedents, it was found that the existing prepared TOD designs for the Jakarta LRT still refers to the development of conventional apartment buildings [7]. The implication of this practice is that the benefits of TOD are not utilized, and regional development will not be in line with expectations.

This study aims to improve the function of the TOD project while still fulfilling the characteristics of TOD in order to come up with alternative TOD designs that have added value. The results of this research are expected to be an input for the launched TOD projects itself as well as for implementers or practitioners who are interested in developing TOD concept in the future.

The method used in this study is Value Engineering (VE) as a method. VE is an application of a systematic process that involves various disciplines to increase the value of a project through analysis of its functions [8]. VE has been widely applied in development projects abroad as well as infrastructure development in Indonesia. One example of successful VE implementation in infrastructure development planning in Indonesia is the Sunda Strait Bridge megaproject, the funding feasibility of which can be improved by adding innovative functions such as tidal power, fiber optic information networks as well as the development of surrounding areas [9]. By implementing VE approach to areas developed with TOD principle, effective and optimal schematic plans is expected to able to be achieved.

1.1 TOD Typology

Even though the concept of TOD is well established and can already be implemented generally, the implementation of TOD should still consider certain circumstance of an area. This circumstance is difficult for city planners and policy makers because of the heterogenous condition of each transit station. A solution that can be used to simplify the complexity of each train station's condition is by establishing the typology of TOD [4]. The city planners and policy makers can formulate the appropriate and focused strategies in line with the

characteristics of the typology of the area, therefore the actions of implementation such as investment decision for regional development that can effectively solve problems in each type [10].

Peter Calthorpe divides TOD with a normative approach into two types of TOD, namely urban TOD and neighborhood TOD [11] (see Fig. 2). On the other hand, the municipality of Denver (USA) develop the categorization of TOD by dividing it into seven types of TOD: downtown, major urban center, urban center, urban neighborhood, commuter town center, main street, dan campus/special events [12]. The same approach was also implemented by the government of Queensland (Australia), with its six types of TOD, namely city center, activity center, specialist activity center, urban, suburban, dan neighborhood [13]. These TOD typologies and their standard characteristics can be seen in Table 1.

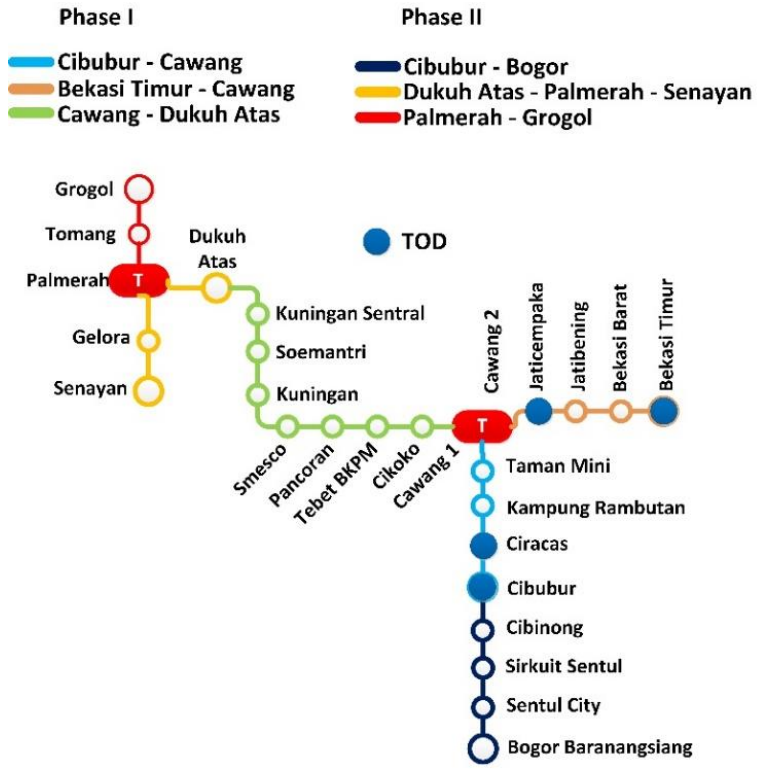

Fig. 1. Jakarta LRT lines.

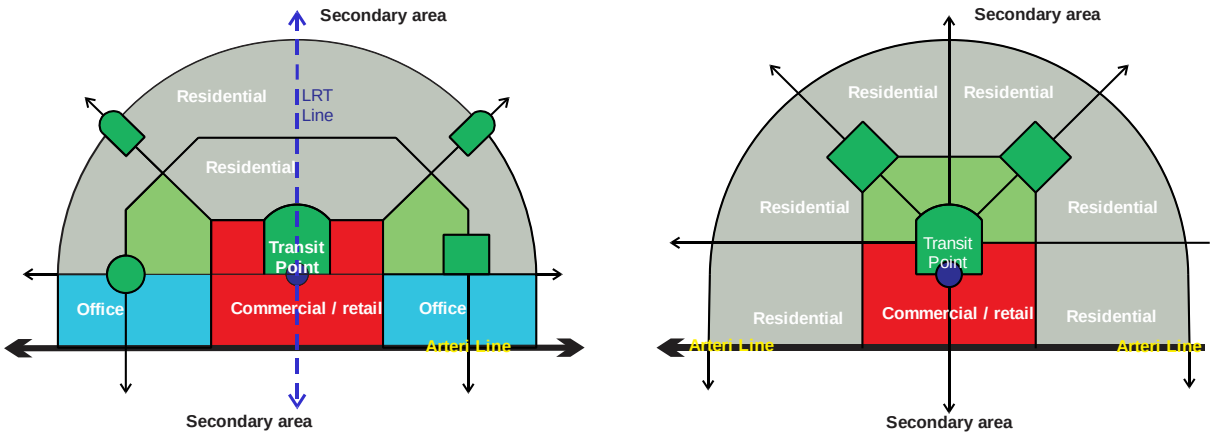

Fig. 2. Illustration of TOD typology according to Peter Calthorpe, urban TOD (right) dan neighborhood TOD (left) [11].

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Table 1. TOD Typology.

No.	Reference	Type	Characteristics	
1	Peter Calthorpe [11]	*urban TOD*	Public	5% - 15%
			Commercial/Office	30% - 70 %
			Residential	20% - 60%
		neighborhood TOD	Public	10% - 15%
			Commercial/Office	10% - 40 %
			Residential	50% - 80%
2	The municipality of Denver [12]	*downtown*	Desired land use mix	Office, residential, retail, entertainment, and civic uses
			Desired housing types	*Multi-family*, *loft*
			Commercial employment types	*Prime office*, *shopping location*
			Proposed scale	Five stories and above
		major urban center	Desired land use mix	Office, retail, residential and entertainment
			Desired housing types	*Multi-family, townhome*
			Commercial employment types	Employment emphasis, with more than 250,000 sf office and 50,000 sf retail
			Proposed scale	Five stories and above
		urban center	Desired land use mix	Residential, retail and office
			Desired housing types	*Multi-family, townhome*
			Commercial employment types	Limited office. Less than 250,000 sf office. More than 50,000 sf retail
			Proposed scale	Three stories and above
		urban neighborhood	Desired land use mix	Residential, neighborhood retail
			Desired housing types	*Multi-family, townhome and small lot single family*
			Commercial employment types	Local-serving retail. No more than 50,000 sf
			Proposed scale	2–7 stories
		Commuter town center	Desired land use mix	Office, retail, residential
			Desired housing types	*Multi-family, townhome, small lot single-family*
			Commercial employment types	Local and commuter- serving. No more than 25,000 sf
			Proposed scale	2–7 stories
		main street	Desired land use mix	Residential, neighborhood retail
			Desired housing types	*multi-family*
			Commercial employment types	Main Street retail infill
			Proposed scale	2–7 stories
		campus/special events	Desired land use mix	University Campus, Sports Facilities
			Desired housing types	*Limited multi- family*
			Commercial employment types	Limited office/retail
			Proposed scale	Varies

