GENERATION AND ATRACTION TRAVEL IN BOGOR DISTRICT

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ABSTRACT

Cibungbulang District has 32.66 km² area with 15 villages, Ciampea District has 51.06 km² area with 13 villages, Dramaga District has 24.47 km² area with 10 villages, and Ranca Bungur District 21.68 km² area with 15 villages are conterminal districts to Kota Bogor, and are crossed by the main road that connects between West Java Province and Banten Province. The increase of movement in and out of this area affects the number of movements and also the trip generation and trip attraction caused in the four districts such as education centers, offices, hospitals and recreation places. Conduct a Traffic counting survey on the main road sections that begin to be processed based on MKJI 2017 methode. Also using Trip Generation Manual, describe the number of trip generation and trip attraction to MAT. Then, modeled into SATURN Software. So that, the research results are 9,522 trip/hour trip generation with 382,504 smp/hour trip attraction. And has Level of Service on A-F with B level average. This proves the need for improvement and equitable distribution of infrastructure and facilities, traffic infrastructure. And to realize alternative roads and mass transportation.

Key word: trip generation; trip attraction; MAT; transportation.

INTRODUCTION

The current high development, especially in Bogor Regency, has also resulted in the high demand for transportation which is a must to be fulfilled

Cibungbulang Subdistrict, Ciampea Subdistrict, Dramaga Subdistrict, and Ranca Bungur Subdistrict are sub-districts that are directly adjacent to Bogor City, and are crossed by the main road connecting West Java Province with Banten Province. Each district has an area of 32.66 km² with a population of 133,845 people/km² in Cibungbulang District, 51.06 km² with a population of 160,487 people/km² in Ciampea District. Meanwhile, 24.47 km² with a population of 111,119 people/km² in Dramaga District and an area of 21.68 km² with a population of 54,260 people/km² in Ranca Bungur District (Bogor Regency in Figures 2018). In this research area, one of the best universities in Indonesia has also been built, hospitals, markets, to natural and family tourism destinations. Thus, it causes a movement of the awakening and attraction of the journey of people and goods which is expected to cause several problems, especially in the decline in road performance (Badan Pusat Statistik Kabupaten Bogor, 2018); (Badan Pusat Statistik Kabupaten Bogor, 2018a); (Badan Pusat Statistik Kabupaten Bogor, 2018b); (Badan Pusat Statistik Kabupaten Bogor, 2018c); (Badan Pusat Statistik Kabupaten Bogor, 2018d); (Dinas Kabupaten Bogor, 2018); (Direktorat Jenderal Pelayanan Kesehatan, 2018); (Direktorat Jenderal Pendidikan Dasar dan Menengah, 2015) (IPB University, 2014).

The movement of the awakening

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 (Mecky.R.E.M, Theo.KS, 2011); (Prasetyo.W.H,2018); (Silvia.S., 199); (Suriyadi.RA, Azmeri, 2017); (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.

A person's journey is influenced by a need; a need is someone's guidance in traveling. People travel either using motorized vehicles or non-motorized vehicles. Using a motorized vehicle affects the importance of traveling. This need will support daily activities, whether traveling or not. So that motorized vehicles are very useful so that they can be categorized as vehicles as a necessity (M. Mubarak, et.al, 2020); (S. Syaiful, A. Fadly, 2020); (Thamrin, Syaiful, 2016).

The distribution of movements
The goal of moving within an area will cause problems, such as congestion, air pollution, noise, delays and so on. One way to be able to find solutions to these problems is to understand the current and future movement patterns. Understanding patterns can be identified by searching data about the origin and destination of movements, the magnitude of the movements, and when the movements occur.

Origin Destination Matrix (MAT)
MAT is a matrix of origin and destination which contains information about the magnitude of movement between zones within a certain area. In this case, the $Tid$ notation states the amount of movement flow (vehicles, passengers, and goods) moving from origin zone $i$ to destination zone $d$ during a certain time interval.

Degree of saturation
The value of the degree of saturation or Volume Capacity Ratio (VCR) for roads is obtained based on the analysis of traffic volume divided by road capacity. To obtain road and intersection capacity, geometric measurements of existing roads and intersections are required. Furthermore, the amount of traffic volume in the coming period will be calculated based on traffic forecasting analysis. The amount of the traffic growth factor is based on the growth rate of vehicles.

| Service level | City Size Factor (FVBUK) | Scope Limit V/C |
|---------------|--------------------------|-----------------|
| A             | Free traffic flow conditions with high speed and low traffic volume | 0.00 – 0.20     |
| B             | The flow is stable, but the operating speed is starting to be limited by traffic conditions | 0.20 – 0.44     |
| C             | The current is stable, but the speed and motion of the vehicle are controlled | 0.45 – 0.74     |
| D             | The current is close to stable, the speed can still be controlled, $V / C$ can still be tolerated | 0.75 – 0.84     |
| E             | Flow unstable speed sometimes stops, demand is close to capacity | 0.85 – 1.00     |
| F             | Forced flow, low speed, volume over capacity, long queue (jammed) | $\geq 1.00$     |

(Source: MKJI, 2017)
**Simulation and Assignment of Traffic on Urban Road Network (SATURN)**

SATURN (Simulation and Assignment of Traffic on Urban Road Network) is a computer software developed by the Institute of Transport Studies, University of Leeds.

