

TRANSIT ORIENTED DEVELOPMENT (TOD) IN KAWASAN BAKRIE NIRWANA RESIDENCE MULYA HARJA

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ABSTRACT

The regional development plan and integrated transportation network in the city of Bogor, especially in the Bogor Nirwana Residence Mulya Harja area, requires a plan for determining transit-based movements. The concept of transit oriented development (TOD) is a spatial engineering approach that focuses its development around transit points. The space developed in a transit-oriented area has the characteristics of high density, various mixes (updates) and a design area that is friendly to pedestrians and bicycle users. As for anticipating the emergence of transportation problems in the development of the TOD area, a study is carried out on the analysis of potential generation and attraction to find out how much movement is entering a zone or leaving a zone. to predict the amount of traffic pull generation to and from the TOD area development location. Data collection techniques include existing observations, traffic surveys and document review. The analysis of land use designation refers to the standards and regulations related to the development of transit-oriented areas, while the calculation of the generation of attraction uses the coefficient of ITE (Institute Transportation Engineers) Generation 9th. The results of the research are the level of conformity of the Basic Building Coefficient (KDB), Building Floor Coefficient (KLB) and Green Base Coefficient (KDH) on land use designation on the application of the TOD concept in the BNR area. The results were KDB with a preset rate of 64%, KLB with a percentage rate of 3.28 and KDH of 10%. In the calculation results of the movement generation obtained in the study area with a total of 2,118 (trips/hour), while for the results of the movement of the movement obtained in the study area with a total of 31,780 (trips/hour).

Keywords: transit Oriented Development; BNR; land use; generation; attraction.

| Received: | Revised: | Accepted: | Available online: |
|------------|------------|------------|-------------------|
| 2020-06-20 | 2020-11-09 | 2020-12-19 | 2021-04-15 |

INTRODUCTION

Bogor City is one of the cities located in West Java which has an area of 118.50 km², consists of 6 Districts and 68 Kelurahan and has a high population density because the population in 2019 is 1.19%, namely 1.2 million people (Central Agency Bogor City Statistics, 2019). In Bogor Nirwana Residence (BNR) housing located in the South Bogor area in Mulya Harja Village, which has an area of 400 hectares, which is located directly adjacent to the city center, has community activities that can attract visitors from inside and outside the city as an area of limited economic development, directed to the main activities are centers of automotive, shopping tourism, accommodation services and ecotourism so that it has quite large community activities.

The BNR Mulya Harja area is one of several areas in the city of Bogor which will be used as a TOD transit-oriented area. The existence of the BNR, which will be traversed by the Bogor Inner Ring Road (BIRR) ring road and the Bogor LRT Loop Line, is an opportunity to develop a connectivity system in the BNR area, especially at the BNR LRT Loop Line station inside the housing. Because the city of Bogor, especially in the BNR area, has the opportunity to be used as a designation for a transit area that is tailored to the character of the area, which can optimize the potential as an appropriate transit area. In the designation of transit-oriented areas, intermodal facilities and transit areas are inseparable aspects,

Transit Oriented Development

Transit Oriented Development (TOD) is the concept of developing areas within and around transit nodes so that added value focuses on the integration between mass public transport networks and non-motorized transportation modes, reducing the use of motorized vehicles accompanied by the development of mixed, dense areas with moderate to moderate space utilization intensity. high. (Permen ATR/BPN No. 16 of 2017).

Generation and Withdrawal

Awakening is the number of movements originating from a land use (zone) while attraction is the amount of movement towards a zone. Movement generation is a modeling stage that estimates the amount of movement originating from a zone or land use and the amount of movement attracted to a land use or zone. Traffic movement is a land use function that produces traffic movements (Tamin, 2000). This traffic generation includes:

1. Traffic leaving a location
2. Traffic to or from a location

The output from the calculation of traffic generation and attraction is the number of vehicles, people, or goods per unit of time, for example vehicles / hour. We can easily count the number of people or vehicles entering or leaving a certain land area in one day (or one hour) to get the generation and attraction of the movement.