2. Methodology

The stages of the VE study were adopted as a methodology in this research. The information phase is the first stage of the VE study. In this phase information about the Jakarta LRT TOD project is collected as much as possible. There are 4 stations that will be developed into TOD namely Bekasi Timur, Cibubur, Ciracas and Jaticempaka. Likewise, information on TOD projects that have succeeded in the world today will become a reference in implementing VE studies. Study literature, Focus Group Discussion (FGD), Benchmarking and case studies are ways and methods to gather the information above. The function analysis phase is the next VE Study stage. In this phase, the TOD-related functions will be identified and then logically connected with the help of the FAST (Function Analysis System Technique) diagram (see Fig. 3) [14]. In the creativity phase, a brainstorming process is carried out based on previously collected information and resources with the aim of increasing the value of the project. The increase in value marked by the addition of functions is described in the previous FAST updated diagram. The end of this process is an alternative design proposal for the TOD project of Jakarta LRT.

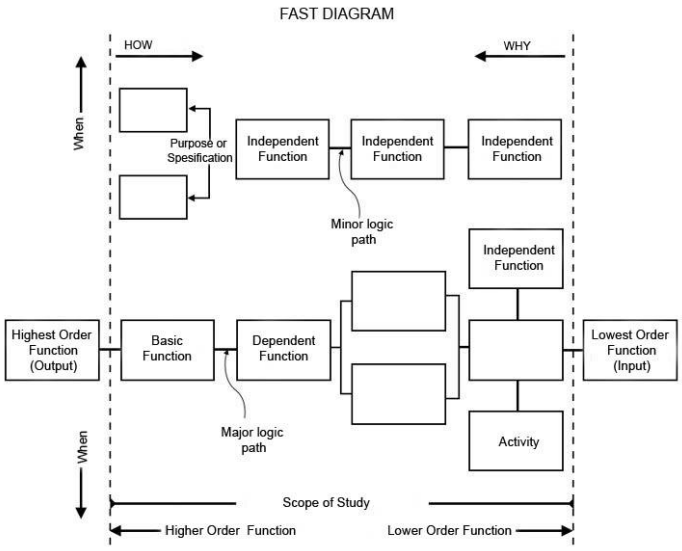

Fig. 3. The Basic FAST Diagram.

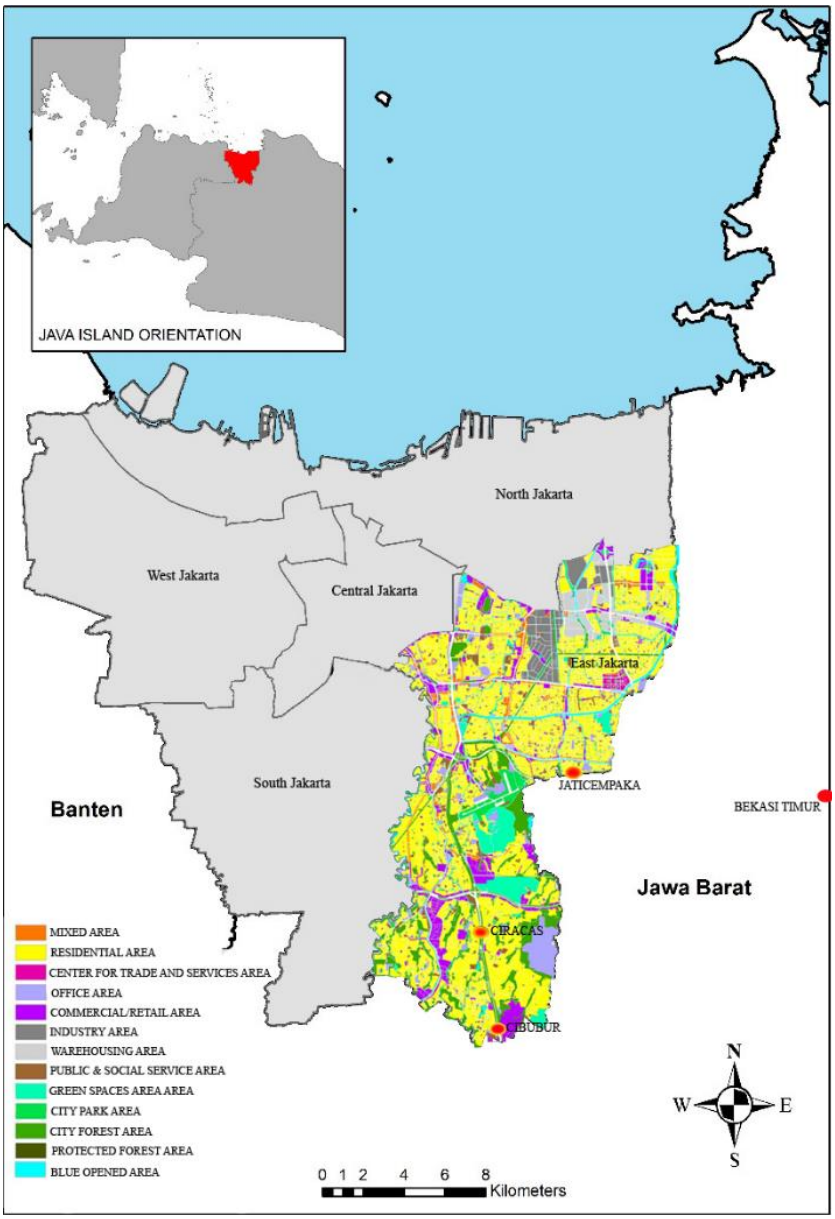

Fig. 4. Maps of East Jakarta's land use (Source: Document of Jakarta 2030 Regional Spatial Plan).

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3. Result and Discussion

3.1. Existing TOD Project of Jakarta LRT

The main objective of this project is to support the procurement of the Jakarta LRT project, and besides that, it is also expected that the development of TOD can reduce dependence on private vehicles and increase public interest in the use of transit modes.

After the ratification of the Jakarta 2030 in August 2011, one of the policies of spatial developments in DKI Jakarta is to prioritize the development of cities towards the east, west, and north corridors and limit development to the south in order to achieve an ecosystem balance.

The development of Ciracas, Cibubur, Jaticempaka and East Bekasi TODs refers to the Jakarta 2030 Regional Spatial Plan and the regulation of Bekasi city planning office regulation, the location of the development will be designated for urban settlements and trade and service centers (see Fig. 4).

