FINAL PROJECT

COMPARISON OF ROAD PERFORMANCE ON MALIOBORO AREA BEFORE AND AFTER THE APPLICATION OF A ONE-WAY SYSTEM

Submitted to the Islamic University of Indonesia Yogyakarta to Fulfill the Requirements to Obtain a Bachelor's Degree in Civil Engineering

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Arranged by

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a Bachelor's degree in Civil Engineering

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I hereby solemnly declare that the Final Project report that I compiled as part of the Bachelor program at the Civil Engineering Study Program, Faculty of Civil Engineering and Planning, Islamic University of Indonesia is my own work. Certain parts of the Final Project report that I quoted from the work of others were written clearly in the source in accordance with the norms, rules, and ethics of writing scientific papers. If it is discovered in the future that all or part of this Final Project report was not the result of my own work, or that there is plagiarism in certain sections, I am willing to accept sanctions, including the revocation of my academic degree, in accordance with applicable laws and regulations.

Yogyakarta, 21 March 2022

Who make the statement,

METERAI TEMPEL

Thareq Ikramul Tanza

(17511243)

PREFACE

Praise and gratitude I pray to Allah SWT, because thanks to His grace and guidance I was able to complete this final project entitled comparison of road performance on Malioboro street before and after the application of a one-way system. This final project is one of the academic requirements in completing undergraduate studies at the Civil Engineering Study Program, Faculty of Civil Engineering and Planning, Islamic University of Indonesia, Yogyakarta.

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Finally, I hope that this Final Project can be useful for various parties who read it and for developments in the world of Civil Engineering for further research.

Yogyakarta, 21 March 2022

Author,

Thareq Ikramul Tanza

17511243

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LIST OF NOTATIONS AND ABBREVIATIONS

LV	= *Light Vehicle*
HV	= *Heavy Vehicle*
MC	= *Motor Cycle*
UM	= *UnMotorized*
IHCM 1997	= Indonesian Highway Capacity Manual 1997
OWS	= One Way System
Emp	= Passenger Car Equivalence
FV	= Light vehicle free flow speed
FV_0	= The basic free flow speed of light vehicles
FV_W	= Effective traffic lane width adjustment
FV_{SF}	= Side resistance condition adjustment factor
FV_{CS}	= City size adjustment factor
C	= Capacity (pcu/hour)
C_0	= Basic capacity (pcu/hour)
FC_W	= Traffic Lane width adjustment factor
FC_{Sp}	= Directional separation adjustment factor
FC_{SF}	= Side resistance adjustment factor
FC_{CS}	= City size adjustment factor
DS	= *Degree of Saturation*
Q	= Total flow (pcu/hour)
V	= LV average speed (km/h)
L	= Segment length (m)
TT	= Average LV travel time along segment (seconds)
LOS	= *Level of Service*
PTV - AG	= *Planning Transportasi Verkher AG*
VISSIM	= *Verkehr InStadten Simulations Model*
m	= meter
km	= kilometer

pcu	= Passenger car unit
GEH	= Validation value using the GEH Equation

ABSTRACT

The Malioboro area is a shopping and tourist area in Yogyakarta that is a popular tourist destination, resulting in traffic jams. The implementation of the One-Way System is one of the efforts to alleviate traffic congestion in the Malioboro area. The goal of this study was to determine the performance of Malioboro Street before and after the one-way system was implemented, as well as the impact of the one-way system on the surrounding roads such as Abu Bakar Ali Street, Malioboro Street, Margo Mulyo Street, Suryatmajan Street, PS Senopati Street, Mayor Suryotomo Street, and Mataram Street.

The quantitative descriptive method is used in this study. The primary data for this study came from a survey conducted at the research site, and the secondary data came from the Yogyakarta City Transportation Agency. The two sets of data were then analyzed in Microsoft Excel and modeled in PTV VISSIM. After confirming the validity of the modeling results, proceed with the analysis of road performance using Indonesian Highway Capacity Manual 1997 (Manual Kapasitas Jalan Indonesia 1997) to obtain a comparison of the degree of saturation, speed, and level of service on the road sections studied before and after the implementation of the one-way system in the Malioboro area in accordance with the Regulation of Transportation Minister Number 96 of 2015.

The Malioboro Road Section had a saturation level of 0. prior to the implementation of the One Direction system in the Malioboro Area. After the implementation of the One Direction system in the Malioboro Area, the degree of saturation improves to 1,22, a 42 percent decrease with an average speed of 22 km/hour, and the average speed of the Malioboro Road Section increased with an average speed of 24,8 km/hour but remained on level of service F. The speed of the Abu Bakar Ali Road Section has decreased by 58 percent and remains at level of service F with a 51 percent decrease in the degree of saturation, the speed of the Malioboro Road Section has increased by 11 percent and remains at level of service F with a 42 percent decrease in the degree of saturation, and the speed of the Suryatmajan Road Section has decreased by 19 percent with a 27 percent decrease in the degree of saturation, and overall decreases in speed and increasing number of degree of saturation while still in the F Level of Service in Mataram Street, Margoo Mulyo Street, PS Senopati Street and Mayor Suryotomo Street.

Keywords: Degree of saturation, IHCM 1997, level of service, speed, and *PTV VISSIM*.

CHAPTER I
BACKGROUND

1.1 Background

Malioboro Street is one of three streets in Yogyakarta City that connect Tugu Yogyakarta with the Yogyakarta Post Office. It is comprised of three streets: Pangeran Mangkubumis, Malioboros, and Jend. A. Yanis. This Street is the axis of the Yogyakarta Palace Imaginary Line. Along Malioboro Street, rows of street vendors sell a variety of goods, including batik clothing, accessories, handicrafts, ethnic bags, sandals, and other Yogyakarta-specific items that pedestrians can access.

This road is frequently congested with people and vehicles traveling and conducting business. Due to an increase in vehicle volume, this area is almost always crowded with tourists and traders, causing overcrowding and congestion. This has an impact on road performance in the Malioboro area. Finally, traffic planning and structuring has been completed. As a result, the Malioboro area is pedestrian-friendly and free of traffic jams.

In collaboration with PT Dwi Eltis Consultant, the Yogyakarta Communications and Informatics Department of Transportation will determine traffic engineering for the impact of pedestrianization in 2020 to help improve traffic mobility and flow on Malioboro Street and its surrounding roads. One-way streets are being implemented around Malioboro Street on Mayor Suryotomo Street and Mataram Street, which have now changed directions to the north, while Pasar Kembang Street has changed to a one-way system to the west, and Letjen Suprapto is a street that goes south. One-way streets have benefits and drawbacks, and the urban traffic network is a complicated and vast system. Any change in traffic conditions could affect the network's overall state. Traditional solution methods are convenient and quick to calculate, but their accuracy is often limited, and the need for more precise calculation results drives us to improve traditional solution methods. As a result, from the standpoint of the overall network, it is necessary to optimize the layout of one-way streets in the network and steer the development of the street network traffic operation efficiency in a positive direction.

Before it was determined, a study was conducted on the modeling of the area, and the scenario with the lowest V/C ratio value was obtained and then determined. According to the Minister of Public Works (1997), the standard V/C ratio for urban roads is 0.75. As a result of the scenario, some of these roads that previously had a two-way system now have a one-way system. Following the modeling, the V/C Ratio on the roads in the Malioboro area should decrease. A change in direction on several roads in the Malioboro area caused the decrease in V/C ratio value. Some two-way streets in the Malioboro area have been converted to one-way streets, while others have remained unchanged.

Malioboro Street, Margo Mulyo Street, which is still a one-way street, KH. Ahmad Dahlan Street, and Pangeran Senopati Street, which are both two-way streets, have not changed direction. Changes in traffic flow occurred in the Malioboro Street Area, particularly on Mayor Suryotomo Street, which went from two directions (North - South and South - North) to one direction (South – North), Abu Bakar Ali Street, and Mataram Street, which were previously two directions. Malioboro Street had a V/C ratio of 0.93 prior to the one-way system's implementation according to Yogyakarta Department of Transportation (2019).

Road performance research needs to be carried out after the implementation of the one-way system on Malioboro Street with a looping system with surrounding roads, namely Abu Bakar Ali Street, Margo Mulyo Street, Pangeran Senopati Street, Mayor Suryotomo Street, and Mataram Street. Prior to the implementation of the one-way system, Abu Bakar Ali Street had a V/C ratio of 0.99, Pangeran Senopati had a V/C ratio of 0.83, Mayor Suryotomo had a V/C ratio of 0.80, and Mataram had a V/C ratio of 0.76 according to Yogyakarta Department of Transportation (2019). Performance research is required following the implementation of the one-way system on Malioboro Street with a looping system with surrounding roads. The PTV VISSIM *Software* was used to model and simulate traffic scenarios in this study.

1.2 Problem Formulation

According to the context described above, the problem is formulated as follows:

1. How is the Malioboro Street performing before and after the implementation of the One-way System
2. How does the one-way traffic system on Malioboro Street affect the service level of the surrounding Streets (Suryotomo Street, Mataram Street, Abu Bakar Ali Street, Malioboro Street, Margo Mulyo Street, Suryatmajan Street, and P. Senopati Street)?

1.3 Research purposes

The objectives of the research are as follows.

1. Understanding the condition of the Malioboro Street's performance before and after implementing one-way traffic.
3. Determine the impact of Malioboro Street's one-way traffic system on the service level of the surrounding Streets Streets (Suryotomo Street, Mataram Street, Abu Bakar Ali Street, Malioboro Street, Margo Mulyo Street, Suryatmajan Street, and P. Senopati Street)?

1.4 Research Benefits

The findings of this study are expected to be useful to the following parties:

1. In terms of traffic management on the Malioboro Street.
2. As a source of information for the government about the current state of Malioboro Streets, it is hoped that the research will improve the condition of Malioboro Streets and its surroundings.
3. Serve as a resource for students interested in Street planning, particularly traffic management.

1.5 Research Limit

The following are the research limitations in this study.

1. The study took place on Malioboro Street in Yogyakarta City.

The boundaries of the research area consist of Abu Bakar Ali Street, Malioboro Street, Senopati Street, Mayor Suryotomo, Matram Street, Margo Mulyo Street, and Surwell as 4 intersections connecting these sections which can be seen in Figure 1.1

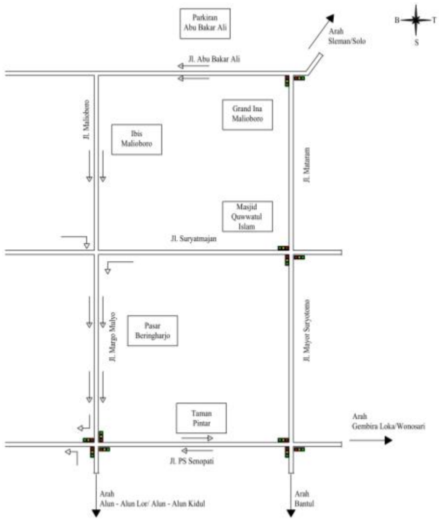


Figure 1.1 Research sites

2. During peak hours, field surveys were conducted using *CCTV* to determine previous traffic conditions and the number of motorized vehicles on Malioboro Street in Yogyakarta.
3. The method of analysis is modeling with the PTV Vissim *Software*.
4. The road performance is being analyzed using Indonesian Highway Capacity Manual (IHCM) 1997.
5. The level of service on the road sections are evaluated according to the PM 96 of 2015.
4. According to the special conditions in the Indonesian Highway Capacity Manual (IHCM)1997, the side friction class is determined by looking at the conditions around the road segment.
5. The degree of saturation, Speed and the capacity of the road segment on Malioboro Street in Yogyakarta City are used to determine road segment performance parameters.
6. Compare data before and after the study using the Transportation Department

of Communication and Informatics Final Report from 2019

7. The aisle around the location is not taken into consideration.

CHAPTER II
LITERATURE REVIEW

2.1 General review

Regardless of whether or not a traffic signal is present, a road segment is a section of road between a track on and off. Land transport infrastructure, including complementary Street infrastructure, on the ground surface, above ground or water surfaces, and beyond water areas, excluding railways, trucks, and cableways, and including all areas of roads, including complementary buildings, was defined as road in 2006. Roads are used as part of the transportation infrastructure to maximize human prosperity in the areas of economics, sociocultural, environmental protection, politics, defense, and safety. In terms of economics, Wall Street acts as a link between the market and the consumer.