In each determining policies related to road traffic based on the standard regulations set by the government. So that there will be no more violations of traffic on the highway. With this concept, the journey of people to the place of activity will be more comfortable (Syaiful, A.Lutfi, 2015); (Thamsrin, Syaiful, 2016); (S.Syaiful, A.Fadly, 2020). This activity that is delivered indicates that the community needs good and mutually supportive conditions, so that it is hoped that in the future there will be no more disturbances in the field including motorized vehicles including the environment and noise (M.Mubarak, et.al, 2020); (S.Syaiful, S.W.Mudjanarko, 2019); (S.Syaiful, N.Nurwahid, 2020); S.Syaiful, Y.Elvira, 2017).

RESEARCH METHODS

The location of this research was conducted in the Bogor Nirwana Residence area, Kelurahan Mulya Harja Bogor Selatan. The research time was carried out from March to April 2020.



Picture 1. Research sites (Source: Google earth)

The stages of this research are shown in the form of a flow chart as follows:

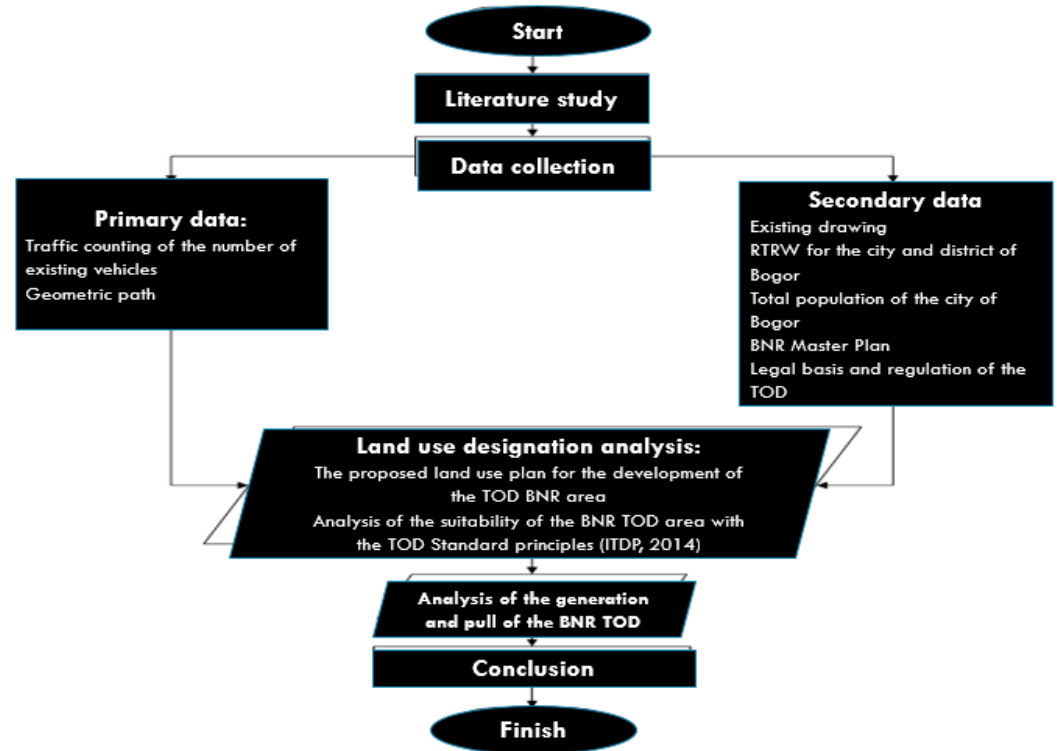


Figure 2. Research flow chart

RESULTS AND DISCUSSION

Survey Results

The traffic survey was carried out on eleven roads in the vicinity of the BNR TOD development plan, which are described in the table below.