In general, the information obtained from the document of feasibility study is as follows. The development of the Jakarta TOD is within the distance of approximately 400 meters from each LRT station.

Bekasi Timur TOD will be built in an area of 5 hectares with a gross floor area (GFA) of 178,100 square meters, most of which were apartments and the rest were retail areas (shopping centers) (see Figs. 5-6).

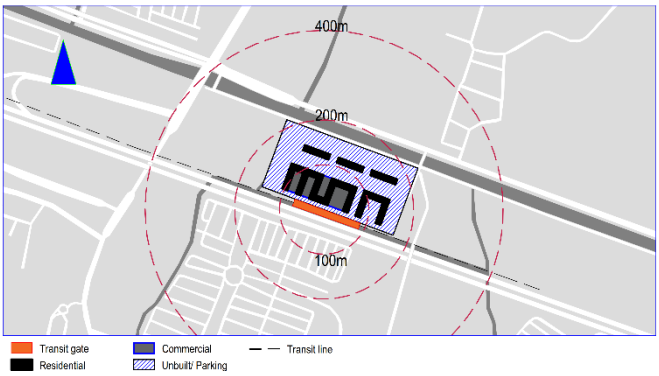

Fig. 5. Layout of existing Bekasi Timur.

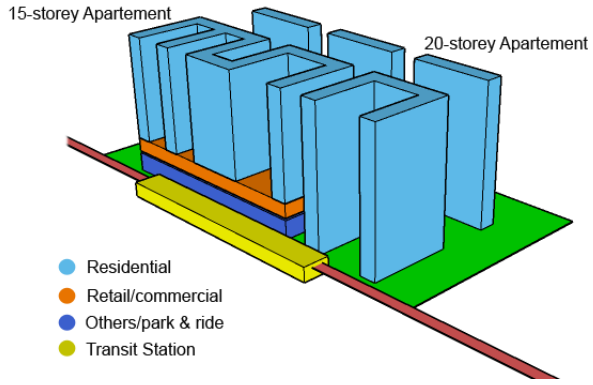

Fig. 6. Perspective view of the existing Bekasi Timur TOD

Cibubur TOD is located in an area of 1.5 hectares with GFA of 55,588 square meters, which 94% of the building area (55,000 m²) are apartments; the remaining 6% are shopping (retail) (see Figs. 7-8).

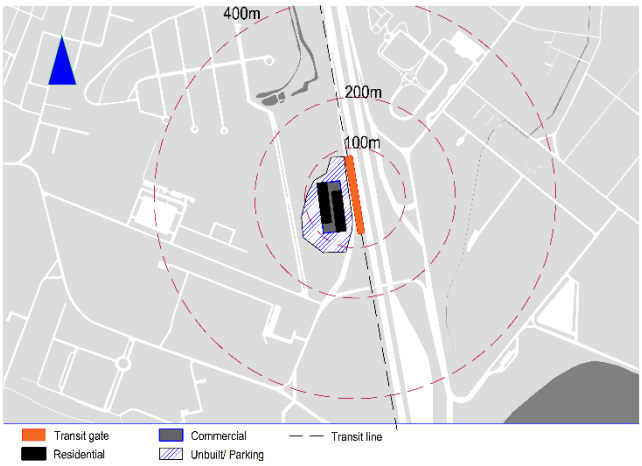

Fig. 7. Layout of existing Cibubur TOD

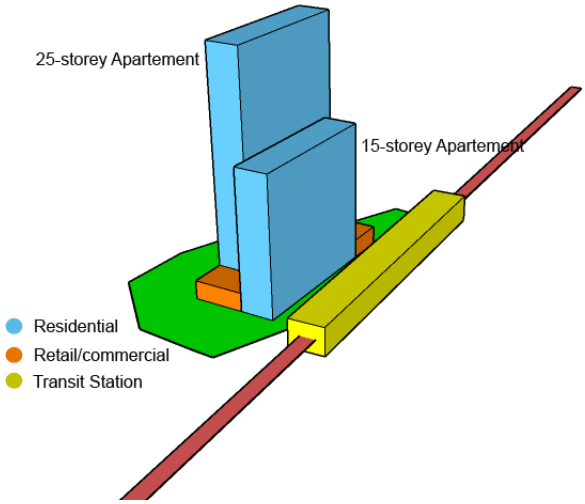

Fig. 8. Perspective view of existing Cibubur TOD.

Furthermore, TOD Ciracas has an area of 12.23 hectares with a total GFA of 286,710 m2, 72% of which is residential (see Figs. 9-10).

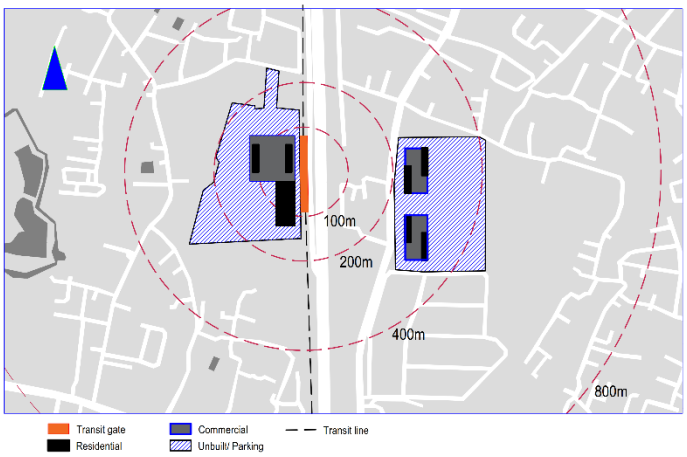

Fig. 9. Layout of existing Ciracas TOD.

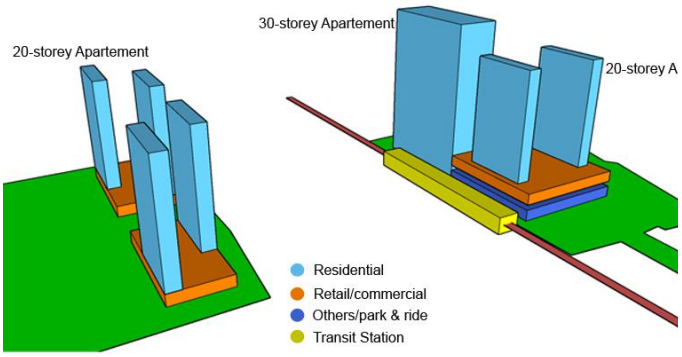

Fig. 10. Perspective view of existing Ciracas TOD.

And the last is Jaticempaka TOD with a land area of 53,574 m2 and a total building area of 138,007 m² (see Figs. 11-12). The entire existing TOD design focuses a lot on developing multi-storey apartments (see Table 2 and Fig. 13).