From a socio-cultural standpoint, the existence of the Road strengthens the horizon of the community and can serve as a vehicle for social change, tolerance, and the dismantling of cultural frictions. Road is required to support sustainable development from an environmental standpoint. From a political standpoint, Road connector and bind regions, whereas from a defense and security standpoint, Road provide access and mobility in the implementation of the defense and security system.

Public roads and special roads are divided into two categories based on their designation. Special Streets are built for the benefit of agencies, businesses, individuals, or community groups, whereas public Roads are designed for general traffic. The system, function, status, and class of public roads are all classified. Meanwhile, special roads are used to distribute goods and services and are not designed for general traffic. According to Chutipong Paraphantakul's research, Indonesia has five types of roads: National Road, Provincial Road, District Road, Urban Road, and Village Road (2014).

2.2 Previous Research Results

Many other researchers have conducted research on Road performance evaluation, despite the fact that the Road studied are in different locations and times. The results of previous researchers' research are very useful as a reference for the research to be done and as a comparison of the success rate of the research carried out.

Dewi (2012), with the subject C. Simajuntak Street sector as the subject, performed a study on the Indonesian Highway Capacity Manual method (IHCM 1997). The survey on traffic flow was conducted in sunny weather during two days from 11:00 to 13:00 and 15:30 to 17:30 The saturation degree is 0.97 based on the results of the observations and analysis. Installing stop signs and no parking signs to increase the value of side frictions in order to improve Street performance is how traffic management is done. However, the obtained saturation value of 0.85 is insufficient to improve Street performance and comply with the provisions. Furthermore, between 06.00 and 06.00 18.00, one-way Streets are implemented to improve the performance of these Streets. As a result, the saturation level was 0.44.

Winnetou and Munawar (2015) conducted a study on the use of *VISSIM Software* for the evaluation of the 1997 IHCM count on the performance of urban Streets on Street Affandi, Province of the Special Region of Yogyakarta. This study compared the speed of a car (LV) with a motorcycle (MC) on urban Streets on Street Affandi. The primary goal of this study is to determine the dependability of the *VISSIM Software* for use in Street performance analysis in Indonesia, specifically on Street Affandi, and to state whether there are significant differences in the LV and MC analysis calculations between the *VISSIM Software* with field conditions and the 1997 IHCM method with field conditions. The *VISSIM* calibration and validation and the validation of the vehicle speed analysis were carried out by statistic tests in this study. Validation of the volume of vehicle shall be carried out using the statistical formula of Geoffrey E. Havers (GEH) and validation of average vehicle speed shall be carried out by means of the MPF (MAPE). During the speed analysis, it will be determined whether there is a significant difference between the speed in the field and the speed in the 1997 IHCM and *VISSIM Software*.

According to the research, the *VISSIM* calibration procedure is extremely important in order to simulate the real conditions in the field, and the speed analysis of the *VISSIM* running results shows that the velocity of cars or motorcycles is not significantly different from the on-the-ground speed in the *VISSIM Software*. Meanwhile, the speed of the car and the speed of the motorcycle for IHCM is significantly different; this is due to the development of transportation in Indonesia, which resulted in different vehicle speeds and driver characteristics (Winnetou & Munawar, 2015).

Daulay (2017) investigated the performance of the South Mangkubumi Street under current conditions and then modelled the Street using the *VISSIM Software*. The study makes use of secondary data gathered by the Yogyakarta Transportation Agency in 2015. According to the findings of the observations and analyses, the degree of saturation of South Mangkubumi Street in its current condition is 0.71, Magelang Street is 0.84, Diponegoro Street is 0.51, and Wolter Mongunsidi Street is 0.46. In the current condition, vehicles passing on Street Mangkubumi Selatan average 10.43 km/h, with speeds ranging from 26.52 km/h on Street Magelang to 25.50 km/h on Street Diponegoro and 23.16 km/h on Street Wolter Mangunsidi.

On the surrounding sections, the impact of the one-way system design on Street Mangkubumi Selatan decreases from 0.71 to 0.60 on the Mangunsidi Street, Wolter 0.46 on the Street, and Street Diponegoro on the South Magelang Street from 0.51 to 0.57, the South Magelang Street, and the degr of the one-way systems design, on the Selatan. The speed on each Street increased to 29.71 kilometers per hour on Street Magelang, 30.56 kilometers per hour on Diponegoro Street, and 22.87 kilometers per hour on Wolter Mangunsidi Street.

Hidayat (2016) conducted research on the Prawirotaman Street. The *VISSIM Software* is modeled. The data used in this study were derived from a three-hour afternoon volume survey of conditions following use of single-way traffic conducted by the Yogyakarta City Transport Service in the period 15.30-8.30 WIB based on peak hour volume in 2015. The degree of saturation on Street Prawirotaman before the change in the one-way system was 0.46, while the condition after the change in the one-way system was 0.06, indicating an increase of 87.45 percent. The condition of the Prawirotaman Street's degree of service did not alter before and after the one-way implementation, remaining at F value despite a 15.72 percent rise in speed, from 23.87 km/h to 27.62 km/h.

Bandi & George (2020), investigated the use of *VISSIM* to undertake microsimulation-based modeling with a focus on gaining a proper understanding of Mangalore City's traffic flow characteristics for heterogeneous traffic composition. Using a previously calibrated and validated *VISSIM* model, the current analysis focused on identifying short and long-term improvements at chosen places in Mangalore City’s Road network. Based on video-graphic data on automobile flows across 18 mid-block areas in the city, the model was calibrated for vehicle, driver, and roadway characteristics. Microsimulation techniques are used in the modeling of vehicular flows on urban road networks. These methods provide the foundation for investigating traffic flow characteristics.

Simulation-based approaches are cost-effective in modeling traffic flow, performing detailed analyses on existing traffic scenarios, and studying the impact of short-term and long-term road network improvements. According to the study on short-term and long-term improvements at selected city locations, overall stopped delays have decreased from 25.06s to 12.08s, saving 52 percent in fuel due to vehicle idling. On average, there has been a 37% improvement in stopped delays for auto-rickshaws, compared to a 78% improvement for buses, autos, and light commercial vehicles (LCVs)(Bandi & George, 2020).

Zhang et al.(2020)do research to convert a two-way street in China into a one-way street to relieve traffic congestion in a megacity, which has the advantages of saving money, convenience, and speed. A one-way street's location in China is currently largely determined by human experience and lack of scientific basis. They establish a one-way street network planning model in this context. The optimal method of adding a one-way street to the existing traffic network is found using this model, which is solved using a genetic algorithm. The abstract things are quantified, and the traffic control department is given some feasible, specific, and efficient implementation steps for designing a one-way street network. Furthermore, using traffic in the core area of Tongzhou New City as an example, they construct the actual street network model and the one-way street network model in the core area of Tongzhou New City and compares their simulation results.

They design a one-way street network in the core area of Beijing's Tongzhou New City using the proposed one-way street network planning model and improved GA. The results show that, when compared to the actual street network, the improved one-way street network planning scheme increased the average number of vehicles passing, the average traffic volume, the average speed, and the average parking time by 22 percent, 20 percent, 9.23 percent, and 24 percent, respectively, validating the effectiveness of this model(Zhang et al., 2020).

The differences between the author's research and the preceding studies are shown in Table 2.1 on the next page.

Table 2.1 Comparison of previous research related to the study

Parameters	Dewi (2012)	Winnetou &Munawar (2015)	Hidayat (2016)
Title	Performance Analysis of C. Simanjuntak Street Section	Evaluation of 1997 MKJI calculations on the Performance of Urban Streets Using *VISSIM Software*	Before and After Application of a one-way system on Prawirotaman Street
Objective	Using a method based on the Indonesian Street Capacity Manual, we improved the performance of the C. Simanjuntak Street section (MKJI)	Knowing the dependability of *VISSIM* for Street performance analysis in Indonesia, particularly on the Affandi Street in Yogyakarta, and the accuracy of speed analysis on *VISSIM* and the MKJI method in field conditions	Knowing the state of the Street service level on the Street Prawirotaman section before and after one-way traffic regulation
Location	Street C. Simanjuntak Yogyakarta	Affandi Street, Yogyakarta	Street Prawirotaman,Yogyakarta

Source: Dewi (2012), Winnetou &Munawar (2015) Hidayat (2016),

Continuation of Table 2.1 Comparison of previous research related to the study

Parameters	Marsh M. and Varghese (2020)	Jun, Xinxin, yanni, & Bing (2020)	Daulay(2017)
Title	Performance Analysis of C. Simanjuntak Street Section	Evaluation of 1997 MKJI calculations on the Performance of Urban Streets Using *VISSIM Software*	Street Performance Optimization Using the One-Way Method (Regional Case Study Jetis Yogyakarta)
Objective	Analyzing the performance of the existing mangalore city road network, then modeling it with *VISSIM Software*	Using the proposed one-way street network planning model and improved GA, this paper designs a one-way street net- work in the core area of the Tongzhou New City in Beijing aiming to maximize the relative total benefits obtained by travelers.	Analyzing the performance of the existing Mangkubumi Selatan Street segment, then making it one-way and modeling it with *VISSIM Software*.
Location	Mangalore	Tongzhou New City, Beijing	Jetis area of Yogyakarta

Source: Daulay(2017) Marsh & Varghese (2020), and Zhang et al (2020)

Continuation of Table 2.1 Comparison of previous research related to the study

Parameters	Tanza (2021)
Title	Comparison of road performance on Malioboro street before and after the application of a one-way system
Objective	Knowing the current performance of the Malioboro Street and knowing what affects of the one way system implementation to the performance of the Malioboro Street using *VISSIM Software* modeling
Location	Malioboro Street, Yogyakarta

Source: Tanza (2021)

2.3 Differences between current research and previous research

The following is the difference between previous research and the research proposed by the current author.

1. This study was conducted on Malioboro Street, Yogyakarta.
2. The study compares the conditions before and after traffic management, specifically the conversion of the system from two to one direction.
3. The researchers used *VISSIM Software* to model the affected sections in three dimensions (3D) and to assess their performance.

CHAPTER III
THEORETICAL BASIS

3.1 Traffic Management

Congestion is a problem in cities where the number of vehicles exceeds the capacity of the traffic infrastructure, and it is exacerbated by car accidents. This issue has an impact on many aspects of society, including economic development, traffic accidents, an increase in greenhouse emissions, time spent, and health damages. This is where traffic control systems come in handy.

Traffic management systems are a collection of application and management tools designed to improve the overall traffic efficiency and safety of transportation systems. The traffic management system, on the other hand, gathers data from various sources, analyzes it to identify potential hazards that could impair traffic efficiency, and then provides services to mitigate them(de Souza et al., 2017).

3.1.1 Traffic Management Goals

The goal of traffic management, according to Malkhamah (1996), is as follows.

1. Obtain an efficient level of overall traffic movement with a high level of accessibility by balancing demand with available supporting facilities,
2. Increase the level of safety from users that is acceptable to all parties and improve the level of safety as much as possible, and
3. Protect and improve the condition of the environment where the traffic flow is located.

3.1.2 Traffic Management Objectives

The following are the traffic management objectives based on the aforementioned goals.

1. Control and simplify traffic flow by managing various types, speeds, and Street users to minimize disruption and smooth traffic flow.
2. Reducing traffic congestion by increasing capacity or decreasing traffic volume on a Road.

3. Optimizing the Road segment by determining the Street's function and controlling activities that are incompatible with the Street's function

3.1.3 Traffic Management Strategies and Techniques

There are three general traffic management strategies that can be combined as part of a traffic management plan. These techniques are as follows.