SATURN can also function as both a loading model and a pure intersection simulation model. SATURN is also equipped with other standard loading models, such as Generalized Cost, All or Nothing, Wardrop Balance, Burrel Multi-Route Loading (SUE), and others. SATURN can also be used to estimate the trip matrix using traffic flow data or update an existing matrix, as part of an external iteration using the output of the last loading in the iteration process.

**RESEARCH METHODS**

**Executing Place**

The research locations are located on main roads, education centers, office buildings, recreation and tourism areas, economic and health centers located in the four study areas.

![Figure 1. Study area (Google Maps, 2019)](image_url)

**Research time**

The research was carried out at peak hours based on daily traffic habits through Google Maps.

**Materials and tools**

1) The materials needed in this study are primary and secondary data obtained from the analysis and related agencies in the form of growth data for Bogor Regency, existing conditions in Bogor Regency, and RTRW Map data for Bogor Regency.

2) The tools needed consist of: Traffic Counting questionnaire form, stationery, counting, a computer for data processing, and a printer, A4 paper as a print out of the planning results.

**Procedure**

The way this research works is described based on the stages that have been designed in the research flow diagram shown in Figure 2 below.
RESULTS AND DISCUSSION
Existing Condition of the Study Area

The categories of road functions in the study area based on the 2016 RTRW of Bogor Regency are shown in Table 2.

| No | Road name       | Road type | The width of roads | Road function          |
|----|----------------|-----------|--------------------|------------------------|
| 1  | Jl. Leuwiliang  | 2/2 TT    | 7 m                | Primary Collector I    |
|    | Bogor           |           |                    |                        |
| 2  | Jl. Baru Galuga| 2/2 TT    | 8 m                | Secondary Artery       |
| 3  | Jl. Raya Galuga | 2/2 TT    | 6 m                | Secondary Collector I  |
Vehicle surveys are carried out on road sections based on the 2016 RTRW of Bogor Regency which are then adjusted based on times of daily congestion on the Google Maps application. Which then counts the total volume and the total flow of the vehicle is calculated.

**Table 3. Vehicle Volume Flow with Urban Road Classification in Dramaga District**

| No | Road name                          | Road type | The width of roads | Road function          |
|----|-----------------------------------|-----------|--------------------|------------------------|
| 4  | Jl. Lapangan Tembak               | 2/2       | 5 m                | Secondary Collector I  |
| 5  | Jl. Leuwiliang Bogor (Ciampea)    | 2/2       | 7 m                | Primary Collector I    |
| 6  | Jl. Letnan Sukarna                | 2/2       | 6 m                | Secondary Collector I  |
| 7  | Jl. Cikampak-Cicadas              | 2/2       | 5 m                | Secondary Collector I  |
| 8  | Jl. Cihideung Ilim               | 2/2       | 4 m                | Secondary Collector I  |
| 9  | Jl. Cihideung Udik                | 2/2       | 4 m                | Secondary Collector I  |
| 10 | Jl. Pumawarman                    | 2/2       | 4 m                | Secondary Collector I  |
| 11 | Jl. Lapangan Tembak (Ciampea)     | 2/2       | 5 m                | Secondary Collector I  |
| 12 | Jl. Leuwiliang Bogor (Jl. Raya Dramaga) | 2/2 | 7 m | Primary Collector I |
| 13 | Jl. Lingkar Laladon              | 2/2       | 14 m               | Secondary Artery       |
| 14 | Jl. H. Miing                     | 2/2       | 8 m                | Secondary Collector I  |
| 15 | Jl. Raya Cagak                   | 2/2       | 6 m                | Secondary Collector I  |
| 16 | Jl. Raya Rancabungur             | 2/2       | 7 m                | Secondary Collector I  |
| 17 | Jl. Letkol Atang Sanjaya         | 2/2       | 5 m                | Secondary Collector I  |
| 18 | Jl. Mekarsari                    | 2/2       | 5 m                | Secondary Collector I  |

Source: Analysis Results

Flow of volume Jl. Laladon Circle to the west and east.

**Table 4. Vehicle Volume Flow with Urban Outer Road Classification in Dramaga District**

| Period | Road                      | SM | KBM | BB | KR | Volume | Total Q (flow hour) |
|--------|---------------------------|----|-----|----|----|--------|--------------------|
| 17:00-18:00 | Jl. Leuwiliang-Bogor (Jl. Raya Dramaga) | 1164 | 32  | 3  | 612 | 1811   | 1352.7            |
|         | T                         | 2080 | 26  | 2  | 560 | 2668   | 1841.8            |

(Source: Analysis Results)
(Source: Analysis Results)

Flow of volume Jl. Leuwiliang Bogor (Ciampea) west and east.

**Table 5. Vehicle Volume Flow with Urban Road Classification in Ciampea District**

| Period   | Road Description                  | Direction | SM | KBM | BB | KR | Volume | Total Q/hour |
|----------|-----------------------------------|-----------|----|-----|----|----|--------|--------------|
| 07:00-08:00 | Jl. Leuwiliang – Bogor (Ciampea) | B         | 1728 | 12 | 0  | 472 | 2212    | 1523.2       |

(Source: Analysis Results)

Traffic volume in Ciampea Subdistrict, west and east, north and south.