As it has been mentioned before; there are five criteria that characterize the TOD, which is usually called as 5D (Density, Diversity, Design, Destination accessibility, Distance to transit). Density is the level of compactness and efficiency of land use in the development area. This can be seen from the floor area ratio (FAR) and building coverage ratio (BCR) values in the area. FAR describes the ability of one development to accommodate the size of the floor area on the available land area [15]. While BCR measures the use of the land area for building sites. From the results of benchmarking the world's best TOD, it was found that for a minimum value of FAR 6.57 and BCR 80%. Whereas Diversity illustrates the variety of land use and space in the TOD area. There are at least five development functions that can be concluded from the results of benchmarking TOD including; Residential, Office, Hotel, Retail, and others (parking). For Design criteria, the focus is in the form of regional development that facilitates and supports walking and cycling activities [15, 16]. The condition in question is the presence of pavement with a smooth and comfortable surface when used, as well as designing a route with a minimal bend. From the benchmark, it is also found that pedestrian paths will be better in conditions protected from rain and sunlight, so that not only has an easy path but also meets pedestrian needs to feel comfortable.

Destination accessibility is closely related to design aspects. This characteristic is an implication of the existence of good design, wherewith the realization of a good pedestrian pathway; the accessibility between parts of development can also increase. These characteristic indicators can also be seen from how the development parts are connected to one another. For this condition, transit users can "ride" through the development section and do not need to spin around to reach the destination. from the benchmarks, it was found that there was a general area that became a transition from station to other development parts, such as a commercial area which also served as a circulation area. For Distance to transit, Calthorpe [11] initiates a maximum distance of 2,000 steps or 5 minutes walking distance to reach the farthest destination of development. At present, the determination of the maximum distance depends on the regional development agency and authority, with consideration and results of the study of each in the form of a development radius. In fact, this development radius does not necessarily reflect the actual distance that the transit user (passenger) must take to his destination. The distance travelled further than what is reflected in the development radius. This could be due to a non-integrated design so that transit users have to whirligig to reach the destination or pedestrian paths are inadequate, making it difficult to access development areas.

From the initial information gathered when viewed from a 5D perspective with indicators obtained from the results of benchmarking TOD in the world, it was found that the initial designs of TOD from Bekasi Timur, Cibubur, Ciracas and Jaticempaka points were as follows (see Table 3).

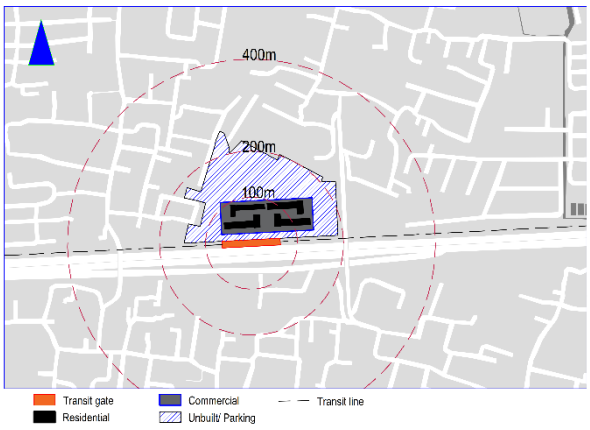

Fig. 11. Layout of existing Jaticempaka TOD

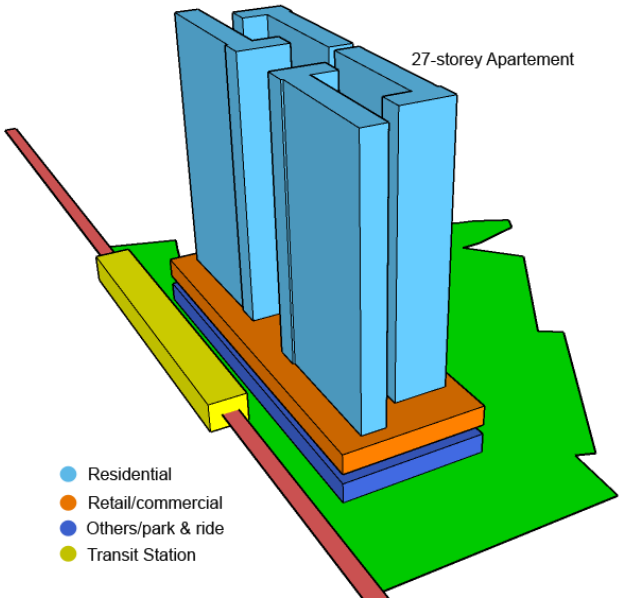

Fig. 12. Perspective view of existing Jaticempaka TOD.

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Table 2. Existing Design of TOD Jakarta.

	Bekasi Timur	Cibubur	Ciracas	Jaticempaka
Land area	50,000 m²	15,000 m²	122,239 m²	53,574 m²
Building area	10,000 m²	4,500 m²	24,672 m²	14,100 m²
GFA	178,100 m²	55,588 m²	286,710 m²	138,007 m²
BCR	20%	30%	20%	26%
FAR	3.56	3.76	2.35	2.60
Residential	150,000 m²	55,000 m²	206,612 m2	116,266 m2
Office	-	-	-	-
Hotel	-	-	-	-
Retail / commercial	10,000 m²	588 m2	18,672 m2	18,600 m2
Others	18,100 m²	-	61,426 m2	33,423 m2

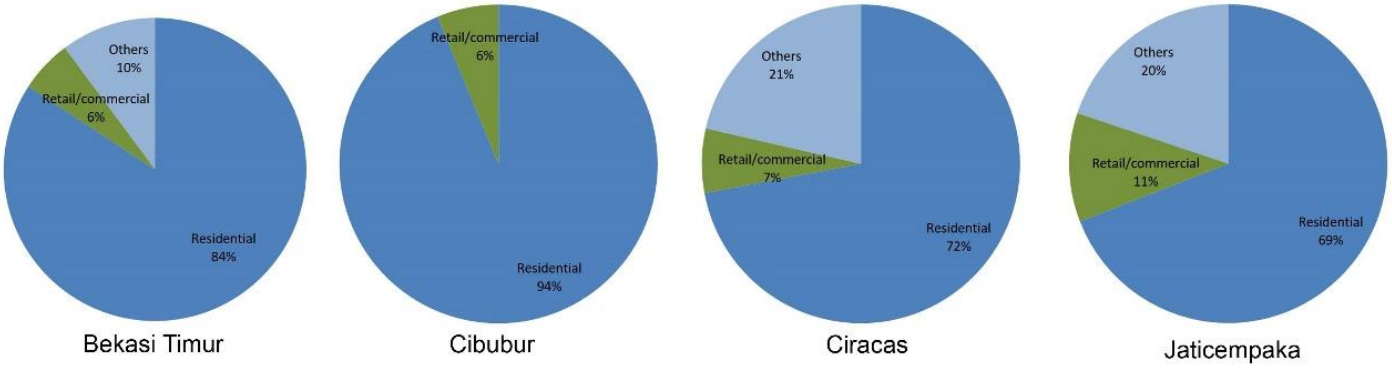

Fig. 13. floor area proportion of TOD Jakarta existing design.

Table 3. Characteristic TOD Jakarta Existing.