Table 1. Characteristics of roads around the study area

| No. | Street Name | Road Width (m) | Road Type |
|-----|-----------------------------|----------------|-----------|
| 1 | Cibereum Highway No. 2 | 6 | 2/2 UD |
| 2 | Kosasih Way | 7 | 2/2 UD |
| 3 | Pabuaran Street | 4 | 4/2 UD |
| 4 | Captain Yusuf's Way | 6 | 2/2 UD |
| 5 | Street. Harmony Jaya | 4 | 4/2 D |
| 6 | Jalan Soemanto Direja | 6 | 2/2 UD |
| 7 | Protected Path | 7 | 2/2 UD |
| 8 | Arjuna Street | 7 | 2/2 UD |
| 9 | Cibereum Highway No. 1 | 6 | 2/2 UD |
| 10 | Jalan BNR Orchard Walk No.1 | 4 | 4/2 UD |
| 11 | Jalan BNR Orchard Walk No.2 | 4 | 4/2 UD |

(Source: Analysis results)

Road Section Capacity Calculation

The calculation of road capacity based on MKJI 2017 is stated in the following table:

$$C = C_0 \times FCW \times FCPA \times FCHS$$

Table 2. Road segment capacity

| No. | Street Name | Road Type | Adjustment factor for base capacity | | | | City size | Capacity (C) |
|-----|----------------------------|-----------|-------------------------------------|------------|---------------------|------------|-----------|--------------|
| | | | Basic capacity | Lane width | Direction Separator | Resistance | | |
| | | | Co | FCw | FCsp | FCHs | | |
| 1 | Jl Ciberem No.2 | 2/2 UD | 2900 | 0.87 | 1 | 0.89 | 1 | 2245 |
| 2 | Jl Kosasih | 2/2 UD | 2900 | 1 | 1 | 0.92 | 1 | 2668 |
| 3 | Jl Pabuaran | 4/2 UD | 6000 | 1 | 1 | 0.95 | 1 | 5700 |
| 4 | Jl Kapten Yusuf | 2/2 UD | 2900 | 0.87 | 1 | 0.92 | 1 | 2321 |
| 5 | Jl Harmony Jaya | 4/2 D | 6600 | 1.08 | 1 | 0.98 | 1 | 6985 |
| 6 | Jl Soemanto Direja | 2/2 UD | 2900 | 0.87 | 1 | 0.92 | 1 | 2321 |
| 7 | Jl Nyalindung | 2/2 UD | 2900 | 1 | 1 | 0.92 | 1 | 2668 |
| 8 | Jl Arjuna | 2/2 UD | 2900 | 1 | 1 | 0.92 | 1 | 2668 |
| 9 | main Street Cibereum No. 1 | 2/2 UD | 2900 | 0.87 | 1 | 0.89 | 1 | 2245 |
| 10 | Jl BNR Orchard Walk No.1 | 4/2 UD | 6000 | 1.09 | 1 | 1 | 1 | 6540 |
| 11 | Jl BNR Orchard Walk No.2 | 4/2 UD | 6000 | 1.09 | 1 | 1 | 1 | 6540 |

(Source: Analysis results)

Vehicle Volume Calculation

The recapitulation of vehicle volume flows in the TOD BNR area is shown in the following table:

Table 3. Recapitulation of vehicle volume

| No. | Street Name | Directions | Drajat of Saturation | Los |
|-----|--------------------------|-------------|----------------------|-----|
| 1 | Jl Raya Cibereum No. 2 | North South | 0.36 | B |
| | | South North | 0.32 | B |
| 2 | Jl Kosasih | West East | 0.1 | A |
| | | East West | 0.1 | A |
| 3 | Jl Pabuaran | West East | 0.05 | A |
| | | East West | 0.04 | A |
| 4 | Jl Kapten Yusuf | North South | 0.34 | B |
| | | South North | 0.32 | B |
| 5 | Street. Harmony Jaya | East West | 0.05 | A |
| | | West East | 0.05 | A |
| 6 | Jl Soemanto Direja | South North | 0.19 | A |
| | | North South | 0.22 | B |
| 7 | Jl Nyalindung | East West | 0.63 | D |
| | | West East | 0.14 | A |
| 8 | Jl Arjuna | South North | 0.14 | A |
| | | North South | 0.15 | A |
| 9 | Jl Raya Cibereum No. 1 | South North | 0.21 | A |
| | | North South | 0.17 | A |
| 10 | Jl BNR Orchard Walk No.1 | North South | 0.13 | A |
| | | South North | 0.1 | A |
| 11 | Jl BNR Orchard Walk No.2 | North South | 0.2 | A |
| | | South North | 0.17 | A |

Based on the results of the calculation of the volume of vehicles in the table above, the peak or highest volume of each road segment is obtained with an hourly time interval and a time period

starting at 06.00-18.00. Then to describe the volume of vehicles from each road segment, it can be seen in the graph below:

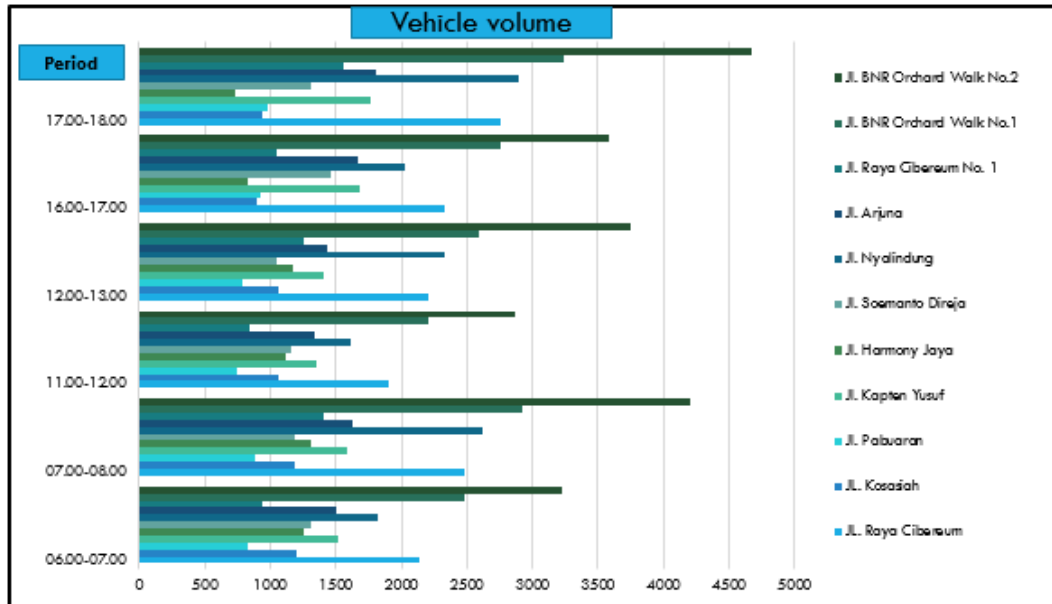


Figure 3. Vehicle Volume in the BNR TOD Area (Source: Analysis results)

Study Zone Conditions

The study areas are located in several areas including the sub-districts of South Bogor, Central Bogor, East Bogor, Ciomas and Cijeruk which have several villages from each of these sub-districts. The zoning table for the regions is shown in the following table:

Table 4. Zoning in the study area

| No. | Kelurahan | Districts |
|-----|-----------------|-------------|
| 1 | Ex. Mulya Harja | South Bogor |
| 2 | Ex. Pamoyanan | |
| 3 | Ex. Tile | |
| 4 | Ex. Rancamaya | |
| 5 | Ex. Muarasari | |
| 6 | Ex. Cipaku | |
| 7 | Ex. Ranga Mekar | |
| 8 | Ex. Bojungkerta | |
| 9 | Ex. Harjasari | |
| 10 | Ex. Tajur | |
| 11 | Ex. Cikaret | |
| 12 | Ex. Pakuan | |

(Source: Analysis results)

Origin Destination Matrix

MAT is a two-dimensional matrix that contains information about the amount of movement between zones within a certain area. The row represents the origin zone and the column represents the destination zone, so that each matrix cell represents the magnitude of the movement flow that moves from the origin zone i to the destination zone d. The origin destination matrix table is shown in the following table:

Table 5.Origin destination matrix in the TOD BNR study area

| Matriks OD | Zona | Kel. Mulya Harja | Kel. Pamoyanan | Kel. Genteng | Kel. Rancamaya | Kel. Muarasari | Kel. Cipaku | Kel. Rangga Mekar | Kel. Bojongkerta | Kel. Harjasari | Kel. Tajur | Kel. Cikaret | Kel. Pakuan | Total OI |
|-------------------|-----------|------------------|----------------|--------------|----------------|----------------|--------------|-------------------|------------------|----------------|--------------|--------------|--------------|---------------|
| | NO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | OI |
| Kel. Mulya Harja | 1 | 0 | 88 | 218 | 111 | 130 | 98 | 135 | 91 | 324 | 108 | 315 | 106 | 1,724 |
| Kel. Pamoyanan | 2 | 250 | 0 | 98 | 98 | 88 | 206 | 239 | 165 | 145 | 102 | 220 | 87 | 1,697 |
| Kel. Genteng | 3 | 326 | 217 | 0 | 34 | 1,594 | 508 | 47 | 31 | 18 | 209 | 177 | 98 | 3,258 |
| Kel. Rancamaya | 4 | 95 | 98 | 61 | 0 | 1,573 | 683 | 62 | 57 | 33 | 60 | 237 | 243 | 3,201 |
| Kel. Muarasari | 5 | 98 | 88 | 658 | 42 | 0 | 2,166 | 31 | 73 | 30 | 103 | 299 | 306 | 3,893 |
| Kel. Cipaku | 6 | 326 | 306 | 76 | 16 | 788 | 0 | 16 | 53 | 23 | 76 | 161 | 166 | 2,007 |
| Kel. Rangga Mekar | 7 | 215 | 239 | 23 | 10 | 95 | 193 | 0 | 12 | 13 | 23 | 27 | 27 | 877 |
| Kel. Bojongkerta | 8 | 87 | 206 | 274 | 17 | 1,124 | 1,673 | 61 | 0 | 109 | 147 | 92 | 321 | 4,111 |
| Kel. Harjasari | 9 | 326 | 163 | 343 | 41 | 1,407 | 1,131 | 41 | 239 | 0 | 135 | 393 | 117 | 4,338 |
| Kel. Tajur | 10 | 326 | 108 | 61 | 8 | 183 | 147 | 10 | 23 | 5 | 0 | 69 | 39 | 979 |
| Kel. Cikaret | 11 | 360 | 316 | 90 | 20 | 686 | 219 | 20 | 25 | 26 | 66 | 0 | 196 | 2,023 |
| Kel. Pakuan | 12 | 133 | 100 | 107 | 43 | 2,049 | 888 | 24 | 102 | 59 | 78 | 90 | 0 | 3,673 |
| Total DD | DD | 2,542 | 1,928 | 2,008 | 439 | 9,717 | 7,912 | 686 | 871 | 786 | 1,107 | 2,081 | 1,704 | 31,780 |

(Source: Analysis results)

In the calculation of the origin destination matrix, the movement in the zone in the study area was found to be 31.780 cur / hour and it was predicted that for one demad day it would reach 317.8 cur/day. The Desire line or the line of desire to travel in the TOD BNR study area uses the original destination matrix that has been charged and is then modeled in the SATURN application shown in the following Figure:

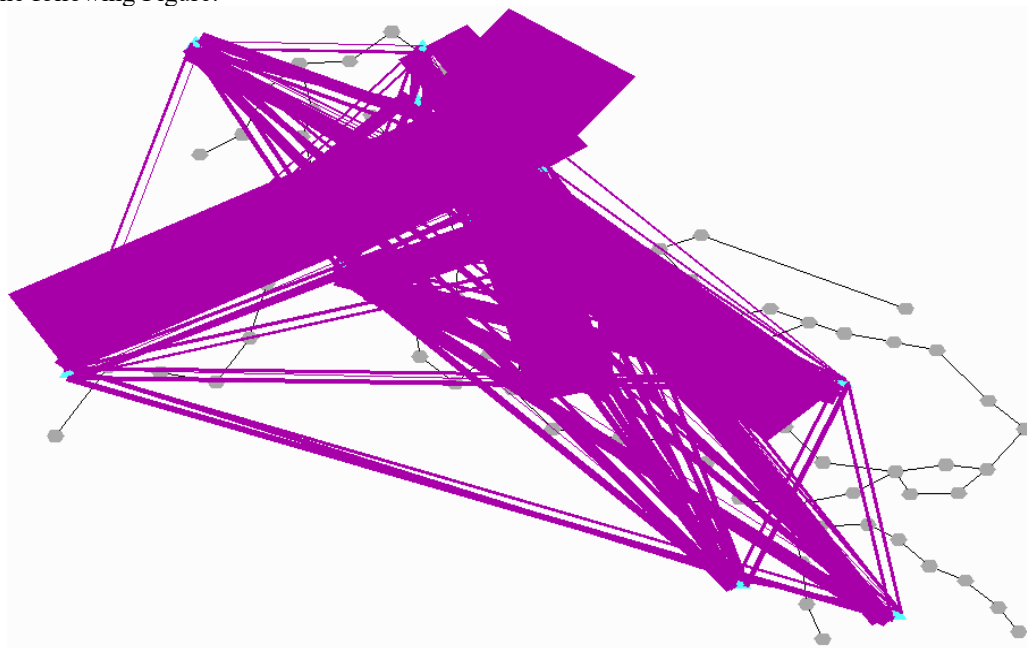


Figure 4. Desair line or the MAT wish line, the year 2020 (Source: Analysis results)

After doing the MAT modeling in Saturn, the results of the traffic counting survey data are assigned to all road network models on each road section in the study area, so that the traffic volume on all the road networks studied is known. The results of traffic counting on the road network in the study area are shown in the following figure:

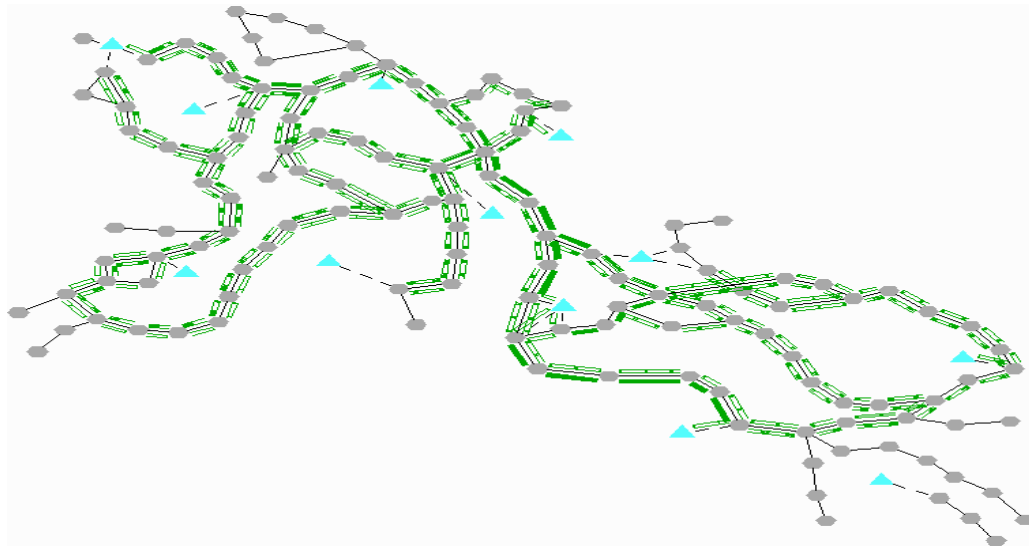


Figure 5. The results of the traffic count loading in the study area (Source: Analysis results)

Land Use Allocation Analysis

The component of mixed use designation. This is applied to the BNR TOD site where there is a mix of land use between residential land uses such as residential and non-residential such as commercial. Analysis of the site area and floor area with the results of the percentage of KDB and KLB is shown in the following table:

Table 6. Analysis of site area and percentage of KDB

| No. | Block | Land Allocation | Footprint | | |
|------------------|-------|-----------------|-----------------------------|-----|----------|
| | | | Footprint (m ²) | KDB | TotalKDB |
| 1 | F | Appartment | 1050 | 11% | 64% |
| 2 | D | Hotel | 980 | 10% | |
| 3 | E | Office | 860 | 9% | |
| 4 | B | Mall | 1360 | 14% | |
| 5 | C | Retail | 820 | 8% | |
| 6 | A | Park and Ride | 1300 | 13% | |
| 7 | G. | RTH | 480 | | |
| Sub-Total | | | 6370 | | |

(Source: Analysis results)

Table 7. Analysis of floor area and percentage of outbreaks

| No. | Block | Land Allocation | Building Floor | | | | |
|-----|-------|-----------------|------------------------------|------------------|------------------|----------|----------|
| | | | Floor Area (m ²) | Number of Floors | Total Floor Area | Outbreak | TotalKLB |
| 1 | F | Appartment | 900 | 14 | 12600 | 1.26 | 3.28 |

| | | | | | | |
|------------------|---|---------------|------|---|--------------|------|
| 2 | D | Hotel | 860 | 7 | 6020 | 0.60 |
| 3 | E | Office | 710 | 5 | 3550 | 0.36 |
| 4 | B | Mall | 930 | 4 | 3720 | 0.37 |
| 5 | C | Retail | 780 | 3 | 2340 | 0.23 |
| 6 | A | Park and Ride | 1150 | 4 | 4600 | 0.46 |
| Sub-Total | | | | | 32830 | |

(Source: Analysis results)

Table 8. Recapitulation of land use designation

| Land Size: 10000 m ² | | | | | | |
|---------------------------------|-----------------|-------------|------------------|--------------------------------------|--------------|-----------|
| Space Utilization Intensity | Footprint | | Number of Floors | Building Floor | | Total KLB |
| | Footprint area | Total KDB | | Total Floor Area (m ²) | Total | |
| Closed Area | | | | | | |
| 1 | Residential | 2030 | | 7-14 | 18620 | |
| 2 | Non-Residential | 4340 | 64% | 3-5 | 14210 | 3.28 |
| Sub-Total | | 6370 | | | 32830 | |
| Open Area | | | | | | |
| 1 | RTH | 1000 | | Total Land Area m² | | |
| 2 | Street | 2630 | | Closed Space + Open Space | | |
| Sub-Total | | 3630 | | 10000 m² | | |

(Source: Analysis results)

Prediction of TOD area generation calculation with the calculation method Institute Transport Engineers (ITE)