Table 3.1 Traffic Management Strategis and Techniques

Strategies	Techniques
Capacity Management	1) Junction repair 2) Road segment management: - Separation of vehicle types - "on street parking" control (place, time) - Street widening 3) Traffic control areas: - Limitation of turning places - One-way street system - Traffic light coordination
Priority Management	1) Priority buses, for example, special bus lanes 2) Access to freight transportation, unloading, and loading 3) Bike path 4) Parking lot management
Demand Management (*restrain*)	1) Parking regulations 2) lane closures 3) Control and area licensing *4)* Physical constraints

Source: Direktorat Jendral Bina Marga (1997)

According to Munawar (2006), traffic management strategies are traffic control systems, which are traffic regulations in the form of orders or prohibitions. The order or prohibition is communicated through traffic lights, traffic signs, or Street markings. The traffic control system consists of.

1. At the Crossing Road.
    a. Optimization of traffic lights
    b. Priority for city buses at signalized intersections
    c. Traffic light coordination
2. At the intersection's entrance or exit.
    a. One-way street
    b. Turn left and continue at the red light
    c. No turning right
    d. The Street is only for local residents.
3. Utilization of a Road Path
    a. No cars with fewer than three passengers
    b. Reversible path
    c. Designated public transportation lanes
4. Use of The Side of The Road.
    a. Parking restrictions
    b. Bus stop placement
    c. Determination of loading and unloading zones
    d. Sidewalk widening or narrowing
5. Vehicle Speed.
    a. Installation of Road bumps
    b. Special parking for public transportation
    c. Parking time limitations
    d. Parking lot control
    e. Information for Street users
    f. *Road pricing* (paid Street system)
    g. Modification of public transportation operations
    h. Modification of Road users

3.*2* Road Section

A Road section, according to the Directorate General of Highways (1997), is a section or section of a Street between two nodes/intersections on or off a plot, whether or not equipped with a traffic signaling device.

Road is land transportation infrastructure that include all parts of the Street, including complementary buildings and traffic equipment, that are on the ground surface, above the ground surface, below the ground and/or water surface, and above the water surface, excluding Streets, railroad, lorries, and cableways.

3.*3* Road Perfomance

To be able to solve traffic problems on a Street section, a performance evaluation that provides an overview of the current conditions on that Street section is required. Traffic parameters can be used to evaluate the performance of urban Streets. Furthermore, the appropriate solution to the problems that arise on the Street segment can be planned. The variables that can be used as traffic parameters are as follows.

a. Traffic flow,
b. Capacity,
c. Degree of saturation,
d. Travel speed

3.4 Road Characteristics and Conditions

Each Street stretch has its own set of characteristics. Here are some Street characteristics.

3.4.1 Road Geometry

According to Direktorat Jendral Bina Marga (1997), geometric condition is a condition that reflects the shape, composition, and proportion of the observed Street segment. To determine the geometric conditions of the Street, direct measurements in the field and a sketch of the cross section of the Street segment are required. The following sections of the Street need to be reviewed:

1. A traffic lane is the width of the part of the Street designated for motorized

vehicles to pass, stop, and park, excluding the Street shoulder.

2. The median is the area that separates the traffic directions on a Street segment.
3. A curb is an elevated boundary made of rigid material that is located between the edge of the traffic lane and the sidewalk.
4. The Street shoulder is the side of the planned traffic lane reserved for stopped vehicles, pedestrians, and slow vehicles.
5. A sidewalk is a section of the Street designated for pedestrians that runs parallel to the Street and is separated from it by a curb.
6. An edge channel is a channel along the edge of a Street body that is designed to store and distribute water so that the Street body is not affected by water.

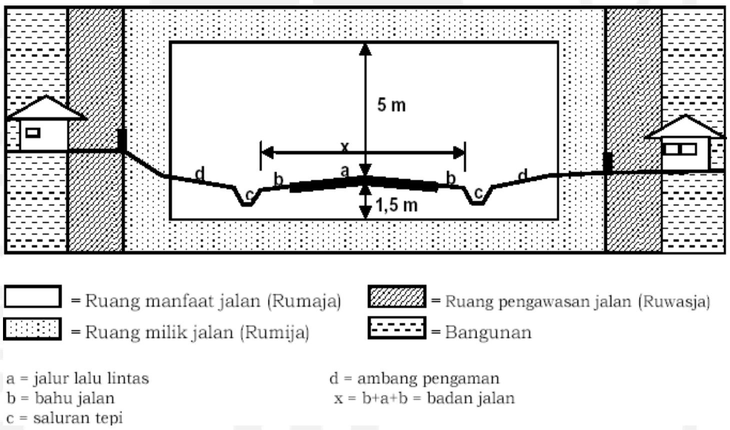


Figure 3.1 Road Cross-Section Sketch

Source : Bina Marga 2006

3.4.2 Traffic Flow

According to The Direktorat Jendral Bina Marga (1997), traffic flow is defined as the number of motorized vehicles passing through a point on a Street per unit time. Traffic volume data in the form of AADT (*Annual Average Daily Traffic*) or peak hour volume data can be used to analyze Street performance using the 1997 Indonesian Highway Capacity Manual (IHCM). The goal of a traffic volume study is to obtain accurate data on the number of vehicle movements that occur on the Street under consideration.

According to Alamsyah (2008), when calculating the number of vehicles, factors or conditions in the field that can affect traffic volume must be considered.

The following conditions in the field must be avoided when performing calculations.

1. Special time conditions: holidays, sporting events, performances, strikes by public transport employees and others.
2. The weather is not normal.
3. Street blocks/repairs near the area.

The time of manually calculating the volume of traffic is adjusted to the conditions of the place where the schedule for going to and returning from work, school, shopping, and recreation is adjusted. The calculation period is determined by taking into consideration the peak hours when the most volume is present. The following calculation schedule can be used as a guide in the implementation of traffic calculations in this study.

1. 12 Hour Period : 06.00 – 18.00
2. 8 Hour period : 06.00 – 10.30 and 14.00 – 17.30
3. 4 Hour Period : 06.00 – 08.00 and 15.00 – 17.00

The flow of various types of vehicles must be converted into passenger car units in order for it to be used (pcu). The passenger car equivalent (emp) is a factor used to compare different types of vehicles to light vehicles in terms of their impact on the speed of light vehicle capacity in traffic flow. The passenger car equivalent (emp) for each vehicle type is determined by the type of Street and the total traffic flow, which is expressed in vehicles per hour. The emp value is classified according to the type of vehicle as follows.

1. A Light Vehicle (LV) is a two-axle, four-wheeled vehicle with an axle distance of 2.0 – 3.0 m. (including passenger cars, microbuses, pickups, and small trucks according to the Bina Marga classification system).
2. A Heavy Vehicle (HV) is a motor vehicle with an axle distance greater than 3.5 m and more than four wheels (including bus, 2 axle truck, 3 axle truck, and combination truck according to the Bina Marga classification system).

3. A Motorcycle (MC) is a two- or three-wheeled motorized vehicle with two or three wheels (including motorcycles and 3-wheeled vehicles according to the Bina Marga classification system).

The emp value for urban Streets is shown in Tables 3.2 and 3.3.

Table 3.2 Passenger Car Equivalent (emp) for Undivided Urban Streets

Street type: Undivided Lane	Traffic flow per lane (Veh/Hour)	Emp		
		HV	MC	
			Wc traffic lane width (m)	
			≤ 6	> 6
Two Undivided Lane (2/2 UD)	0	1,3	0,5	0,40
	≥ 1800	1,2	0,35	0,25
Four undivided lanes (4/2UD)	0	1,3	0,40	
	≥ 3700	1,2	0,25	

Source: Direktorat Jendral Bina Marga (1997)

Table 3.3 Passenger Car Equivalent (Emp) for Divided and One-Way Urban Streets

Street type: Oneway street and divided Street	Traffic flow per lane (Veh/Hour)	Emp	
		HV	MC
Two lanes one way (2/1) and Four-divided lanes (4/2 D)	0	1,3	0,40
	≥ 1050	1,2	0,25
Three lanes one way (3/1) and Six-divided lanes (6/2 D)	0	1,3	0,40
	≥ 1100	1,2	0,25

Source: Direktorat Jendral Bina Marga (1997)

Directorate General of Highways (1997), The passenger car unit factor (Fsmp) is a factor for converting the flow of traffic vehicles into equivalent flows in SMP for the purpose of capacity analysis. The passenger car unit factor can be calculated by Equation 3.1.

$$Fsmp = \frac{Qsmp}{Qkend} \qquad (3.1)$$

Information:

Fsmp = unit factor of passenger cars,

Qsmp = total flow of vehicles in smp, and

Qkend = total flow of vehicles.

3.4.3 Traffic Composition and Directional Separators

If the flow and capacity are expressed in vehicles/hour, the flow velocity relationship is affected by the ratio of motorcycles or heavy vehicles in the traffic flow. If flow and capacity are expressed in passenger car units (pcu), then traffic composition has no effect on light vehicle speed and capacity (pcu/hour). Table 3.4 shows typical traffic composition values.

Table 3.4 Normal Values for Traffic Composition

City Size (CS) (Million Citizen)	LV %	HV %	MC %
< 0,1	45	10	45
0,1 – 0,5	45	10	45
0,5 – 1,0	53	9	38
1,0 – 3,0	60	8	32
> 3,0	69	7	24

Source: Direktorat Jendral Bina Marga (1997)

The directional distribution of traffic on two-way Streets is known as directional split (usually expressed as a percentage of the total flow in each direction). Equation 3.2 can be used to calculate Directional Separation (SP)

$$SP = \frac{Q_{DH.1}}{Q_{DH.1+2}} \tag{3.2}$$

Information:

SP = direction Separator (%),

QDH.1 = total Lane 1 vehicle flow (Veh/Hour), and

QDH.1+2 = total Lane 1+2 vehicle flow (Veh/Hour)

3.4.4 Side Friction

Side friction, is the degree of interaction between regular traffic flow and other nearby activities such as on-street parking, pedestrian movement, and non-motorized vehicles. These activities have a negative impact on the overall performance of a road by impeding traffic. Street parking, for the most part, reduces the capacity of roads in two ways. First, it narrows the carriageway by enclosing the traffic flow and second gave more instability.(Biswas et al., 2021). Many activities are carried out alongside the Street in Indonesia, which is referred to as side friction. Side friction frequently causes Street conflicts, reducing Street capacity and performance. The following are examples of side friction:

1. Pedestrians.
2. Stopping public transportation and other vehicles.
3. Slow-moving vehicles, such as rickshaws or trains.
4. Vehicles enter and exit the land adjacent to the Street.
5. Street vendors who sell their wares on the side of the Street.

Table 3.5 shows the various types of side frictions for urban Streets.

Table 3.5 Side Friction Classification for Urban Roads

Side Friction class (SFC)	Code	Number of incident weights per 200 m per hour (two-sides)	Special conditions
Very low	VL	< 100	Residential areas; side street.
Low	L	100 – 299	Residential areas; some public transportation etc.
Medium	M	300 – 499	Industrial area, a few shops on the side of the Street.
High	H	500 – 899	Commercial area, high street side activity.
Very high	VH	> 900	Commercial area with market activity beside the Street.

Source: Direktorat Jendral Bina Marga (1997)

3.5 Variables Affecting Road Performance

The performance of a Road segment is a numerical measurement that describes certain conditions that occur on a street segment. The performance of a Street segment can be defined as the extent to which the Street's ability to perform its function (Morlok, 1978), with the Degree of Saturation being used as a parameter by Ditjend Bina Marga(1997). (DS). Ditjend Bina Marga(1997) also explains that the scope of the Q/C Street segment can be used to calculate the level of Street service. The level of service on the Street is a qualitative measure that explains the operational conditions in traffic flow and the driver's perception of driving quality.

3.5.1 Free Flow Speed

Free Flow Speed is a condition in which a driver is able to drive at their own pace, unhindered by factors such as, the proximity of other vehicles in front, non-permanent obstructions to the road layout such as roadworks or a broken down vehicle, and adverse weather (Highways England, 2019). Equation 3.3 can be used to calculate the free flow speed.

$$FV = (FV_0 + FV_W) \times FFV_{SF} \times FFV_{CS} \quad (3.3)$$

Information:

FV = light vehicle free flow speed (km/hour),

FV_0 = light vehicle basic free flow speed (km/ hour),

FV_W = effective traffic lane width adjustment (km/ hour),
FFV_{SF} = side friction condition adjustment factor, and
FFV_{CS} = city size adjustment factor.