Characteristics	Indicator	Bekasi Timur	Cibubur	Ciracas	Jaticempaka
Density	FAR > 6.57	3.56	3.76	2.35	2.6
	BCR > 80%	20%	30%	20%	26%
Diversity	Residential	yes	yes	yes	yes
	Office	no	no	no	no
	Hotel	no	no	no	no
	Retail	yes	yes	yes	yes
	Others	parking	parking	parking	parking
Design	The existence of a pedestrian path	not distinctive	not distinctive	not distinctive	not distinctive
	Protected pedestrian path	not definitely	not definitely	not definitely	not definitely
	Direct access to the station	no	no	under consideration	yes
	Interconnected development section	partially	partially	partially	partially
Destination accessibility	circulation area that connects all parts of the development	no	no	no	not definitely
	The circulation area is open to the public	not definitely	not definitely	not definitely	not definitely
Distance to transit	Actual distance does not differ from the development radius	not definitely	not definitely	not definitely	not definitely

As a result, it was found that the four existing TODs did not reflect the characteristics previously found in the TOD benchmark. All are still not utilizing land use optimally, characterized by FAR and BCR which tend to below, and land use is still too dominated by residential functions

3.2. Jakarta TOD Basic Functions

Function analysis of TOD Jakarta found that its highest order function is Supporting transit system [17–19], lowest order function is increasing revenue, the design objective is Increasing contractor capacity, a Basic function is Increasing transit usage [17,19–21]. The dependent function of TOD Jakarta is to change transportation patterns [22], increase accessibility [23, 24], develop property [25]. While building an apartment and commercial area is the process. The logical relationship of all the functions mentioned above is arranged in the FAST diagram (see Fig. 14).

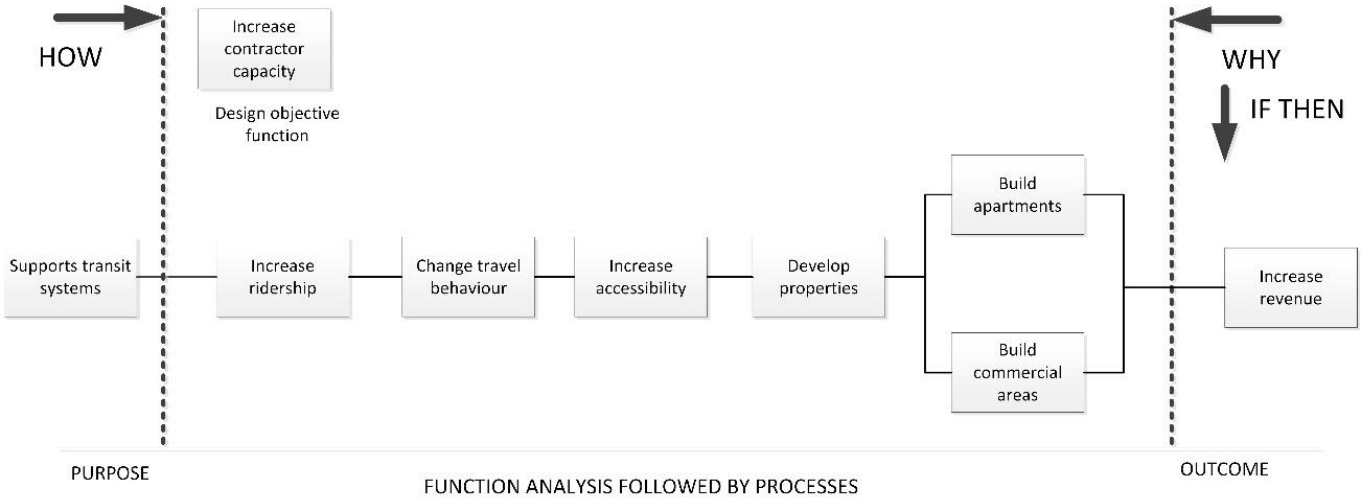

Fig. 14. FAST diagram of TOD Jakarta existing.

3.3. Alternative Design for TOD Jakarta

Through the creative process are made efforts to develop functions that have added value but still fulfil the basic functions of TOD Jakarta. the results of the benchmarking process are used as input to form a conceptual model and as input for analyzing and developing the existing TOD design. The TOD chosen as a benchmark is Union Square in Hong Kong, Namba Parks in Osaka, Japan, and D'Cube City in Seoul, South Korea [7] with the following details (see Table 4).

Table 4. Design TOD *benchmark*.

	Union Square	Namba Parks	D'Cube City	Mean	Range
Land area	135.400 m²	33.700 m2	63.600 m2		
Building area	135.400 m2	28.010 m2			
GFA	1.090.026 m2	243.800 m2	418.140 m2		
BCR	~100%	76%	~100%	92%	76 ~ 100%
FAR	8,05	7,23	6,57	7,29	6,57 – 8,05
Residential	608.026 m2	60.000 m2	110.300 m2	44%	24-56%
Office	231.778 m2	60.000 m2	24.480 m2	18%	6-24%
Hotel	167.472 m2	0 m2	18.360 m2	10%	4-15%
Retail / commercial	82.750 m2	86.000 m2	107.800 m2	16%	8-34%
Others	0 m2	44.700 m2	171.000 m2	12%	18-40%

By examining the characteristics of the 5D TOD benchmark project, a conceptual model of TOD development was made as a reference for improvement in existing designs. The result is a development model with residential, office, hotel, retail / commercial functions and others with proportions, as shown in Fig. 5 that are developed in a solid manner. This is indicated by a minimum of FAR 6.57 and BCR ~ 80% [7].

To fulfil the characteristics of design, destination accessibility and distance to transit, retail / commercial functions and transit stations are integrated into the form of public circulation areas that can be accessed directly.

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This section is shaped like a podium while other functions such as apartments, offices and hotels stand on it, as shown in Fig. 15. With this configuration, transit users can enjoy a comfortable walking path, protected from heat, rain and interconnected to all parts - development section. With the existence of comfortable pedestrian facilities with good accessibility, it is expected to reduce dependence on private vehicles and increase interest in transit use.

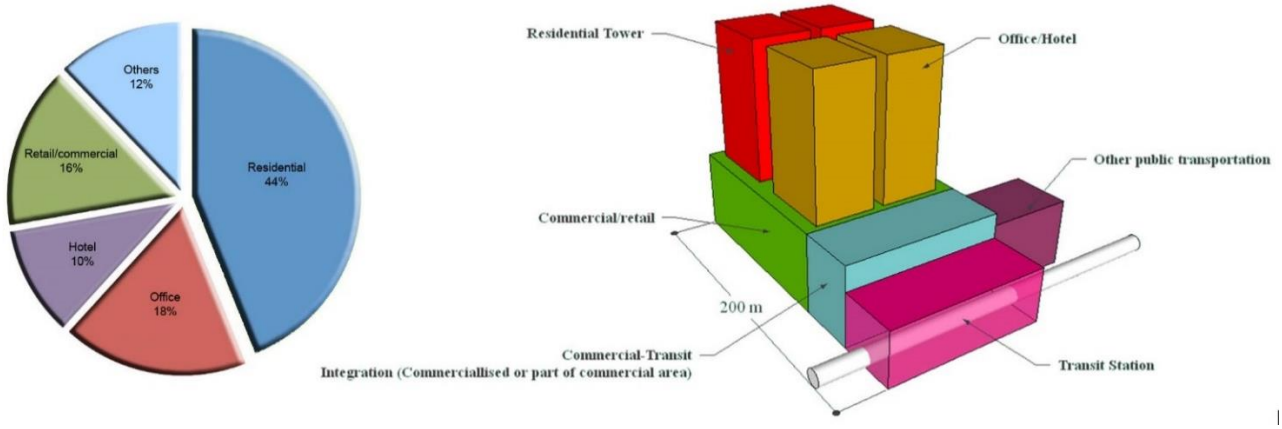

Fig. 15. Model design conceptual TOD.