**Table 6. Vehicle Volume Flows with the Classification of Urban Outer Roads in Ciampea District**

| Period   | Road Description                  | Direction | SM | KBM | BB | KR | Volume | Total Q/hour |
|----------|-----------------------------------|-----------|----|-----|----|----|--------|--------------|
| 08:00-09:00 | Jl. Letman Sukarni              | U         | 1164 | 0   | 0  | 248 | 1412    | 946.4        |
| 10:00-11:00 | Jl. Cihidueng Ilir              | U         | 384  | 0   | 0  | 72  | 456     | 302.4        |
| 11:00-12:00 | Jl. Cihidueng Udile              | S         | 448  | 0   | 0  | 64  | 512     | 332.8        |
| 10:00-11:00 | Jl. Lapangan                    | S         | 216  | 0   | 0  | 16  | 232     | 158.4        |
| 11:00-12:00 | Jl. Cikampak – Cieadas          | S         | 376  | 7   | 1  | 88  | 472     | 323.3        |

(Source: Analysis Results)

Flow of volume Jl. Leuwiliang - Bogor (Cibungbulang) west and east.

**Table 7. Vehicle Volume Flow with Urban Road Classification in Cibungbulang District**

| Period   | Road Description                  | Direction | SM | KBM | BB | KR | Volume | Total Q/hour |
|----------|-----------------------------------|-----------|----|-----|----|----|--------|--------------|
| 11:00-12:00 | Jl. Leuwiliang – Bogor (Cibungbulang) | B         | 1520 | 0   | 4  | 460 | 1984    | 1377.2       |

(Source: Analysis Results)

Vehicle volume flow in Cibungbulang subdistrict to the west and east, north and south.

**Table 8. Flow of Vehicle Volume with the Classification of Urban Outer Roads in Cibungbulang District**
The flow of vehicle volume in Rancabungur District is west and east, north and south.

**Table 9. Vehicle Volume Flow with Urban Outer Road Classification in Ranca Bungur District**

| Period   | Road                  | Direction | SM | KBM | BB | KR | Volume |
|----------|-----------------------|-----------|----|-----|----|----|--------|
| 10:00-   | Jl. Baru Galuga       | B         | 476| 4   | 208| 588| 498.8  |
| 11:00    |                       | T         | 416| 2   | 216| 634| 488   |
| 15:00-   | Jl. Raya Galuga       | U         | 368| 0   | 80 | 466| 311.6 |
| 16:00    |                       | S         | 88 | 0   | 112| 200| 164.8 |
| 09:00-   | Jl. Lapangan Tembak (Cibungbulang) | B | 332| 0   | 100| 432| 299.2 |
| 10:00    |                       | T         | 288| 0   | 56 | 284| 192.8 |

(Source: Analysis Results)

Road Speed and Capacity Calculation

The calculation of road speed and capacity in the study location is calculated based on the results of a road clarification survey which is then processed and adjusted based on the 2017 MKJI.

Speed Calculation

\[ V_b = (V_{bd} + V_{bl}) \cdot F_{vbhs} \cdot F_{vbuk} \] (1)

**Table 10. Average Speed of Urban Road Classification Section**

| No | Road                          | VBD | VBL | FvBhs | FvBuk | Vb(min) |
|----|-------------------------------|-----|-----|-------|-------|---------|
| 1  | Jl. Raya Bogor - Leuwaliang (Cibubulan) | 42  | 0   | 0.93  | 1.03  | 40.23   |
| 2  | Jl. Raya Bogor - Leuwaliang (Ciampea) | 42  | 0   | 0.93  | 1.03  | 40.23   |
| 3  | Jl. Raya Bogor - Leuwaliang (Darmaga) | 42  | 3   | 0.93  | 1.03  | 43.11   |
Vb = (Vbd + Fvb-W). Fvb-Hs.Fvb-Fj (2)

Table 11. Average Speed of Outer-Urban Road Classification Section

| No | Road                          | VBD | VBL | FVBSH | FVBJ | VB |
|----|-------------------------------|-----|-----|-------|------|----|
| 1  | Jl. Raya Galuga               | 68  | 3   | 0,96  | 0,98 | 61,15 |
| 2  | Jl. Baru Galuga               | 68  | 3   | 1     | 1    | 65  |
| 3  | Jl. Lapangan Tembok           | 65  | 3   | 1     | 1    | 62  |
| 4  | Jl. Raya Cikampak-Cicadas     | 65  | 11  | 0,91  | 0,98 | 48,16 |
| 5  | Jl. Ciheuneg Hir              | 65  | 11  | 0,91  | 0,94 | 46,19 |
| 6  | Jl. Ciheuneg Udik             | 61  | 9   | 0,96  | 0,94 | 46,92 |
| 7  | Jl. Raya Pasear Cianpea       | 68  | 11  | 0,85  | 0,91 | 44,09 |
| 8  | Jl. Purnawarman               | 61  | 9   | 0,96  | 0,94 | 46,92 |
| 9  | Jl. Lap. Tembok               | 61  | 9   | 1     | 0,94 | 48,88 |
| 10 | Jl. Lingkor Laladon           | 68  | 0   | 0,96  | 0,93 | 60,71 |
| 11 | Jl. Raya Cagak                | 68  | 3   | 0,91  | 0,93 | 55,01 |
| 12 | Jl. Raya Rancabungur          | 61  | 0   | 0,96  | 0,93 | 54,46 |
| 13 | Jl. Letkol Atang Sanjava      | 68  | 11  | 0,91  | 0,93 | 48,24 |
| 14 | Jl. Mekarsari                 | 65  | 11  | 1     | 0,94 | 50,76 |
| 15 | Jl. H. Ming                   | 65  | 3   | 1     | 1    | 58,28 |