The free flow speed of a Road segment under ideal conditions is defined as the basic free flow speed. The Table on the Indonesian Highway Capacity Manual (IHCM)1997 is used to calculate the value of the basic free flow speed of light vehicles (FV_0). Table 3.6 shows the value of the basic free flow speed of light vehicles (FV_0).

Table 3.6 Basic Free Flow Rate (FV0) for Urban Streets

Road Type	Traffic Speed			
	Light Vehicle (LV)	Heavy Vehicle (HV)	Motorcycle (MC)	All Vehicle (Average)
Six-lane split (6/2 D) or Three-lane one-way (3/1)	61	52	48	57
Divided Four-lane (4/2 D) or Two-lane one-way (2/1)	57	50	47	55
Undivided Four-lane (4/2 USD)	53	46	43	51
Undivided Two-lane (2/2 USD)	44	40	40	42

Source: Direktorat Jendral Bina Marga (1997)

The Indonesian Highway Capacity Manual's provisions are used to calculate the speed adjustment factor for traffic width (FV_W) (IHCM). Table 3.7 shows the value of the speed adjustment factor for the effective traffic lane width (FV_W).

Table 3.7 Adjustment Factor for the Effect of Traffic Lane Width (FV_W)

Road Type	Effective traffic lane width (Wc) (m)	FV_W (km/Hour)
Divided Four Lane or One-way Street	Each Lane	
	3,00	-4
	3,25	-2
	3,50	0
	3,75	2
	4,00	4
Undivided Four Lane	Each Lane	
	3,00	-4
	3,25	-2
	3,50	0
	3,75	2
	4,00	4
Two undivided lanes	Total	
	5	-9,5
	6	-3
	7	0
	8	3
	9	4
	10	6
	11	7

Source: Direktorat Jendral Bina Marga (1997)

For side friction conditions, the provisions of the 1997 IHCM are used to determine the value of the speed adjustment factor (FFV_{SF}). The value of the adjustment factor for side resistance conditions (FFV_{SF}) can be seen in Table 3.8.

Table 3.8 Urban Street Side Friction Condition Adjustment Factor (FFV_{SF})

Road Type	Side Friction Class (SFC)	Curb – Barrier Distance, W_K (m)			
		≤ 0,5	1,0	1,5	≥ 2,0
Divided Four Lane 4/2 D	Very low	1,00	1,01	1,01	1,02
	Low	0,97	0,98	0,99	1,00
	Medium	0,93	0,95	0,97	0,99
	High	0,87	0,90	0,93	0,96
	Very high	0,81	0,85	0,88	0,92
Undivided Four Lane 4/2 UD	Very low	1,00	1,01	1,01	1,02
	Low	0,96	0,98	0,9	1,00
	Medium	0,91	0,93	0,96	0,98
	High	0,84	0,87	0,90	0,94
	Very high	0,77	0,81	0,85	0,90
Two undivided lanes 2/2 UD or One way street	Very low	0,98	0,99	0,99	1,00
	Low	0,93	0,95	0,96	0,98
	Medium	0,87	0,89	0,92	0,95
	High	0,78	0,81	0,84	0,88
	Very high	0,68	0,72	0,77	0,82

Source: Direktorat Jendral Bina Marga (1997)

The value of the speed adjustment factor for the size of the city is determined using a table from the Highway Capacity Manual (IHCM)1997. Table 3.9 shows the value of the city size adjustment factor (FFV_{CS}).

Table 3.9 Free Flow Speed Adjusment Factor for City Size (FFV_{CS})

City size (population)	Adjustment factor for city size
< 0,1	0,90
0,1 – 0,5	0,93
0,5 – 1,0	0,95
1,0 – 3,0	1,00
> 3,0	1,03

Source: Direktorat Jendral Bina Marga (1997)

3.5.2 Capacity

Capacity (C) is defined by the Directorate General of Highways (1997) as the maximum flow through a point on the Street that can be maintained per unit hour under certain conditions.

It is specified for two-way flows (two-way combinations) on two-lane two-way Streets, but the flows are separated per direction and capacity is determined per lane on multi-lane Streets. Equation 3.4 can be used to calculate the value of the capacity (C).

$$C = C_O \times FC_W \times FC_{SP} \times FC_{SF} \times FC_{CS} \quad (3.4)$$

Information:

C = capacity (smp/hour),

C_0 = basic Capacity (smp/hour),

FC_W = traffic Lane width adjustment factor,

FC_{SP} = direction separation adjustment factor,

FC_{SF} = side friction adjustment factor, and

FC_{CS} = city size adjustment factor.

The capacity of a Street segment under predetermined geometric conditions, traffic flow patterns, and environmental factors is known as basic capacity (C_0). The basic capacity (C_0) was calculated using the provisions listed in the Indonesian Highway Capacity Manual (IHCM)1997 Table of Base Capacity for Urban Streets. Table 3.10 below shows the basic capacity values for urban Streets.

Table 3.10 Basic Capacity (C_0) for Urban Streets

Street type	Basic capacity (pcu/hour)	description
Four lanes divided or One way street	1650	Per Lanes
Four undivided lanes	1500	Per Lanes
Two undivided lanes	2900	Total two-way

Source: Direktorat Jendral Bina Marga (1997)

The value of the capacity adjustment factor for traffic lane width was determined using a table from the 1997 Indonesian Highway Capacity Manual (IHCM). Table 3.11 displays the value of the traffic lane width adjustment factor (FC_W).

Table 3.11 Capacity Adjustment Factor for Traffic Lane Width (FC_W)

Road Type	Effective traffic Street width (Wc) (m)	FCw (km/Hour)
Four lanes divided or One way street	Per lane	
	3,00	0,92
	3,25	0,96
	3,50	1,00
	3,75	1,04
	4,00	1,08
Four undivided lanes	Per lane	
	3,00	0,91
	3,25	0,95
	3,50	1,00
	3,75	1,05
	4,00	1,09
Two undivided lanes	Two-way total	
	5	0,56
	6	0,87
	7	1,00
	8	1,14
	9	1,25
	10	1,29
	11	1,34

Source: Direktorat Jendral Bina Marga (1997)

On divided Streets and one-way Streets with a direction separation adjustment factor of 1.0, the table in the Indonesian Highway Capacity Manual (IHCM)1997 is used to determine the value of the capacity adjustment factor for direction separation (FC_{SP}). The table from the 1997 Indonesian Highway Capacity Manual (IHCM)is used for undivided Streets. Table 3.12 displays the value of the direction separation adjustment factor (FC_{SP}).

Table 3.12 Capacity Adjustment Factor for Directional Separation (FC_{SP})

Separation of directions SP % - %		50 - 50	55 - 45	60 - 40	65 - 35	70 – 30
FC_{SP}	Two lanes 2-2	1,00	0,97	0,94	0,91	0,88
	Four lanes 4/2	1,00	0,985	0,97	0,955	0,94

Source: Direktorat Jendral Bina Marga (1997)

The distance between the curbs and side frictions is taken into account when determining the capacity adjustment factor for side frictions (FC_{SF}) on Streets with curbs (W_K). Table 3.13 shows the value of the capacity adjustment factor for side resistance (FC_{SF}).

Table 3.13 Capacity Adjustment Factor for Side Friciton (FC_{SF})

Road type	Side Friction class (FC_{SF})	Curb – Barrier Distance, W_K (m)			
Four lanes divided 4/2 D	Very low	0,95	0,97	0,99	1,01
	Low	0,94	0,96	0,98	1,00
	Medium	0,91	0,93	0,95	0,98
	High	0,86	0,89	0,92	0,95
	Very High	0.81	0.85	0.88	0.92

Source: Direktorat Jendral Bina Marga (1997)

Continuation of Table 3.13 Capacity Adjustment Factor for Side Friciton (FC_{SF})

Road type	Side Friction class (FC_{SF})	Curb – Barrier Distance, W_K (m)			
		≤ 0,5	1,0	1,5	≥ 2,0
Undivided Four lane 4/2 UD	Very low	0,95	0,97	0,99	1,01
	Low	0,93	0,95	0,97	1,00
	Medium	0,90	0,92	0,95	0,97
	High	0,84	0,87	0,90	0,93
	Very high	0,77	0,81	0,85	0,90
Two undivided lanes 2/2 UD One way street	Very low	0,93	0,95	0,97	0,99
	Low	0,90	0,92	0,95	0,97
	Medium	0,86	0,88	0,91	0,94
	High	0,78	0,81	0,84	0,88
	Very high	0,68	0,72	0,77	0,82

Source: Direktorat Jendral Bina Marga (1997)

Using the table in the 1997 Indonesian Highway Capacity Manual (IHCM), the capacity adjustment factor for city size (FC_{CS}) can be calculated. Table 3.14 shows the value of the FC_{CS} (capacity adjustment factor for city size).

Table 3.14 Capacity Adjustment Factor for City Size (FC_{CS})

City size (population)	Adjustment factor for city size
< 0,1	0,86
0,1 – 0,5	0,90
0,5 – 1,0	0,94
1,0 – 3,0	1,00
> 3,0	1,04

Source: Direktorat Jendral Bina Marga (1997)

3.5.3 Degrees of Saturation

Direktorat Jendral Bina Marga (1997), the main factor in determining the performance level of intersections and Street segments is the degree of saturation (DS), which is defined as the ratio of current to capacity. The degree of saturation (DS) value indicates whether or not a Street segment has a capacity problem. The main parameter used to determine the performance of a Street segment is the degree of saturation (DS). A degree of saturation (DS) value of less than 0.75 indicates good Street performance.

To get the value of the degree of saturation (DS) can be determined using Equation 3.5.

$$DS = \frac{Q}{C} \tag{3.5}$$

Information:

DS = degree of saturation,

Q = total flow (pcu/hour), and

C = capacity (pcu/hour).

3.5.4 Road Service Level

According to Regulation of Transportation Minister Number 96 of 2015, the level of service on Streets is classified as follows:

1. Service level A, with the following conditions:
   a. Free flow with low traffic volume and a speed of at least 80 kilometers/hour,
   b. Very low traffic density,
   c. The driver can maintain his desired speed without or with little delay.
2. Service level B, with the following conditions:
   a. Stable flow with moderate traffic volume and a speed of at least 70 kilometers/hour,
   b. Low traffic density traffic internal frictions have not affected the speed,
   c. The driver still has enough freedom to choose his speed and the lane of the Street used.
3. Service level C, with the following conditions:

   a. Steady flow but vehicle movement is controlled by a higher traffic volume at a speed of at least 60 kilometers/hour,
   b. Moderate traffic density due to increased traffic internal drag;
   c. The driver has limitations to choose speed, change lanes or overtake.
4. Service level D, with the following conditions:
   a. Approaching unstable flow with high traffic volume and a speed of at least 50 kilometers/hour,
   b. Still tolerable but severely affected by changing current conditions,
   c. Moderate traffic density but fluctuations in traffic volume and temporary obstacles can cause large speed drops,
   d. The driver has very limited freedom in running the vehicle, comfort is low, but this condition can still be tolerated for a short time.
5. Service level E, with the following conditions:
   a. Flow lower than service level D with traffic volume approaching Street capacity and a speed of at least 30 kilometers/hour on inter-city Streets and at least 10 kilometers/hour on urban Streets,
   b. High traffic density due to high traffic internal drag,
   c. Drivers begin to experience short duration traffic jams.
6. Service level F, with the following conditions:
   a. The flow is blocked and there is a long queue of vehicles with a speed of less than 30 kilometers/hour,
   b. Very high traffic density and low volume and congestion occurs for quite a long time;
   c. In the queue state, speed and volume down to 0.

3.6 One-Way Traffic

Because of the characteristics of traffic operation, a reasonable organization is required to improve the quality of traffic operation in old urban areas. The use of one-way traffic organization is an example of a traffic-congestion-reduction measure. It is an effective way to improve road transport efficiency or ensure road traffic safety on the open road without any road reconstruction or expansion. Road congestion has been greatly reduced as a result of domestic one-way traffic (Zhu et al., 2020).