Then adjustments to the existing design are made based on the conceptual model that has been made. By adjusting the FAR and BCR values, the total effective floor area increases and allows new functions to be added. The dominance of apartment functions in existing designs has changed, and more reflects the mix-use development so that the FAST diagram has changed as shown in Fig. 16.

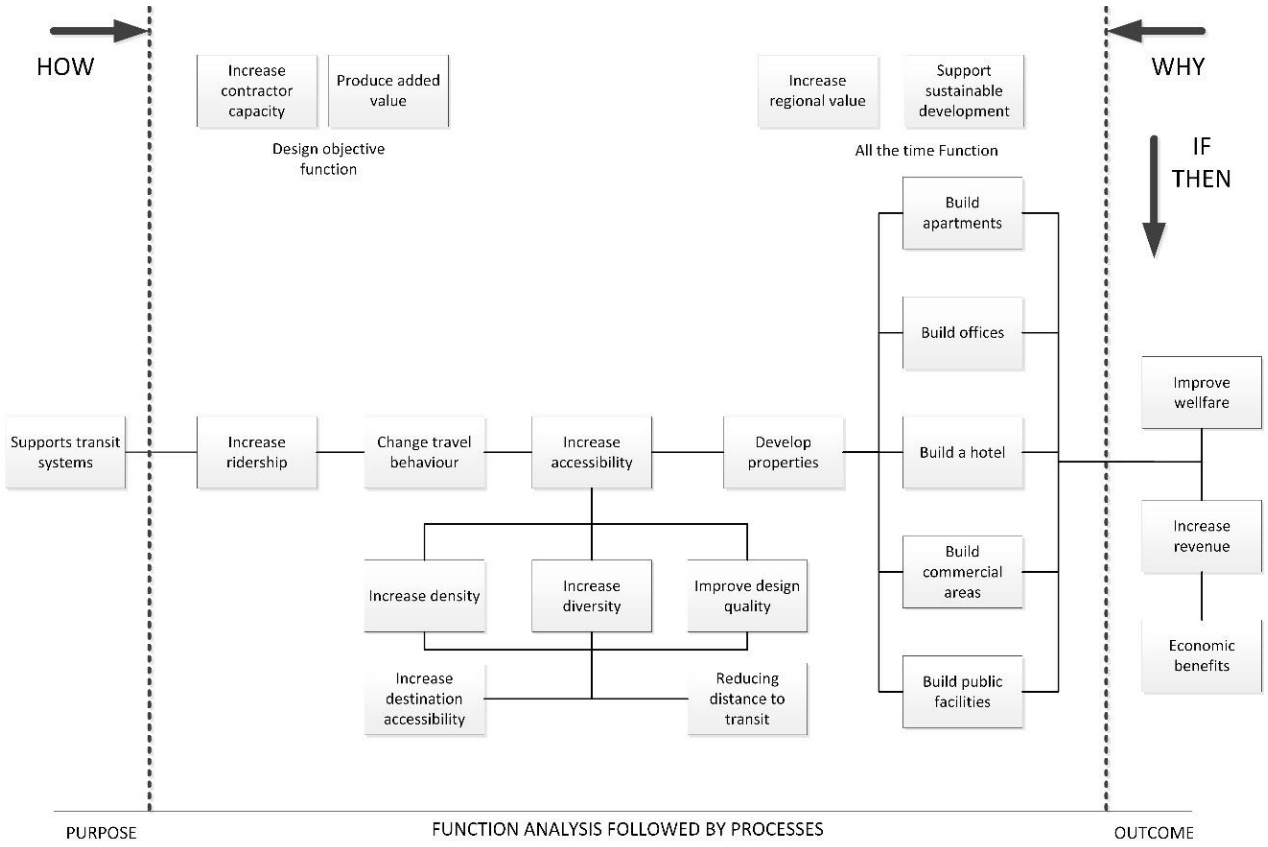

Fig. 16. FAST diagram of conceptual design TOD.

The configuration of the placement of these functions (Fig. 6) is adjusted to the physical model and the proportion of the TOD floor area, as shown in Fig. 5. Design adjustments were made at each of the transit points examined in this research, namely Bekasi Timur, Cibubur, Ciracas and Jaticempaka stations.

3.3.1. TOD Bekasi Timur.

Offices and hotels are new functions added to the design of the TOD. Adjustment of BCR and FAR is made to improve the efficiency of land use, and to realize integrated and solid designs (see Fig. 17). BCR is increased from 20% to 90% and FAR from 3.56 to 7.15. Thus the floor area which was only 178,100 m² has now increased to 357,500 m². 45% of the floor area becomes a residential function in the form of an apartment. 18% are offices, 11% are hotel functions, and 13% are retail areas. The remaining 13% is used for park & ride. The previously scattered TOD parts are made solid and centred on the station. Apartments, offices and hotels stand above the retail area that is connected to the transit station.

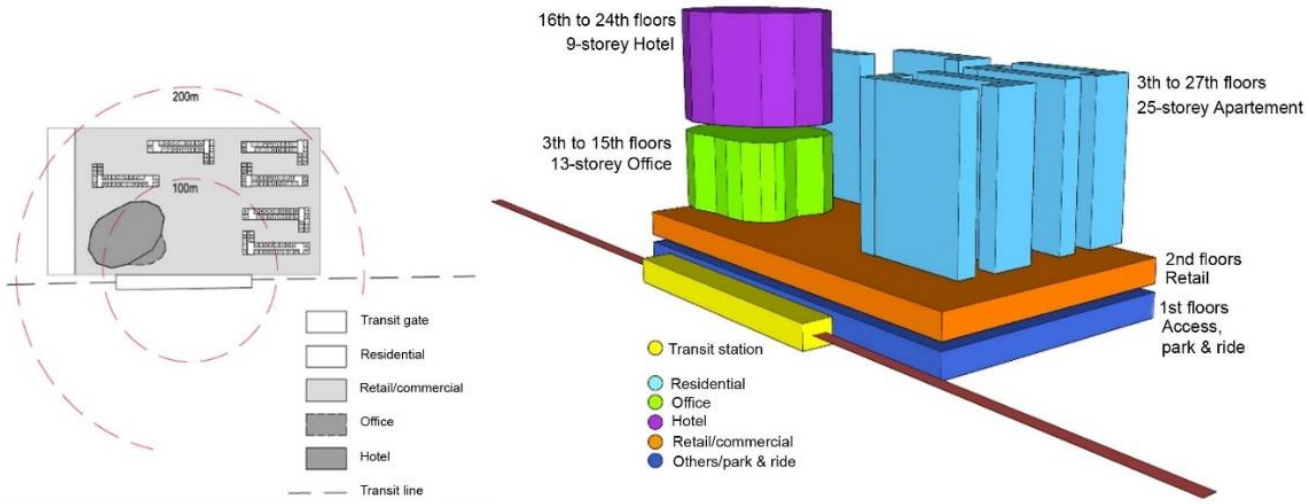

Fig. 17. Alternative design of TOD Bekasi Timur.