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

C = C0 X FcLj X FcPa X FcHS X FcUK (3)

Table 12. Urban Road Capacity

| No | Road                          | Co  | FcLj | FcPA | FcHS | FcUK | C   |
|----|-------------------------------|-----|------|------|------|------|-----|
| 1  | Jl. Raya Bogor - Leuwilang    | 2900| 1    | 1    | 1,04 | 0,92 | 2774,72 |
|    | (Cibubutan)                   |     |      |      |      |      |     |
| 2  | Jl. Raya Bogor - Leuwilang    | 2900| 1    | 1    | 1,04 | 0,92 | 2774,72 |
|    | (Ciampea)                     |     |      |      |      |      |     |
| 3  | Jl. Raya Bogor - Leuwilang    | 2900| 1,14 | 1    | 0,92 | 1,04 | 3163,18 |
|    | (Dranaga)                     |     |      |      |      |      |     |

Table 13. Capacity of Outer Urban Roads

| No | Road                          | Co  | FcLj | FcPA | FcHS | C   |
|----|-------------------------------|-----|------|------|------|-----|
| 1  | Jl. Raya Galuga               | 3100| 0,91 | 1    | 0,88 | 2482,48 |
| 2  | Jl. Baru Galuga               | 3100| 1,08 | 1    | 0,93 | 3113,64 |
| 3  | Jl. Lapangan Tembok           | 3100| 0,69 | 1    | 0,93 | 1989,27 |
| 4  | Jl. Raya Cikampak-Cicadas     | 3100| 0,69 | 1    | 0,84 | 1796,76 |
| 5  | Jl. Ciheuneg Hir              | 3100| 0,69 | 1    | 0,84 | 1796,76 |
| 6  | Jl. Ciheuneg Udik             | 3000| 0,69 | 1    | 0,88 | 1821,6 |
| 7  | Jl. Raya Pasear Cianpea       | 3100| 0,91 | 1    | 0,88 | 2258,80 |
| 8  | Jl. Purnawarman               | 3000| 0,69 | 1    | 0,93 | 1821,6 |
| 9  | Jl. Lap. Tembok               | 3100| 0,69 | 1    | 0,84 | 1989,27 |
| 10 | Jl. Lingkor Laladon           | 3100| 1    | 1    | 0,96 | 2976,00 |
| 11 | Jl. Raya Cagak                | 3100| 0,91 | 1    | 0,84 | 2369,64 |
| 12 | Jl. Raya Rancabungur          | 3100| 1    | 1    | 0,88 | 2738,00 |
| 13 | Jl. Letkol Atang Sanjava      | 3100| 0,69 | 1    | 0,88 | 1882,32 |
| 14 | Jl. Mekarsari                 | 3100| 0,69 | 1    | 0,93 | 1989,27 |
| 15 | Jl. H. Ming                   | 3100| 0,91 | 1    | 0,93 | 2623,53 |
(Source: Analysis Results)

Existing Service Level
Existing Service Level (Level of Service, LoS) of roads in the Study Area in 2019

| Roads                      | Type | The width of the road | skr/hour | c   | VCR | LOS |
|----------------------------|------|-----------------------|----------|-----|-----|-----|
| Jl. Leuwiliang Bogor       | 2/2  | 7 m                   | 2603     | 2775| 0.9 | E   |
| (Cibungbulang)             | TT   |                       |          |     |     |     |
| Jl. Baru Galuga            | 2/2  | 8 m                   | 967      | 3114| 0.3 | B   |
| Jl. Raya galuga            | 2/2  | 6 m                   | 476      | 2482| 0.2 | A   |
| Jl. Lap. Tembak            | 2/2  | 5 m                   | 492      | 1989| 0.2 | A   |
| Jl. Leuwiliang Bogor       | 2/2  | 7 m                   | 3872     | 2775| 1.4 | F   |
| (Ciampea)                  | TT   |                       |          |     |     |     |
| Jl. Letnan Sukama          | 2/2  | 6 m                   | 2492     | 2257| 1.1 | F   |
| Jl. Chidueng Ilir          | 2/2  | 4 m                   | 635      | 1797| 0.4 | B   |
| Jl. Chidueng Udik          | 2/2  | 4 m                   | 304      | 1822| 0.2 | A   |
| Jl. Lap. Tembak            | 2/2  | 5 m                   | 870      | 1989| 0.4 | B   |
| (Ciampea)                  | TT   |                       |          |     |     |     |
| Jl. Purnawarman            | 2/2  | 4 m                   | 741      | 1822| 0.4 | B   |
| Jl. Cikampak-Cicadas       | 2/2  | 5 m                   | 712      | 1797| 0.4 | B   |
| Jl. Raya Dramaga           | 2/2  | 8 m                   | 3195     | 3163| 1.0 | E   |
| Jl. lingkar Laladon        | 2/2  | 7 m                   | 828      | 2728| 0.3 | B   |
| Jl. Raya Cagak             | 2/2  | 6 m                   | 1706     | 2454| 0.7 | C   |
| Jl. Raya Rancabungur       | 2/2  | 7 m                   | 802      | 2728| 0.3 | B   |
| Jl. Letkol ATS             | 2/2  | 5 m                   | 1212     | 1882| 0.6 | C   |
| Jl. Mekarsari              | 2/2  | 5 m                   | 678      | 1989| 0.3 | B   |
| Jl. H. Miing               | 2/2  | 6 m                   | 697      | 2624| 0.3 | B   |