The calculation of generation is a quantity that shows the movements that can be generated by a land use function in the area. The generation estimate in this study uses the coefficient from the 9th Generation of ITE (Institute Transportation Engineers), which is calculated based on the ITE coefficient unit with the unit or total floor area of the building (ha) in the TOD area. The results of the calculation of the generation in the TOD BNR development area (trip/hour) are shown in the following table:

Table 9. Calculation of the BNR TOD area generation (Trip/Hour)

| No. | Amenities | Description (ITE Code) | Units | Sqm GFA | Unit | ITE coefficient | ITE Awakening (Trip / Hour) |
|-----|---------------|------------------------|------------------|---------|-----------|-----------------|-----------------------------|
| 1 | Apartment | Residential | Dwelling Units | | 315 Units | 0.46 | 145 |
| 2 | Hotel | Lodging | Rooms | | 153 Units | 0.53 | 81 |
| 3 | Office | Office | KSF ² | 3550 | 38.21 SF | 1.56 | 60 |
| 4 | Mall | Retail | KSF ² | 3720 | 40.04 SF | 0.96 | 38 |
| 5 | Retail | Retail | KSF ² | 2340 | 25.19 SF | 3.81 | 96 |
| 6 | Park and Ride | Port and Terminal | Parking Space | | 2392 | 0.71 | 1698 |

| No. | Amenities | Description (ITE Code) | Units | Sqm GFA | Unit | ITE coefficient | ITE Awakening (Trip / Hour) |
|------------------|-----------|---------------------------|-------|-------------|------|--------------------|--------------------------------------|
| Sub-Total | | | | 9610 | | | 2118 |

(Source: Analysis results)

In the generation calculation shown in table 9, the generated land use movement generated in the TOD BNR area is 2,118 trips / hour and it is predicted that for one day the number of generation is 21,180 trips/hour.)

The calculation of the generation in the BNR TOD development area (pcu/hour) is shown in the following table:

Table 10. Calculation of the generation of the BNR TOD area (Smp / Hour)

| No. | Land Allocation | ITE | | BC | KR | SMe mp 0.2 | KRe mp 1 | Awakeni ng (pcu / hour) |
|------------------|--------------------|----------------------------------|------------|----|------------|------------------|-------------|-------------------------------|
| | | Awakeni ng (trip/hou r) | | | | | | |
| 1 | Appartmen t | 145 | | | | 22 | 33 | 55 |
| 2 | Hotel | 81 | | | | 13 | 18 | 31 |
| 3 | Office | 60 | | | | 9 | 13 | 23 |
| 4 | Mall | 38 | 77.32 % | | 22.59 % | 6 | 9 | 15 |
| 5 | Retail | 96 | | | | 15 | 22 | 37 |
| 6 | Park and Ride | 1698 | | | | 263 | 384 | 646 |
| Sub-Total | | 2118 | | | | 328 | 479 | 806 |

(Source: Analysis results)

Based on the results of the land use movement generation, TOD BNR from trip / hour is converted to pcu / hour by using the average vehicle data from the traffic count results on each road section, the number of generated generation is 806 pcu / hour.

CONCLUSION

From the results of the analysis of land use designation in the TOD BNR area, the suitability of the Basic Building Coefficient (KDB) in the residential area includes apartments and hotels by 21% and commercial areas including offices, malls, retail, and park and ride at 44%, the total value of KDB obtained throughout the building is 64% of the maximum land cover (land coverage) in the TOD of the city service sub-center by 70% which is contained in the technical criteria for TOD development based on the type of TOD. The suitability figure for the Building Floor Coefficient (KLB) obtained in the residential area is 1.86 and the commercial area is 1.42, so the total KDB figure is 3.28 from a maximum number of 3.0 to 4.0. Based on the calculation of generation and attraction, the number of generation obtained in the TOD BNR area is 2,118 trips / hour, and for a pull of 31,780 cur / hour. Because the BNR TOD area is directed to main ecotourism activities, accommodation services, shopping tours and automotive centers as stated in the RTRW of the city of Bogor.

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