3.3.2. TOD Cibubur.

With the addition of functions, some adjustments will be made to the new conceptual design. To improve land-use efficiency, and to realize an integrated and compact design so that it is easily accessible, adjustments are made for BCR and FAR. BCR increased from 20% to 87%. FAR increased from 3.56 to 7.02. Thus the floor area which was only 55,558 m² has now increased to 98,760 m². 46% of the total area, or 45,360 m², is a function of housing in the form of apartments. 18% or 18,000 m² became offices and 11% or 10,800 m² became hotels. The rest, 12,300 m² or 12% is used for park & ride. The low BCR value in the existing design results in the spread between the development parts and the transit station, so there are open areas between the sections. Adjusting to the benchmark model, the new design of apartments, offices and hotels is built on retail buildings (see Fig. 18). That way the accessibility between stations and parts of the development can be increased even though there is an increase in the floor area of the building.

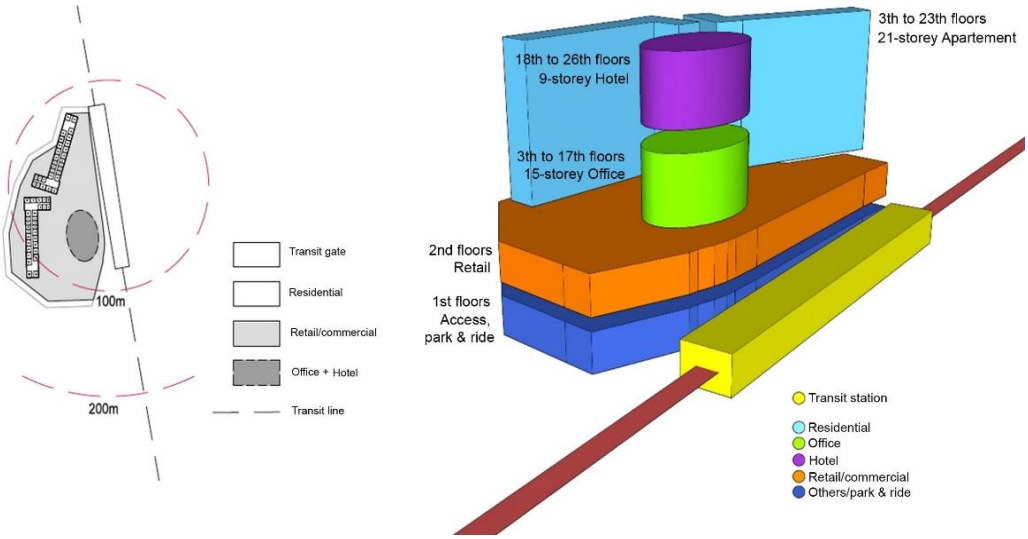

Fig. 18. Alternative design of TOD Cibubur.

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3.3.3. TOD Ciracas.

In addition to adding new functions, namely offices and hotels, TOD Ciracas proposed a connecting bridge between the development areas. This is because the area is separated by a toll road. On both sides of the development established commercial retail and park & ride facilities. On the west side, offices and hotels are built above retail buildings. While on the east side, an apartment is also built above the retail building (see Fig. 19). To maximize land use, the BCR was changed from 20% to 89%. FAR increased from 2.35 to 6.27. Thus the floor area that had been 286,710 m² has now increased to 769,280 m². 30% of the area or 233,280 m² are residential functions in the form of apartments. 17% or 127,500 m² as offices and 10% or 80,000 m² as hotels, 29% or 219,000 m² as retail areas. The rest, 109,500 m² or 14% is used for park & ride.

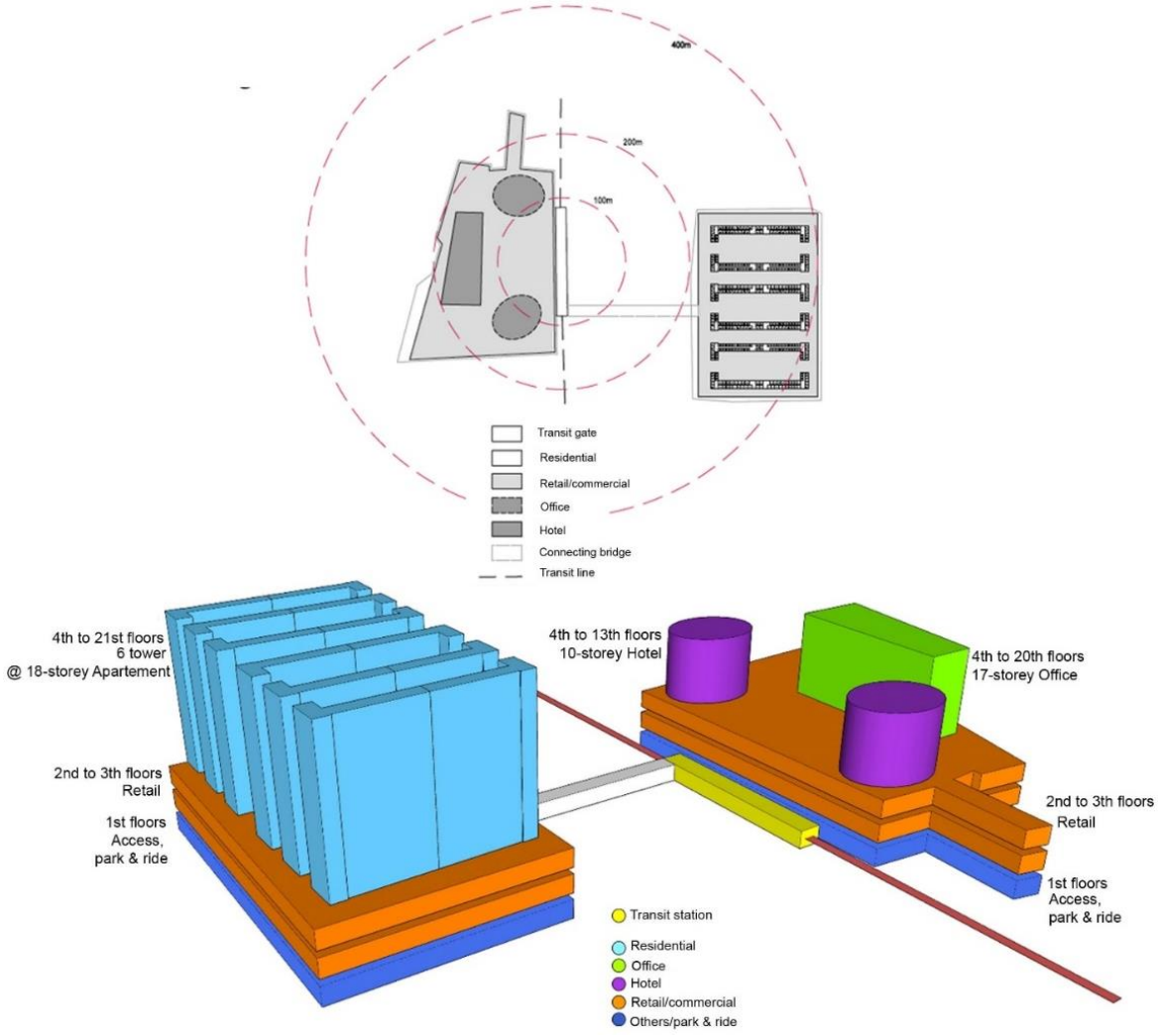

Fig. 19. Alternative design of TOD Ciracas.