(Source: Analysis Results)

Prediction of Generation and Withdrawal Calculations in the Study Area
In the calculation of the generation, an assumption is made of the number of units and the area for each generation, including: schools, offices, apartments, hotels, hospitals to recreation areas in the study area. Furthermore, to get the total number of pcu / hour pulls, the assumption is that the proportion of vehicles is uniform with the traffic counting data which is changed based on the
vehicle coefficient on the MKJI. Estimation of generation and attraction using the Trip Generation Manual ITE (Institute Transportation Engineers).

**Table 15. Calculation of Generation and Withdrawal in Cibungbulang District**

| Description/ITE Code | Description/ITE Code | Units | Large Sqm/Unit Of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------|----------------------|-------|---------------------------|---------------|---------------------------|
| SMA Taman Islam (Senior High School) | INSTITUTIONAL | KSF² | 3815 | 0.97 | 39.83 |
| Pasar Saptu (Wholesale Market) | RETAIL | KSF² | 2750 | 0.88 | 26.05 |
| Kantor Desa Situ Udik (Government Office) | OFFICE | KSF² | 370 | 1.21 | 4.82 |
| SMPS Aulia (Junior High School) | INSTITUTIONAL | KSF² | 700 | 1.19 | 8.97 |
| SMA Aulia (Senior High School) | INSTITUTIONAL | KSF² | 700 | 0.97 | 7.31 |
| SMPS Mulia (Junior High School) | INSTITUTIONAL | KSF² | 32000 | 1.19 | 409.90 |
| SMK Cahaya (Senior High School) | INSTITUTIONAL | KSF² | 5000 | 0.97 | 52.21 |
| Taman Air, Gunung Handeleum (Athletic Club) | RECREATIONAL | KSF² | 10394 | 5.96 | 666.83 |
| Kantor Desa Situ Ilir (Government Office) | OFFICE | KSF² | 350 | 1.21 | 4.56 |
| SMP Ash-Shollhin (Junior High School) | INSTITUTIONAL | KSF² | 2047 | 1.19 | 26.22 |
| SMP Tahfizh Al-Basyir (Junior High School) | INSTITUTIONAL | KSF² | 1000 | 1.19 | 12.81 |
| Kantor Desa Cibatok 2 (Government Office) | OFFICE | KSF² | 480 | 1.21 | 6.25 |
| SMP Taruna Bhakti (Junior High School) | INSTITUTIONAL | KSF² | 3000 | 1.19 | 38.43 |
| Kantor Desa Ciaruteun Udik (Government) | OFFICE | KSF² | 295 | 1.21 | 3.84 |
| Description/ITE Code | Description/ITE Code | Units | Larges Sqm/Unit Of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------|----------------------|-------|---------------------------|---------------|--------------------------|
| Office) SMAN 1        | INSTITUTIONAL        | KSF2  | 10000                     | 0.97          | 104.41                   |
| Cibungbulang (Senior High School) | SMK Bumi Sejahtera Kantor Desa Cibatok 1 (Government Office) | INSTITUTIONAL | KSF2 | 3565 | 0.97 | 37.22 |
| Kantor Desa Sukamaju (Government Office) | OFFICE | KSF2 | 350 | 1.21 | 4.56 |
| Pt. Puspa Damayanti (Utilities) Kantor Desa Cemplang (Government Office) | OFFICE | KSF2 | 400 | 1.21 | 5.21 |
| Pt. M&S Aparel (General Light Industrial) SMK Teknomedika 2 (Senior High School) Kantor Desa Galuga (Government Office) SMP PGRI Cibungbulang (Junior High School) SMK Pertiwi Cibungbulang Bogor (Senior High School) Kantor Desa Dukuh (Government Office) SMPN 1 Cibungbulang (Junior High School) SMPS Al Badariah (Junior | INDUSTRIAL | KSF2 | 5880 | 0.76 | 48.10 |
| Kantor Desa Sukamaju (Government Office) | OFFICE | KSF2 | 680 | 1.21 | 8.86 |
| Pt. M&S Aparel (General Light Industrial) SMK Teknomedika 2 (Senior High School) Kantor Desa Galuga (Government Office) SMP PGRI Cibungbulang (Junior High School) SMK Pertiwi Cibungbulang Bogor (Senior High School) Kantor Desa Dukuh (Government Office) SMPN 1 Cibungbulang (Junior High School) SMPS Al Badariah (Junior | INDUSTRIAL | KSF2 | 33430 | 0.97 | 349 |
| Kantor Desa Sukamaju (Government Office) | OFFICE | KSF2 | 1935 | 0.97 | 20.20 |
| SMPN 1 Cibungbulang (Junior High School) SMPS Al Badariah (Junior | INSTITUTIONAL | KSF2 | 1500 | 1.19 | 19.21 |
| Kantor Desa Sukamaju (Government Office) | INSTITUTIONAL | KSF2 | 8500 | 0.97 | 88.75 |
| SMPN 1 Cibungbulang (Junior High School) SMPS Al Badariah (Junior | INSTITUTIONAL | KSF2 | 5768 | 1.19 | 73.89 |
| Kantor Desa Sukamaju (Government Office) | INSTITUTIONAL | KSF2 | 2657 | 1.19 | 34.03 |
| Description/ITE Code | Description/ITE Code | Units | Larges Sqm/Unit Of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------|----------------------|-------|-----------------------------|---------------|--------------------------|
| High School) Kantor Kecamatan Cibungbulang (Government Office) | OFFICE KSF\(^2\) | 2170 | 1.21 | 28.26 |
| Kantor Desa Cimanggu 2 (Government Office) | OFFICE KSF\(^2\) | 350 | 1.21 | 4.56 |
| Sejahtera (Junior High School) | INSTITUTIONAL KSF\(^2\) | 2400 | 1.19 | 30.74 |
| SMA Bumi Sejahtera (Senior High School) | INSTITUTIONAL KSF\(^2\) | 2000 | 0.97 | 20.88 |
| Nurul Ihsan (Junior High School) | INSTITUTIONAL KSF\(^2\) | 3669 | 1.19 | 47.00 |
| Lembah Pelangi (Regional Park) | RECREATIONAL Acres | 12.6 | 0.20 | 2.52 |
| Kantor Desa Cimanggu 1 (Government Office) | OFFICE KSF\(^2\) | 400 | 1.21 | 5.21 |
| SMPN 2 Cibungbulang (Junior High School) | INSTITUTIONAL KSF\(^2\) | 10300 | 1.19 | 131.94 |
| SMK Matusha Dwi Elang (Senior High School) | INSTITUTIONAL KSF\(^2\) | 4369 | 0.97 | 45.62 |
| SMK Pandu Bogor (Senior High School) | INSTITUTIONAL KSF\(^2\) | 17876 | 0.97 | 186.65 |
| Kantor Desa Girimulya (Government Office) | OFFICE KSF\(^2\) | 350 | 1.21 | 4.56 |
| Kantor Desa Leuwung Kolot (Government Office) | OFFICE KSF\(^2\) | 350 | 1.21 | 4.56 |
| Kantor Desa Ciaruteun Ilir (Government Office) | OFFICE KSF\(^2\) | 700 | 1.21 | 9.12 |
| Prasati Batu Tulis Ciaruteun | INSTITUTIONAL KSF\(^2\) | 2000 | 0.18 | 3.9 |
The results of the analysis of the generation and pull calculations in Ciampea District are presented in the following table:

**Table 16. Calculation of Generation and Withdrawal in Ciampea District**

| Description/ITE Code | Description/ITE Code | Units | Large Sqm/Unit Of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------|----------------------|-------|---------------------------|---------------|---------------------------|
| Pasar Selasa (Wholesale Market) | RETAIL | KSF² | 2420 | 0.88 | 22.92 |
| Kantor Desa Ciampea Udik (Government Office) | OFFICE | KSF² | 700 | 1.21 | 9.12 |
| SMP Madani (Senior High School) | INSTITUTIONAL | KSF² | 5000 | 1.19 | 64.05 |
| SMK Madani (Senior High School) | INSTITUTIONAL | KSF² | 2000 | 0.97 | 20.88 |
| Cakrawala Nuansa Nirwana (Athletic Club) | RECREATIONAL | KSF² | 16200 | 5.96 | 1039.31 |
| Kantor Desa Cinangka (Government Office) | OFFICE | KSF² | 450 | 1.21 | 5.86 |
| SMK Miftaahush Shuduur (Senior High School) | INSTITUTIONAL | KSF² | 20250 | 0.97 | 211.44 |
| Kantor Desa Cibuntu | OFFICE | KSF² | 730 | 1.21 | 9.51 |
| Description/ITE Code | Description/ITE Code | Units | Large Sqm/Unit Of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------|----------------------|-------|---------------------------|---------------|---------------------------|
| (Government Office)  | SMP Bumi Sejahtera Ciampea (Junior High School) | INSTITUTIONAL | KSF² | 3000 | 1.19 | 38.43 |
| Kantor Desa Cicadas (Government Office) | | OFFICE | KSF² | 810 | 1.21 | 10.55 |
| Kp. Wisata Rumah Joglo (Horse Race Track) | | RECREATIONAL | Acres | 8.35 | 4.3 | 35.91 |
| Kantor Desa Tegal Waru (Government Office) | | OFFICE | KSF² | 260 | 1.21 | 3.39 |
| Kantor Desa Bojong Jengkol (Government Office) | | OFFICE | KSF² | 630 | 1.21 | 8.21 |
| PT. G&S (General Light Industrial) | SMA Hanura (Senior High School) | INDUSTRIAL | KSF² | 11200 | 0.97 | 116.94 |
| Kp. Wisata Cinangneng (Country Park) | Kantor Desa Cihideung Udik (Government Office) | INSTITUTIONAL | KSF² | 700 | 0.97 | 7.31 |
| Kp. Wisata Cinangneng (Country Park) | KANTOR DESA CIHIDEUNG UDIK (GOVERNMENT OFFICE) | RECREATIONAL | Acres | 37.06 | 0.09 | 3.34 |
| PT. G&S (General Light Industrial) | SMK Agri Insani (Senior High School) | INSTITUTIONAL | KSF² | 13400 | 0.97 | 139.91 |
| SMP Buana (Senior High School) | | | | | | |
| SMPS Darussolihiin (Junior High School) | | INSTITUTIONAL | KSF² | 1650 | 1.19 | 21.14 |
| SMK Agri Insani (Senior High School) | | INSTITUTIONAL | KSF² | 5035 | 0.97 | 52.57 |
| SMK Farmasi Galenium (Senior High School) | | INSTITUTIONAL | KSF² | 500 | 0.97 | 5.22 |
| SMK Geo Informatika | | | | | |
| Description/ITE Code | Description/ITE Code | Units | Large Sqm/Unit Of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------|----------------------|-------|---------------------------|---------------|---------------------------|
| LODGING              | Office               | 2355  | 0.62                      |               | 1460.1                    |
| KSF^2                |                      |       |                           |               |                           |
| Small                |                      |       |                           |               |                           |
| Lodging              | Office               | 600   | 1.21                      |               | 7.81                      |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 400   | 1.21                      |               | 5.21                      |
| KSF^2                |                      |       |                           |               |                           |
| Lodging              | Office               | 9450  | 1.19                      |               | 121.05                    |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 1225  | 1.19                      |               | 15.69                     |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 650   | 0.97                      |               | 6.79                      |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 15600 | 0.97                      |               | 162.88                    |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 5000  | 0.97                      |               | 52.21                     |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 2450  | 1.21                      |               | 31.91                     |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 450   | 1.21                      |               | 5.86                      |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 6099  | 0.97                      |               | 63.68                     |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 300   | 1.21                      |               | 3.91                      |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 350   | 1.21                      |               | 4.56                      |