A one-way street is a traffic management strategy used to alleviate traffic congestion. The traffic pattern on this Street has been changed from two-way to one-way. This system aims to improve Street safety and capacity, as well as reduce conflicts at intersections, allowing for a more efficient flow of traffic. In Indonesia, this pattern is commonly used, especially in urban areas.

Hobbs (1995) claims that in order to design one-way Streets, complementary Streets with the appropriate frequency of Street connections are required. The grid layout is ideal because it allows for parallel Street pairs with the same capacity to be built. On one-way Streets, stop points are critical locations that require careful planning to avoid conflict points caused by the demand for more turns. On busy streets, a one-way intersection will be beneficial.

The risk of a network crash can be reduced by removing one direction of traffic. As a result, there will be fewer conflicts at intersections, which will make pedestrian crossing movements easier. One-way traffic systems are used to replace 'grid' street patterns and create access-only streets in order to reduce congestion in city centers (usually for access to residential uses). Drivers, on the other hand, may grow accustomed to the lack of opposing traffic and increase their speed. A one-way network can also be confusing to non-locals and cause travel distances to increase.

3.6.1 Basic Conditions of One-Way Street

This category encompasses all one-way Streets with traffic lane widths ranging from 5 to 10.5 meters. The following are the basic conditions of this type of Street, from which the basic free flow speed and capacity are calculated.

1. The width of the traffic lane is 7 meters.
2. Effective shoulder width of at least 2 meters on each side.
3. There is no median.
4. Low side resistance.
5. City size 1.0 – 3.0 million Citizen.
6. Flat alignment type.

3.6.2 One-way Street Planning

There are several factors to consider before implementing a one-way Street system, including the following.

1. Any changes that need to be made in signs, traffic signaling lights, markings and other controlling equipment.
2. Take into account the effects that arise on the operation of public transportation.
3. Take into account the effect of freight transportation.
4. Consider the existing Street network whether there are Street pairs to distribute the previously bidirectional current.
5. Taking into account the effect of the parking system and also taking into account the traffic generating areas around the one-way Street.
6. Is it necessary to consider the installation of no-parking signs to meet a sufficient number of lanes.
7. The geometry of one-way Streets must be considered and considered properly so that at the meeting of two-way traffic it does not cause congestion and safety problems.

3.6.3 One-way Street Design

The features of a one-way street include:

1. In terms of the highway.

   Although the one-way Street system does not differ in detail, it has several basic factors that must be considered in the design of one-way Streets. The factors in question are as follows.

   a. The Street capacity in both directions must be balanced.
   b. The most indicated pairs of one-way streets are those that are close to each other.

2. The end of a one-way street.

   Certain Street network patterns are usually very suitable to be operated as a one-way Street system, for example Streets that intersect and become one "y" shape. In a grid pattern, a one-way street system will end at an intersection with 4 feet. If a one-way Street ends in an arterial Street, it is best if this one-way system is continued up to one block in front, so as not to affect the traffic flow on the arterial Street.

3.7 Traffic Simulation

The mathematical modeling of a transportation system (e.g., freeway intersections, route arteries, roundabouts, downtown network systems, etc.) using computer *Software* to better assist in the planning, design, and operation of the system is known as traffic simulation or transportation system simulation. transportation. Transportation system simulation has been around for more than four decades and is an important part of traffic engineering and planning.

According to Sonny (2015), traffic simulation is a useful tool for analyzing the performance of Street sections because it produces results that are close to reality. This research aims to simulate traffic movements on Streets with a wide range of Streetside land use activities and high levels of activity. The degree of saturation, travel speed, travel time, and level of service (LoS) were all measured in this study, and the results were modeled using *VISSIM Software*.

From a microscopic, macroscopic, and occasionally mesoscopic perspective, traffic simulation models are useful. Transportation planning and operations are two areas where simulation can be useful. The simulation model evaluates the impact of urban development patterns on the performance of transportation infrastructure in transportation planning.

3.8 *VISSIM*

VISSIM is a microscopic multi-mode traffic flow simulation *Software* developed by PTV-AG (2011) that can analyze the operation of private vehicles and public transportation with issues such as lane configuration, vehicle composition, traffic signals, and other issues, making it a powerful tool. Useful for evaluating alternative measures based on transportation engineering criteria and planning their effectiveness.

PTV (*Planung Transport Verkehr AG*) in Karlsruhe, Germany, created *VISSIM*. The acronym *VISSIM* stands for "*Verkehr Stadten – Simulations modell*," which translates to "Traffic in Cities – Simulation Model." This program allows you to create animations with three-dimensional enhancements.

VISSIM provides animation capabilities with major enhancements in 3-D. Simulation of vehicle types (i.e., from passenger cars, trucks, light rail and heavy trains). In addition, video clips can be recorded in the program, with the ability to dynamically change the view and perspective of other visual elements, such as trees, buildings, transit facilities and traffic signs, can be inserted into 3-D animation, PTV-AG (2011).

VISSIM's microscopic simulation model has a complex data input requirement and a large number of model parameters. Two types of data are required to build a simulated *VISSIM* model for this network and calibrate local traffic: the first type is basic input data used for simulation model network coding, and the second type is observation data used for simulation model parameter calibration. Network geometry, traffic volume, and vehicle characteristics, as well as trip demands, vehicle composition, stop signs, and traffic control systems, are all basic input data, PTV-AG (2011).

Model parameters related to physical attributes of the *VISSIM* model development, PTV-AG (2011). In micro-simulation modeling, this defines the calibration steps. The capacity parameter tells the model how well it can reproduce actual traffic capacity and conditions in the field.

VISSIM can analyze traffic and displacement with modeling constraints such as path geometry, vehicle composition, traffic signals, stop lines, driver behavior and others, making it a useful tool for evaluating various alternatives based on transportation engineering as decision-making steps. more effective and efficient in a planning activity including simulation in model development. *VISSIM* can be applied as a useful tool in various transportation problem settings, in the following list are some overviews of *VISSIM* applications.

1. *VISSIM* is used to evaluate and optimize traffic operations combined with network coordinates and actual signal settings.
2. *VISSIM* can be used for analysis of the speed of an area and areas that are joined.
3. *VISSIM* allows for comparisons of alternative designs including signal and stop signal settings at intersections.

3.9 The Use of *VISSIM* in Traffic Simulation

1. Traffic Simulation Base Data

   Because traffic conditions are interconnected and affect one another, such variability in the *VISSIM* application is required. This is accomplished in *VISSIM* by pooling several parameters using a stochastic distribution. The following parameters were used in this study:

   a. Vehicle Input, based on the results of the field survey, enter the amount of traffic flow (Veh/Hour).

   b. 2D/3DModel, Models of vehicles to be included in the simulation are chosen. In Figure 3.2, you can see how the *2D/3D* menu is displayed.

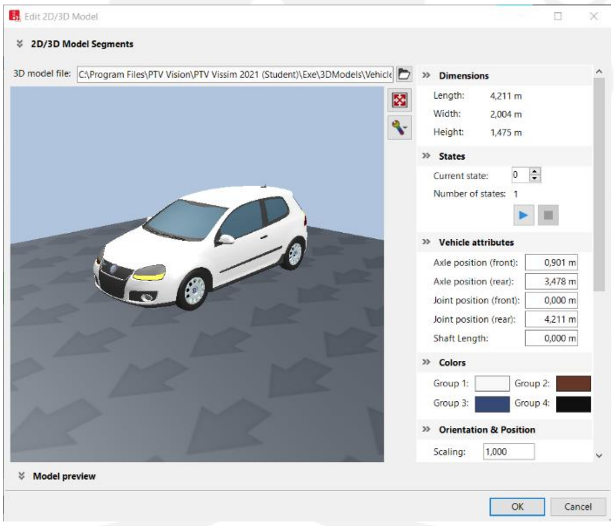
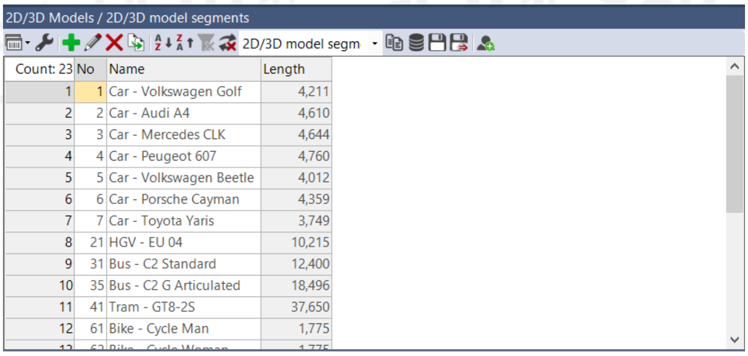


Figure 3.2 3D Models



2D/3D Models / 2D/3D model segments

Count: 23	No	Name	Length
1	1	Car - Volkswagen Golf	4,211
2	2	Car - Audi A4	4,610
3	3	Car - Mercedes CLK	4,644
4	4	Car - Peugeot 607	4,760
5	5	Car - Volkswagen Beetle	4,012
6	6	Car - Porsche Cayman	4,359
7	7	Car - Toyota Yaris	3,749
8	21	HGV - EU 04	10,215
9	31	Bus - C2 Standard	12,400
10	35	Bus - C2 G Articulated	18,496
11	41	Tram - GT8-2S	37,650
12	61	Bike - Cycle Man	1,775

Figure 3.3 2D/3D Models

c. Vehicle Composition, determining the proportion of each vehicle type in the existing traffic flow.

d. Desired Speed Distribution, Speed is an important determining parameter for all types of vehicles, and it has a significant impact on Street capacity and travel speed. If it is not obstructed by other vehicles, the vehicle can travel at its desired speed, which is set by the user. More platoons of vehicles will be formed as more types of vehicles with different desired speeds are developed. Figure 3.4 shows how the *Desire Speed Distribution* is displayed.

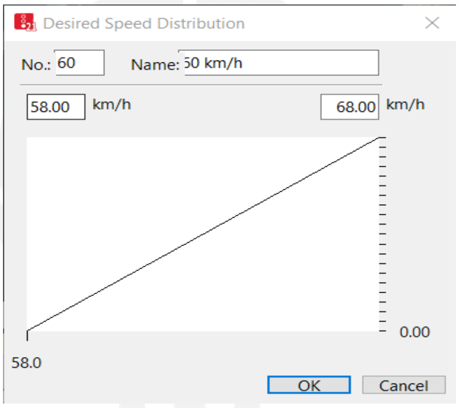


Figure 3.4 Desired Speed Distribution

e. Vehicle type, class and category. The term "vehicle type" refers to a group of vehicles that share similar technical characteristics and driving behavior (Examples: cars, buses, HGVs, trams, motorcycles, bicycles, pedestrians). Vehicle category refers to the pre-determination of static categories of vehicles that share the same interaction. For example, trams are not permitted to change lanes on multi-lane Streets and do not travel at the desired speed. Figures 3.1 and 3.2 show the Vehicle Type and Vehicle Class menu displays, which show that each type of vehicle has a distinct personality, which can be predetermined (such as acceleration and deceleration) or self-determined (such as vehicle color). Figures 3.5 and 3.6 show how Vehicle type and Vehicle class are displayed.