3.3.4. TOD Jaticempaka.

In the development of the Jaticempaka TOD, there are additional functions of offices, hotels and theme parks. The theme park function is at the front of the development and can be accessed directly from the LRT station through public areas in commercial buildings (see Fig. 20). Likewise, with other parts such as apartments, hotels and offices that stand on commercial retail buildings. To improve land-use efficiency, and to realize an integrated and compact design so that it is easily accessible, adjustments are made for BCR and FAR. BCR is proposed to be increased from 26% to 89%. FAR increased from 2.6 to 7.29. Thus the floor area that was only 138,007 m² has now increased to 390,554 m². 40% of the area or 171,481 m² is a residential function in the form of apartments. 16% or 69,678 m² became offices and 11% or 46,867 m² became hotel functions. Theme park uses a floor area of 15,622 m² or 4% of the developed floor area.

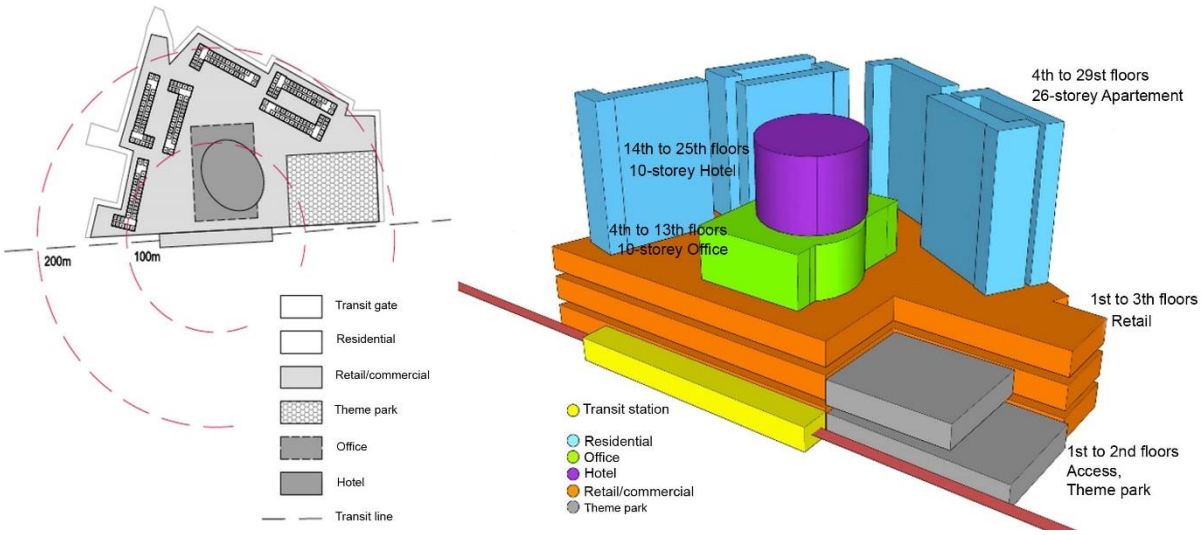

Fig. 20. An alternative design of TOD Jaticempaka.

4. Conclusions

To meet the diversity and density characteristics of the TOD concept, the BCR value is adjusted to a minimum of 80% and a minimum FAR of 6.57 in the existing TOD design in Jakarta. This creates a floor area that can be used to accommodate diverse and compact developments. While a good and integrated design helps facilitate station accessibility with all parts of the development. With the integrated path, it can also maintain the actual distance that must be travelled by ridership to reach the destination of the trip. Adjustment of the existing design is based on the world's best TOD benchmarking results, resulting in an alternative design that is relatively more ideal and in accordance with the 5D TOD concept (see Table 5 and Fig. 21).

Table 5. Alternative conceptual design TOD Jakarta.

	Bekasi Timur	Cibubur	Ciracas	Jaticempaka
Land area	50,000 m²	14,075 m²	122,678 m²	53,574 m²
Building area	45,000 m²	12,300 m²	109,700 m²	47,830 m²
GFA	357,500 m²	98,760 m²	769,280 m²	390,554 m²
BCR	90%	87%	89%	89%
FAR	7.15	7.02	6.27	7.29
Residential	162,000 m²	45,360 m²	233,280 m²	171,481 m²
Office	65,000 m²	18,000 m²	127,500 m²	69,678 m²
Hotel	40,500 m²	10,800 m²	80,000 m²	46,867 m²
Retail / commercial	45,000 m²	12,300 m²	219,000 m²	85,992 m²
Others	45,000 m²	12,300 m²	109,500 m²	15,622 m²

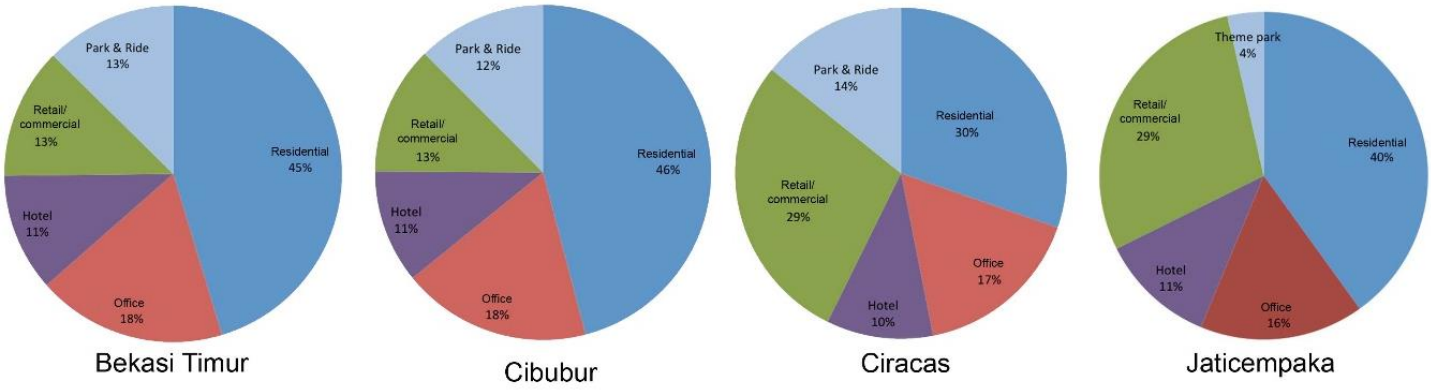

Fig. 21. The proportion of alternative TOD Jakarta floor area.

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Jachrizal Sumabrata, photograph and biography not available at the time of publication.

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