| KSF^2                |                      |       |                           |               |                           |
| Office               |                      | 1200  | 0.97                      |               | 12.53                     |
| KSF^2                |                      |       |                           |               |                           |

**Zainab Nina**  
*Generation and Attraction Travel in Bogor District*
The results of the analysis of the generation and pull calculations in Dramaga District are presented in the following table:

**Table 7. Calculation of Generation and Withdrawal in Dramaga District**

| Description/ITE Code | Description/ITE Code | Units | Large Sqm/Unit of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------|----------------------|-------|---------------------------|---------------|-----------------------------|
| School Yayasan Darulfalah (Senior High School) | INSTITUTIONAL | KSF | 33000 | 0.97 | 344.56 |
| SMPN 1 Ciampea (Junior High School) | INSTITUTIONAL | KSF | 3308 | 1.19 | 42.37 |
| Pasar Ciampea Indah (Wholesale Market) | RETAIL | KSF | 29320 | 0.88 | 277.74 |
| Pasar Lama Ciampea (Wholesale Market) | RETAIL | KSF | 17000 | 0.88 | 161.03 |
| Kantor Desa Ciampea (Government Office) | OFFICE | KSF | 500 | 1.21 | 6.51 |
| Total | | | | | 4636 |

(Source: Analysis Results)
| Description/ITE Code       | Description/ITE Code       | Units | Large Sqm/Unit of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------------|----------------------------|-------|---------------------------|---------------|---------------------------|
| Manggah Dua (Junior High School) |                            |       |                           |               |                           |
| Kantor Desa Suka Wening (Government Office) | OFFICE | KSF² | 610                        | 1.21          | 7.95                      |
| SMP Yafahi (Junior High School) | INSTITUTIONAL | KSF² | 1900                       | 1.19          | 24.34                     |
| SMK Yafahi (Senior High School) | INSTITUTIONAL | KSF² | 1900                       | 0.97          | 19.84                     |
| Kantor Desa Neglasari (Government Office) | OFFICE | KSF² | 550                        | 1.21          | 7.16                      |
| SMK Globin (Senior High School) | INSTITUTIONAL | KSF² | 2400                       | 0.97          | 25.06                     |
| Pasar Dramaga (Wholesale Market) | RETAIL | KSF² | 2760                       | 0.88          | 26.14                     |
| Kantor Desa Sinarsari (Government Office) | OFFICE | KSF² | 400                        | 1.21          | 5.21                      |
| Kantor Desa Cihang (Government Office) | OFFICE | KSF² | 1050                       | 1.21          | 13.68                     |
| SMPN 2 Dramaga (Junior High School) | INSTITUTIONAL | KSF² | 11000                      | 1.19          | 140.90                    |
| SMA Negeri 1 Dramaga (Senior High School) | INSTITUTIONAL | KSF² | 14010                      | 0.97          | 146.28                    |
| Rs. Karya Bhakti Pratiwi (Hospital) | INSTITUTIONAL | KSF² | 7455                       | 0.93          | 74.63                     |
| Kantor Kecamatan Dramaga (Government Office) | OFFICE | KSF² | 2800                       | 1.21          | 36.47                     |
| Mc Donald (Fast Food Restaurant With Drive Through Window) | SERVICES | KSF² | 450                        | 33.84         | 163.92                    |
| Kantor Desa | OFFICE | KSF² | 1150                        | 1.21          | 14.98                     |
The results of the analysis of the generation and pull calculations in Rancabungur District are presented in the following table:

### Table 18. Calculation of Generation and Withdrawal in Rancabungur District

| Description/ITE Code | Description/ITE Code | Units | Large Sqm/Unit of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------|----------------------|-------|--------------------------|---------------|---------------------------|
| Kantor Desa Mekarsari (Government Office) | OFFICE | KSF² | 740 | 1.21 | 9.64 |
| Ponpes Rafah (School) | INSTITUTIONAL | KSF² | 14000 | 1.19 | 179.33 |
| SMPN 1 Rancabungur (Junior High School) | INSTITUTIONAL | KSF² | 10000 | 1.19 | 128.09 |
| Total | | | | | 1131 |
| Description/ITE Code | Description/ITE Code | Units | Large Sqm/Unit Of measure | Coefisien ITE | ITE Generation (trip/hour) |
|----------------------|----------------------|-------|---------------------------|---------------|---------------------------|
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | INSTITUTIONAL KSF² | 3000 | 1.19 | 38.43 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | INSTITUTIONAL KSF² | 30000 | 0.97 | 313.24 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | OFFICE KSF² | 1100 | 1.21 | 14.33 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | OFFICE KSF² | 370 | 1.21 | 4.82 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | INSTITUTIONAL KSF² | 5390 | 0.97 | 56.28 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | OFFICE KSF² | 300 | 1.21 | 3.91 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | OFFICE KSF² | 870 | 1.21 | 11.33 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | INSTITUTIONAL KSF² | 2130 | 0.97 | 22.24 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | INSTITUTIONAL KSF² | 2470 | 0.97 | 25.79 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | OFFICE KSF² | 550 | 1.21 | 7.16 |
| SMP Purnawarna (Junior High School) SMK Pembina Bangsa (Senior High School) Kecamatan Rancabunggu | OFFICE KSF² | 415 | 1.21 | 5.41 |
Table 19. Calculation of Generation and Withdrawal in Rancabungur District

| Zona   | Kelurahan       | Sub-District    |
|--------|------------------|-----------------|
| 1      | Situ Udik        |                 |
| 2      | Situ Ilir        |                 |
| 3      | Cibatok 2        |                 |
| 4      | Ciaruten Udik    | Cibungbulang    |
| 5      | Cibatok 1        |                 |
| 6      | Sukamaju         |                 |
| 7      | Cemplang         |                 |
| 8      | Galuga           |                 |
| 9      | Dukuh            |                 |
| 10     | Cimanggu 2       |                 |
| 11     | Cimanggu 1       |                 |
| 12     | Girimulya        |                 |
| 13     | Leuweung Kolot   |                 |
| 14     | Ciaruten Ilir    |                 |
| 15     | Cijujung         |                 |
| 16     | Ciampea Udik     |                 |
| 17     | Cinangka         |                 |
| 18     | Cibuntu          |                 |
| 19     | Cicadas          |                 |
| 20     | Tegal Waru       | Ciampea         |
| 21     | Bojong Jengkol   |                 |
| 22     | Cihideung Udik   |                 |
| 23     | Cihideung Ilir   |                 |
| 24     | Cibanteng        |                 |
| 25     | Bojong Rangkas   |                 |
The results of the existing 2019 Origin Destination Matrix for the 4 sub-district study areas are shown in the following table:

**Table 20. MAT Existing Study Area 2019**

(Source: Analysis Results)

Road Network Modeling in the 4 sub-district study locations is shown in the following Figure:

**Figure 4. Road Network for the Study Location (Source: Analysis Results)**
The following is a picture of the road loading (VCR Variable Intensity) of the study location.

![Figure 5. VCR Variable Intensity (Source: Analysis Results)](image)

**Figure 5.** VCR Variable Intensity (Source: Analysis Results)

Figure 6. The Pattern of Generation and Withdrawal of the Existing 2019 Study Sites (Source: Analysis Results)

The origin-destination matrix is charged to the road network and calibrated to obtain rsq for the design of the transportation modeling equation in the four study districts, namely \( Y = 2310.06 + 273.16 \times X \) which is presented in the following figure:

![Figure 7. Calibration Results of the 2019 Study Location Network (Source: Analysis Results)](image)

**Figure 7.** Calibration Results of the 2019 Study Location Network (Source: Analysis Results)

**CONCLUSION**

Based on the results and discussion that have been described, the following conclusions can be drawn, the existing condition of the road network in the study area shows that the LoS is in the range A to F service for vulnerable E and F, while other roads in the study area have an average service level value for vulnerable B. This occurs as a result of greater movement in the main road corridor. The number of awakening and withdrawals in the education area, hospital, offices and trade/shopping areas in Cibungbulang District, Ciampia District, Drama District and Rancabungur District is 9,522 trips/hour with an attraction of 382,504 pcu/hour. The design of the transportation modeling equation in the four study districts, namely \( Y = 2310.06 + 273.16 \times X \).

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