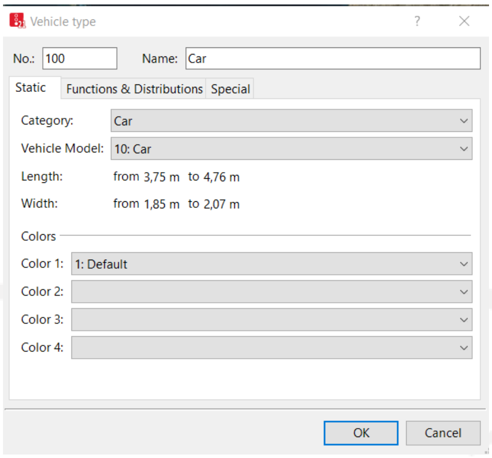
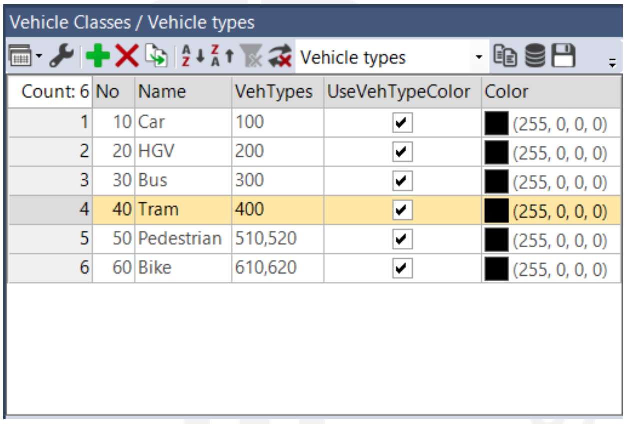


Figure 3.5 Vehicle Type



Vehicle Classes / Vehicle types

Count: 6	No	Name	VehTypes	UseVehTypeColor	Color
1	10	Car	100	✔	(255, 0, 0, 0)
2	20	HGV	200	✔	(255, 0, 0, 0)
3	30	Bus	300	✔	(255, 0, 0, 0)
4	40	Tram	400	✔	(255, 0, 0, 0)
5	50	Pedestrian	510,520	✔	(255, 0, 0, 0)
6	60	Bike	610,620	✔	(255, 0, 0, 0)

Figure 3.6 Vehicle Class

f. Driving behaviour, is a parameter that has a direct impact on vehicle interaction and can lead to significant differences in traffic simulation results. The type of driving behavior is associated with each lane. Even in the same lane, different driving behavior can be used for each class of vehicle. Figure 3.7 illustrates the driving behavior display.

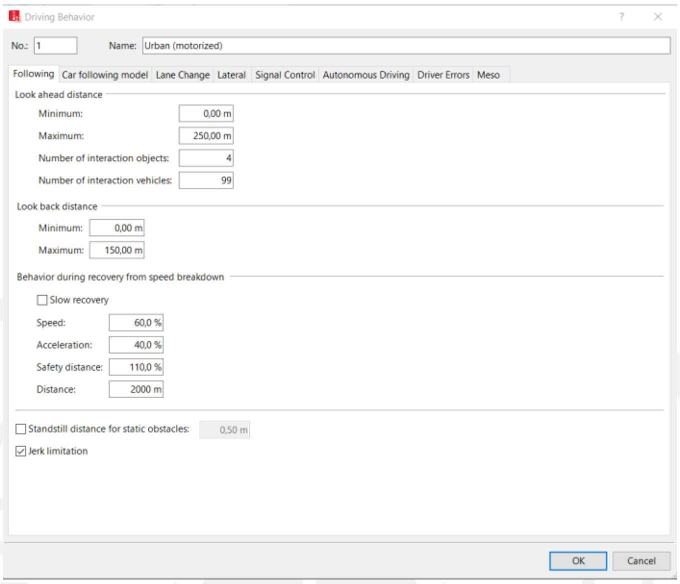


Figure 3.7 Driving Behavior

g. Signal control, is a method used to model a traffic light cycle in the field.

2. Traffic Network

A link represents one or more Road Lane segments with a specific flow direction in VISSIM Soft, and it is the most basic element of the traffic network. By connecting links with connectors, a network can be created. Only connector-connected links are allowed to carry on traffic.

a. Links, are the geometric inputs of the Street network, such as Street width and number of lanes. Display Links can be seen in Figures 3.8 and 3.9 below.

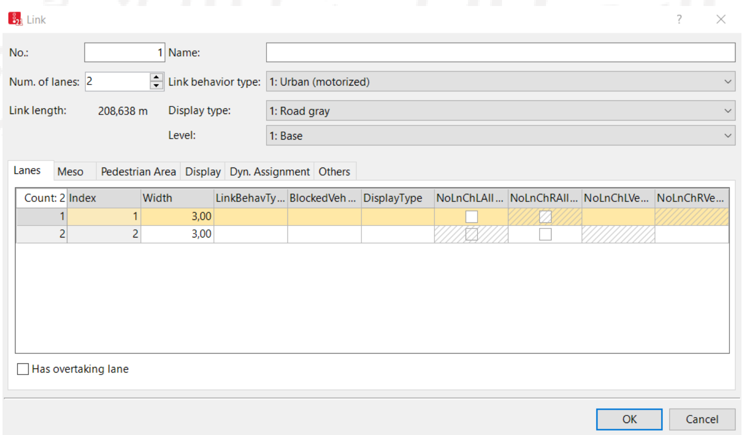


Figure 3.8 Menu Links

Figure 3.9 Links Example

b. Connectors, is a geometric input path that has the function of connecting between links. The Connectors Menu display can be seen in Figure 3.10 below.

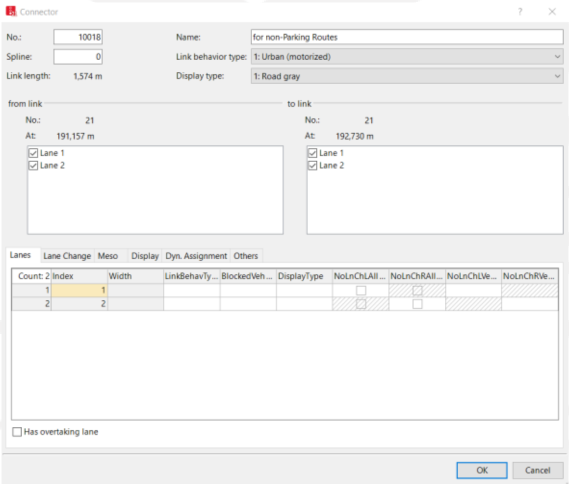


Figure 3.10 Menu Connectors

c. Background and scaling, background settings in the simulation by taking the research location figure from google earth and then inputting it into the VISSIM Software.

3. Evaluation

In VISSIM, a link represents one or more Street Lane segments with a specific flow direction. By connecting links with connectors, a network can be formed.

Only connector-connected links are allowed to continue traffic.

a. Queue counter, determining the point at which the queue length begins to be calculated after the vehicle has stopped.
b. Delay, the delay experienced by the vehicle in relation to a predetermined route is calculated.

4. Wiedemann Approach

Wiedemann approach is a car following model in VISSIM Software. With this approach, the behavior of vehicles in the field can be made more similar to the behavior of vehicles in the VISSIM Software. In addition, this approach can also calibrate the queue length in VISSIM Software if the difference with the situation in the field is too far. The basic idea of this approach is to assume the rider belongs to one of the following 4 rider models:

a. Free driving, in this mode the observer tries to reach the desired speed by himself and maintains it.
b. Approaching, the process of reducing the observer's own speed due to the vehicle in front of him When approaching, the observer reduces his speed so that the difference in speed between the two vehicles is zero when he reaches his desired safe distance.
c. Following, a condition in which the observer follows the vehicle in front of him without slowing or speeding up. It maintains a constant safe distance from the vehicle in front of it, but the speed difference between the two vehicles fluctuates around zero due to flaws in gas control.
d. Braking, When the distance between two vehicles is less than the desired safe distance, applications from medium to high-speed drop.

This happens when the vehicle in front of the observer abruptly slows down, or when a third vehicle enters the lane in front of the observer. There are three car following models in the Wiedemann Approach:

a. Wiedemann 74, model primarily for urban traffic. The parameter available in this approach is the average standstill distance (ax), which is the desired average distance between stopping vehicles, with a variation of -1.0 m to +1.0 m, normally distributed about 0.0 m with a standard deviation of 0.3.

Then the additive part of desired safety distance (bx_add) and multiplic (bx_mult), which is part of the desired safe distance affect the calculation from a safe distance.

b. Wiedemann 99, a model designed primarily for intercity traffic There are more parameters available in this approach, including CC0 (Standstill distance), which is the desired safe distance between two stopped vehicles. There is no variation in CC0.

   1) CC1 (Headway time) is the amount of time (in seconds) that a rider wishes to guard. At speed v [m/s], the higher the value, the more alert the rider is. The safe distance in this model is the shortest distance that a driver wishes to maintain while following another vehicle. This parameter has the greatest influence on capacity in high-volume traffic.
   2) CC2 ("Following" variation) limiting longitudinal motion or how much of the desired safe distance is allowed for the driver before the driver begins to approach the vehicle in front of him. If for example the value is set to 10 m, the next following process is generated at the distance between dx_safe and dx_safe + 10 m. The assumed value at this stage is 4 m, which results in a stable following process.
   3) CC3 ("Threshold for entering „Following"), set the start of the deceleration process, which is when the driver realizes the vehicle in front is slower. In other words, it describes how many seconds before reaching a safe distance, the driver begins to decelerate.
   4) CC4 and CC5 („Following" thresholds), adjust the speed difference during the following state. A smaller value causes the driver to be more sensitive in accelerating or decelerating the vehicle in front, for example when the vehicle is quite tight. CC4 is used for negative and CC5 for positive speed difference.

   The assumption value results in quite strict restrictions in the following process.

   5) CC6 (Speed dependency of oscillation), namely the effect of distance on speed in moving during the following process. If set to 0, the moving

speed is not affected by the distance from the vehicle in front. A larger value leads to a greater moving speed with increasing distance.

6) CC7 (Oscillation acceleration), i.e., the actual acceleration while the vehicle is in motion.
7) CC8 (Standstill acceleration), i.e., the desired acceleration starting from rest (limited by the maximum acceleration in the acceleration curve).
8) CC9 (Acceleration at 80 km/h), the desired acceleration at 80 km/h (limited by the maximum acceleration in the acceleration curve).

c. No interaction, the vehicle does not recognize the presence of another vehicle (can be used to simplify pedestrian behavior).

In this study, the approach used is Wiedemann 74, because it is in accordance with the conditions in the field in this study, namely for urban traffic areas.

3.10 *VISSIM* Calibration and Validation

Calibration in *VISSIM* is a process in forming appropriate parameter values so that the model can replicate traffic to the closest possible conditions. The calibration process can be carried out based on the behavior of the driver of the observed area. The method used is trial and error with reference to previous studies regarding calibration and validation using *VISSIM*.

Validation is a comparison of the effectiveness measurement parameters obtained from the field to the results of the *VISSIM PTV* Software modeling. The effectiveness measure parameter obtained is in the form of the value of the V/C ratio on each road segment. Validation does not meet the criteria if the comparison between the volume of vehicles in the field and in the simulation reaches a value above 5 using the GEH formula calculation. Self-calibration is carried out if it turns out that the results of the validation calculations do not meet the requirements.

CHAPTER IV
RESEARCH METHOD

4.1 General

The research method is a series of research procedures used to solve a problem by collecting, analysing, and identifying the variables studied. The research method aims to plan the work steps for a study beginning with problem analysis, data collection, creating test objects, testing, and data analysis to obtain data analysis results as well as conclusions and suggestions.

4.2 Research Type

Several types of research that are often carried out are descriptive research and quantitative research. This type of research relates to the scientific way to obtain data with a specific purpose and use. In this research, we use descriptive research.

According to Narbuko and Achmadi (2008), descriptive research is a type of research that uses data to determine the current solution. As a result, this study also provides data, analyzes data, and interprets research findings, while quantitative research is one type of research in which the specifications are systematic, well-planned, and clearly structured from the start to the creation of the research design, case in this study is that the Street network has changed due to the implementation of a one-way system in the Malioboro area, causing changes in the performance of Street Malioboro and its surroundings.

4.3 Data Sampling

The sampling technique used is non-random sampling with purposive sampling technique. Purposive sampling can also be referred to as purposive sampling. This sampling technique is carried out by determining special criteria or considering certain characteristics of the sample or research subject to be studied, especially people who are considered experts in their fields or best know a certain event and so on. Sampling is carried out at each intersection in each loop to determine the volume and speed of each road segment in each loop. This is due to the limited time, cost, and resources in the research. Therefore, the samples taken were determined by the researchers themselves with certain considerations but in accordance with the research objectives. The study sampled during the morning and evening rush hours, but not during the afternoon rush hour.

4.4 Research Data

This study relied on primary data and secondary data. Primary data is the main data obtained through direct observation or observation at the following locations.

4.4.1 Primary Data

Primary data is information obtained directly from research sources by measuring, observing, and surveying. The primary data used in this study are as follows.

1. Traffic Volume

   At peak hours, data in the form of traffic volume is used to determine the volume of roads and intersections in the area of Jalan Malioboro and its surroundings, from the data, the feasibility of a road segment in providing vehicle volume capacity can be seen. This traffic volume is determined by conducting a survey with a *CCTV* tool. Every vehicle movement at each intersection arm is automatically recorded by the *CCTV*. The *CCTV* assistive device is installed at the intersection's corners so that the *CCTV* lens can clearly record every movement of the vehicle. To obtain the necessary traffic volume data, the data collection time on roads and intersections is carried out in the same and simultaneous manner over a Two day period. Observations were made during estimated peak and non-peak hours, specifically:

   a. Saturday and Monday afternoon rush hour is from 16.00 to 18.00. The placement of *CCTV* is critical, because *CCTV* must be installed in the correct location in order to record every movement at each intersection. Figure 4.1 depicts the *CCTV* placement scheme for the intersection. Saturday and Monday afternoon rush hour is from 16.00 to 18.00 for 15 minutes. The placement of *CCTV* is critical, because *CCTV* must be installed in the correct location in order to record every movement at each intersection. Figure 4.1 depicts a *CCTV* placement scheme for intersections.

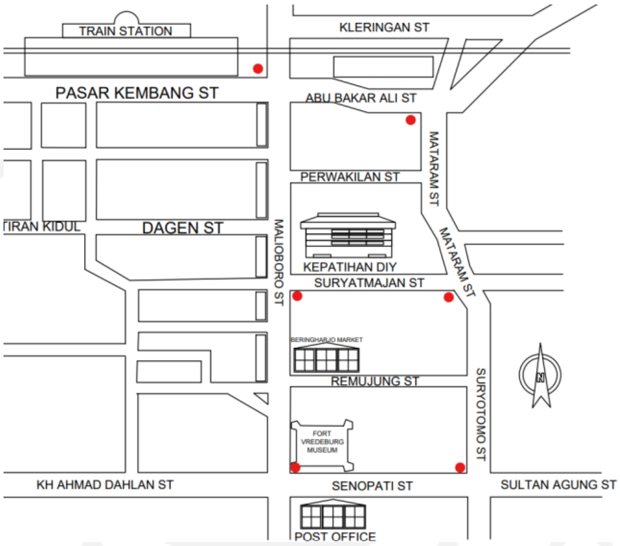


Figure 4.1 CCTV Installation Scheme

Description:

O = CCT Placement Location

2. Vehicle Travel Speed

According to the Directorate General of Highways (1997), travel speed is defined as the average speed (km/hour) of traffic flow calculated from the length of the road divided by the average travel time of vehicles passing through the road segment. The value of travel speed can be calculated using equation 3.4.

$$V = \frac{L}{TT} \qquad (3.4)$$

With:

V = LV Travel Speed (km/hour),

L = Segment Length (km), dan

TT= LV average travel time along segment (hour).

The determination of travel speed according to the Directorate General of Highways (1997) uses a graph of the relationship between free flow speed and the degree of saturation. The graph of the relationship between the free current velocity and the degree of saturation can be seen in Figures 3.3 and 3.4 as follows.

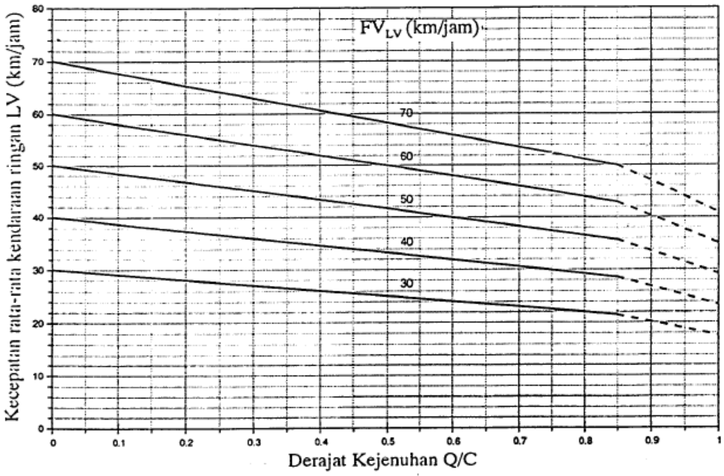


Figure 3.3 Relationship of Average Speed with Degree of Saturation on Road Type 2/2 UD

(Source: Directorate General of Highways, 1997)

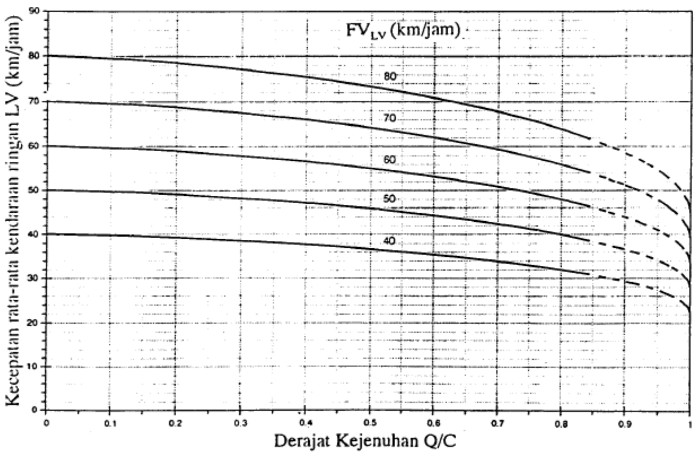


Figure 3.4 Relationship of Average Speed with Degree of Saturation on Types of One-way and Multi- Lane Roads

(Source: Directorate General of Highways, 1997)

3. Driving Behavior.

   The driving behavior of drivers at the research location can be observed through visual observation with placement of markings on the roads to find the distance between vehicle.

4. Land Use

   Land use around the road is observed by visual observation. The aim is to find out the land use around the road which is the object of research is residential land, commercial land or areas with limited access.

5. Road Geometry Data

   The road geometry data includes measurements of the length and width of the road. This information is used to calculate the capacity of road sections. The capacity of the road segment at the time of the study will be compared to the capacity of the road segment according to the transportation Department of communication and informatics Final Report in 2014. The geometry of the road segment is measured in order to determine the geometric characteristics of Malioboro Street and its surroundings, specifically:

   a. Road Type
   b. Lane Width
   c. Curb
   d. Alignment
   e. Road Length

4.4.2 Secondary Data

Secondary data in a study is information obtained indirectly, such as from supporting data in previous studies or from relevant agencies that already have data in the form of reports, profiles, manuals, or libraries. Secondary data in this study include traffic segment performance data from the DIY Transportation Department in 2019.

4.4.3 Tools Required

In this study, several tools were used to assist the implementation of research in the field as follows.

1. Research forms and stationery
2. Meter tool
3. Smartphone
4. *CCTV or Action Camera*
5. Personal Computer

4.5 Data Analysis

The PTV *VISSIM Software* is used for the overall analysis, which employs the 1997 IHCM reference and the following calculation stages.

1. Using *CCTV* cameras, calculate the traffic volume of each intersection arm and peak hour volume to determine the volume of vehicles on each road segment.
2. Using the 1997 IHCM guidelines, calculate the capacity of each road segment by directly measuring the size of the roads in the research area.
3. Using the 1997 IHCM guidelines, calculate the degree of saturation of each road segment by using the equation in the guidlines.
4. Using *PTV VISSIM Software*, model loops with existing conditions.
5. Using *PTV VISSIM Software*, compare the conditions before and after the implementation of the one-way system.

4.5.1 *PTV VISSIM* Analysis

If we have entered data in the form of primary and secondary data, we can run the *VISSIM* PTV *Software*. Traffic volume, vehicle type, intersection geometry, and intersection cycle time are all examples of primary data. Secondary data comes in the form of satellite imagery of the loop's location, which can be obtained using the Google Earth *Software*. After entering primary and secondary data, the *VISSIM* PTV *Software* can analyze the loop; the results of the *VISSIM* PTV analysis are displayed as delay values on each road segment. The steps in the data analysis sequence using *VISSIM* PTV *Software* are as follows.

1. After obtaining the primary data from the field survey, it was analyzed using Microsoft Excel *Software*.
2. Secondary data is entered into the PTV *VISSIM Software* in the form of satellite imagery of the location under study. Location satellite images are used as a backdrop as well as to describe field conditions.
3. Pre-processed primary data in the form of the number of vehicles and vehicle composition is entered into the PTV *VISSIM Software*.
4. Selection of driver behavior according to conditions in the field.
5. A road network model is created and route selection is set. Route selection starts from the starting point to the destination point.

6. Modeling road sections, traffic signals, and modeling intersections according to conditions in the field, then entering the signal phase.
7. After the data is inputted for modeling, the performance of the road segment with the parameter V/C ratio can be known.
8. Calibration and data validation need to be done. Calibration is the process of adjusting the components of the simulation model so that the simulation model accurately represents or approximates what is observed. Validation is the process of comparing the effectiveness measurement parameters obtained in the field to the results of the VISSIM PTV *Software* modeling. The value of the V/C ratio on each road segment was obtained as the effectiveness measure parameter. Validation fails to meet the criteria if the comparison of the volume of vehicles in the field and in the simulation exceeds 5% using the GEH formula calculation. If the results of the validation calculations do not meet the requirements, self-calibration is performed.
9. The performance of the road segment is analyzed based on the effectiveness measure parameter, namely the V/C ratio.
10. Make a loop model in the area of Malioboro Street, then the V/C ratio loop is analyzed and calibration and data validation are carried out in the loop area.
11. Results and conclusions in the form of comparison of Malioboro Street area before and after the implementation of the one-way system.

4.5.2 Road Capacity Analysis

One of the most important factors in traffic flow control is road capacity. The maximum flow through a road point that can be maintained per unit hour under certain conditions is referred to as road capacity. The steps in the sequence of road capacity analysis using the 1997 IHCM guidelines are as follows.

1. Determine Basic Capacity (C_o), for Malioboro Street and surroundings.
2. Determine the traffic lane width adjustment factor (FC_W).
3. Determine the direction separator adjustment factor (FC_{SP}).
4. Determine the adjustment factor due to side resistance (FC_{SF}).
5. Determining the city size adjustment factor (FC_{CS}).

6. The calculation uses the capacity formula.
7. The calculation is carried out using road segment data based on data from the 2019 The transportation Department Final Report and survey data.

4.6 Research Process Flow Chart

The research flow chart shown below can be found at Figure 4.2 below.

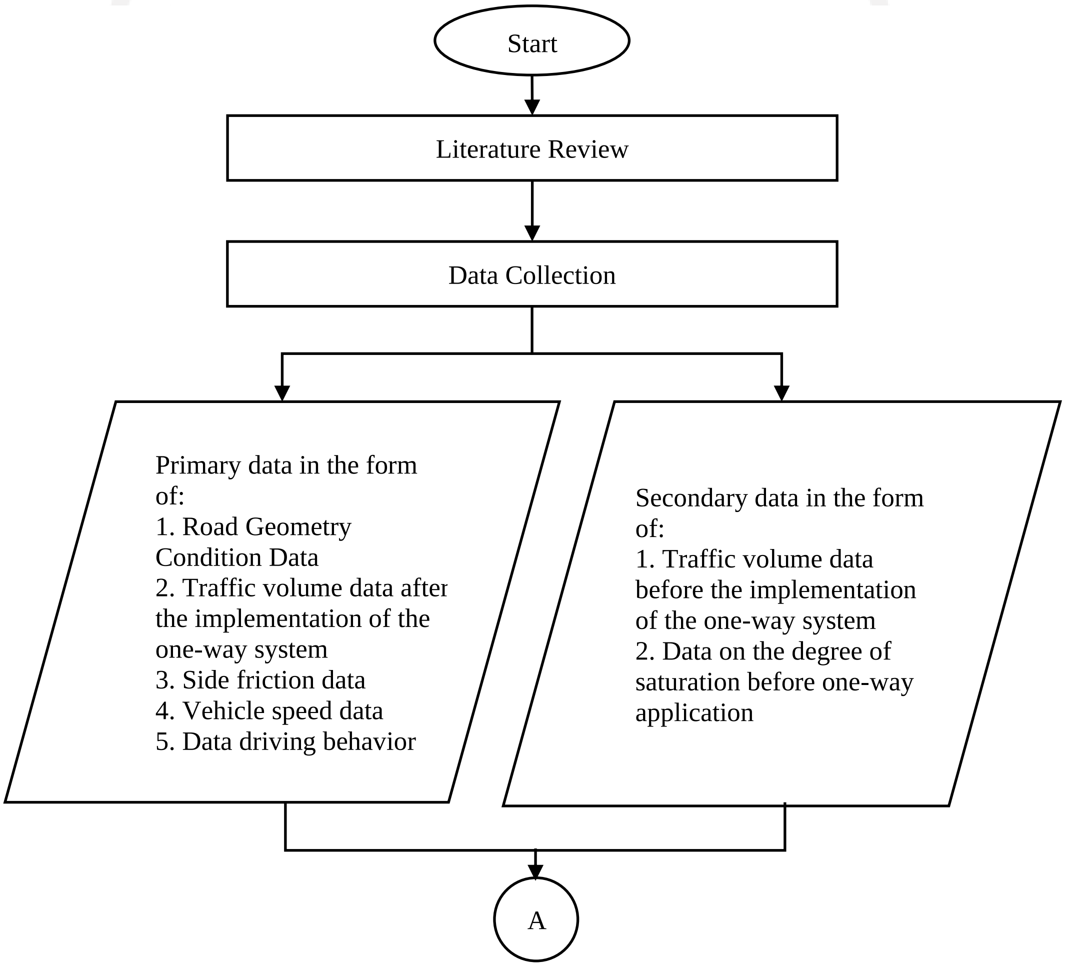
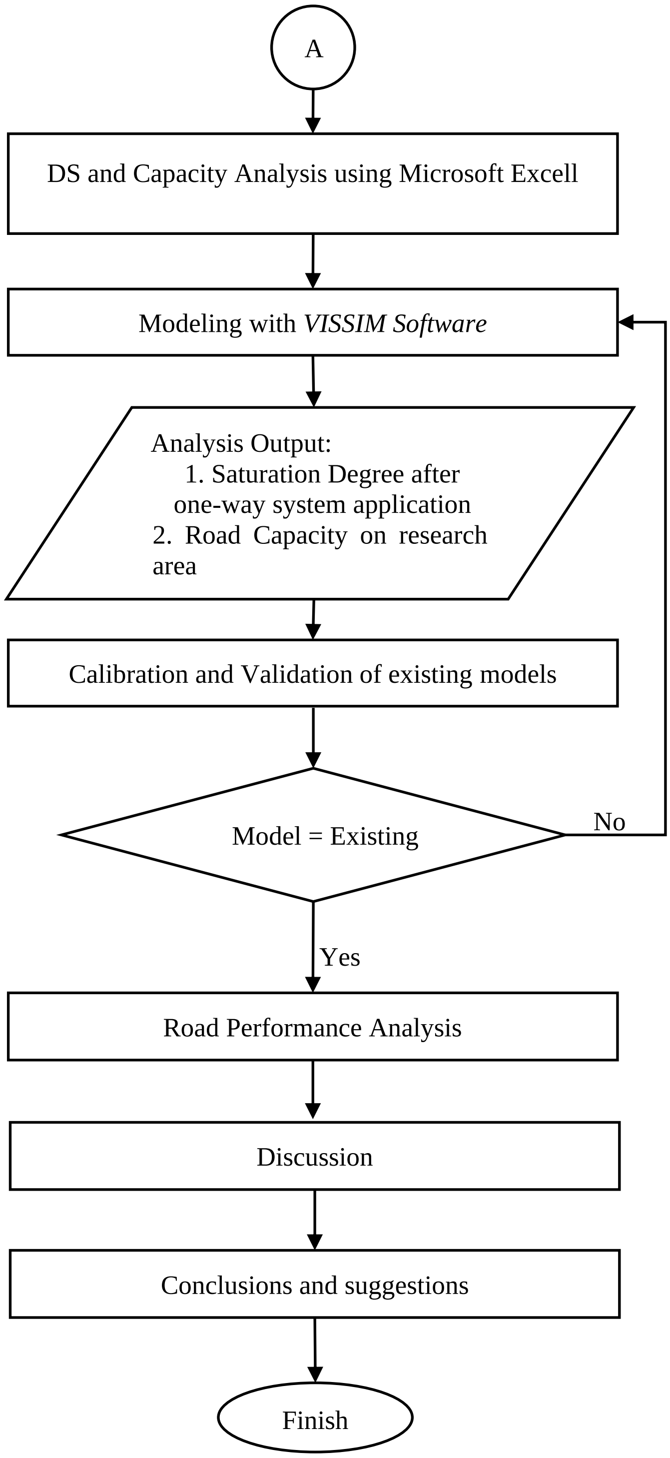


Figure 4.2 Research Flow Chart



Continuation of Figure 4.2 Research Flowchart

CHAPTER V
DATA, ANALYSIS, and DISCUSSIONS

5.1 Data

The data in this study was made up of both primary and secondary sources. Primary data contains data on traffic volume, vehicle speed, road shape, intersection signalling phase, and driving behaviour collected by direct observation at the research site. Secondary data is information derived from the 2014 Malioboro Final Report.

5.1.1 Primary Data

1. Existing Traffic Volume Data

   Road traffic volume data were obtained from field surveys at the research site. The traffic volume survey was conducted on Monday as a representative of the weekday and on Saturday as a representative of the weekend. The traffic volume data survey was conducted in three sessions with details, namely in the morning at 06.00 - 08.00 WIB, daytime at 11.00 - 13.00 WIB, and in the afternoon at 16.00 - 18.00 WIB. The research was conducted at 13 intersections to find the peak hours of the area. Traffic volume data for 13 intersections can be seen in Table 5.1 and Table 5.2 as follows.

Table 5.1 Recapitulation of Malioboro Area Volume Data on Weekdays

Time	Total	
	Veh/Hour	Pcu/Hour
06:00-07:00	33032	24280
06:15-07:15	42009	17543
06:30-07:30	46128	19178
06:45-07:45	49780	20626
07:00-08:00	52724	21666
07:15-08:15	41193	17093
07:30-08:30	27947	11620
07:45-08:45	14456	6115
11:00-12:00	42239	32136
11:15-12:15	49690	21537
11:30-12:30	49751	21691

Continuation Table 5.1 Recapitulation of Malioboro Area Volume Data on Weekdays

Time	Total	
	Veh/Hour	Pcu/Hour
11:45-12:45	49544	21486
12:00-13:00	49358	21437
12:15-13:15	37473	16552
12:30-13:30	24899	10990
12:45-13:45	12561	5687
16:00-17:00	43320	33041
16:15-17:15	52339	22304
16:30-17:30	51998	22065
16:45-17:45	51616	21766
17:00-18:00	50089	21136
17:15-18:15	37285	15991
17:30-18:30	24358	10511
17:45-18:45	12083	5382

Table 5.2 Weekend Malioboro Volume Data Recapitulation

Time	Total	
	Veh/Hour	Pcu/Hour
06:00-07:00	40721	17462
06:15-07:15	43539	18599
06:30-07:30	46173	19633
06:45-07:45	49221	20783
07:00-08:00	50953	21370
07:15-08:15	39577	16837
07:30-08:30	27006	11530
07:45-08:45	13508	5880
11:00-12:00	60356	28216
11:15-12:15	60611	28296
11:30-12:30	60255	28225
11:45-12:45	59876	28045
12:00-13:00	59411	27566
12:15-13:15	44867	21126
12:30-13:30	29854	14056
12:45-13:45	15001	7170
16:00-17:00	73244	32948
16:15-17:15	74120	33060
16:30-17:30	73521	32899
16:45-17:45	72618	32553
17:00-18:00	69948	31514

Continuation Table 5.2 Weekend Malioboro Volume Data Recapitulation

Time	Total	
	Veh/Hour	Pcu/Hour
17:15-18:15	51448	23678
17:30-18:30	33223	15402
17:45-18:45	16184	7699

The data on the volume recapitulation of the Malioboro area on weekdays and weekends is then displayed as a graph of peak hours in Figure 5.1 on the following page.

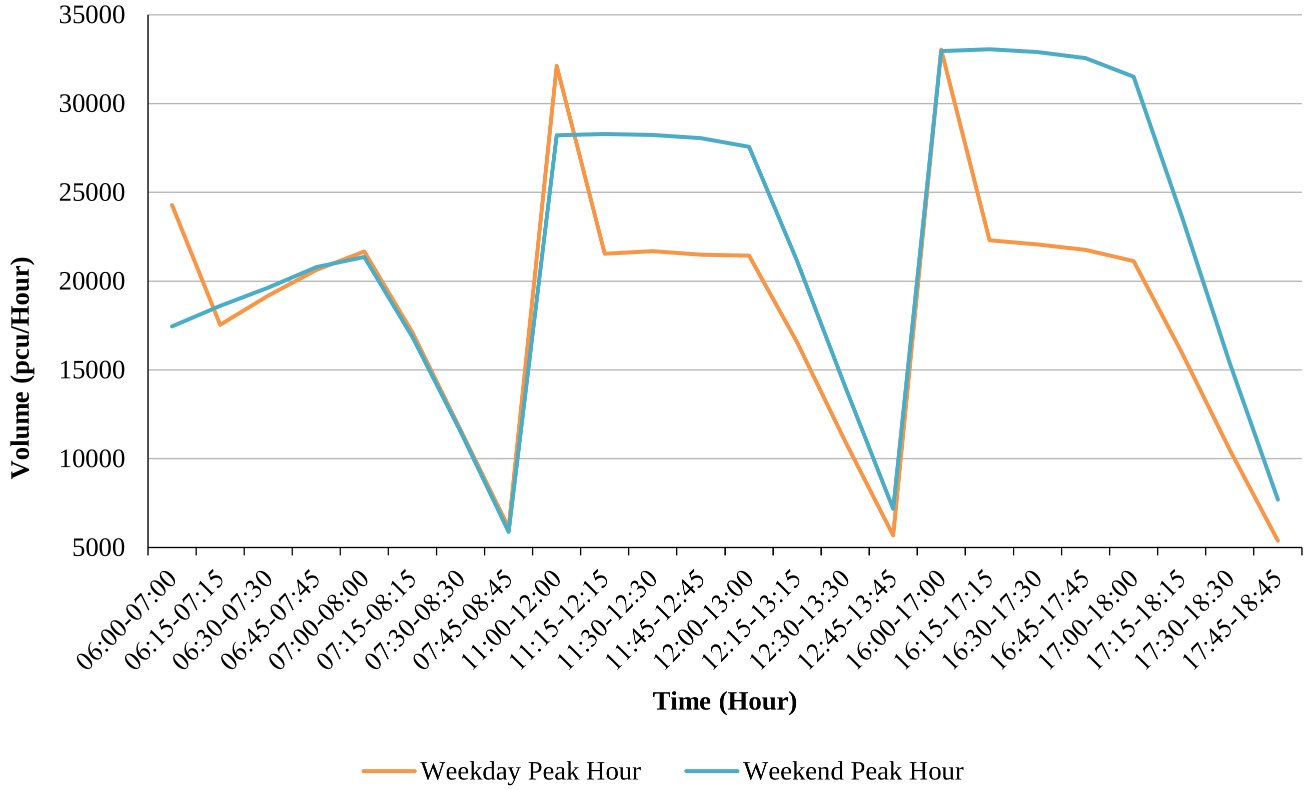


Figure 5.1 Peak Hour Traffic Volume Graph

From Figure 5.1, it is found that the peak hours of the Malioboro area are on weekends at 16:15 – 17:15 with a volume of 33320 Pcu/Hour. After obtaining the regional peak hours, the volume of vehicles at the 6 main intersections studied (Abu Bakar Ali Intersection, Pasar Kembang intersection, Suryatmajan Intersection, KM 0 Intersection, PS Senopati Intersection, and Juminahan Intersection.) in units of vehicles/hour can be seen in Figure 5.2 on the next page.

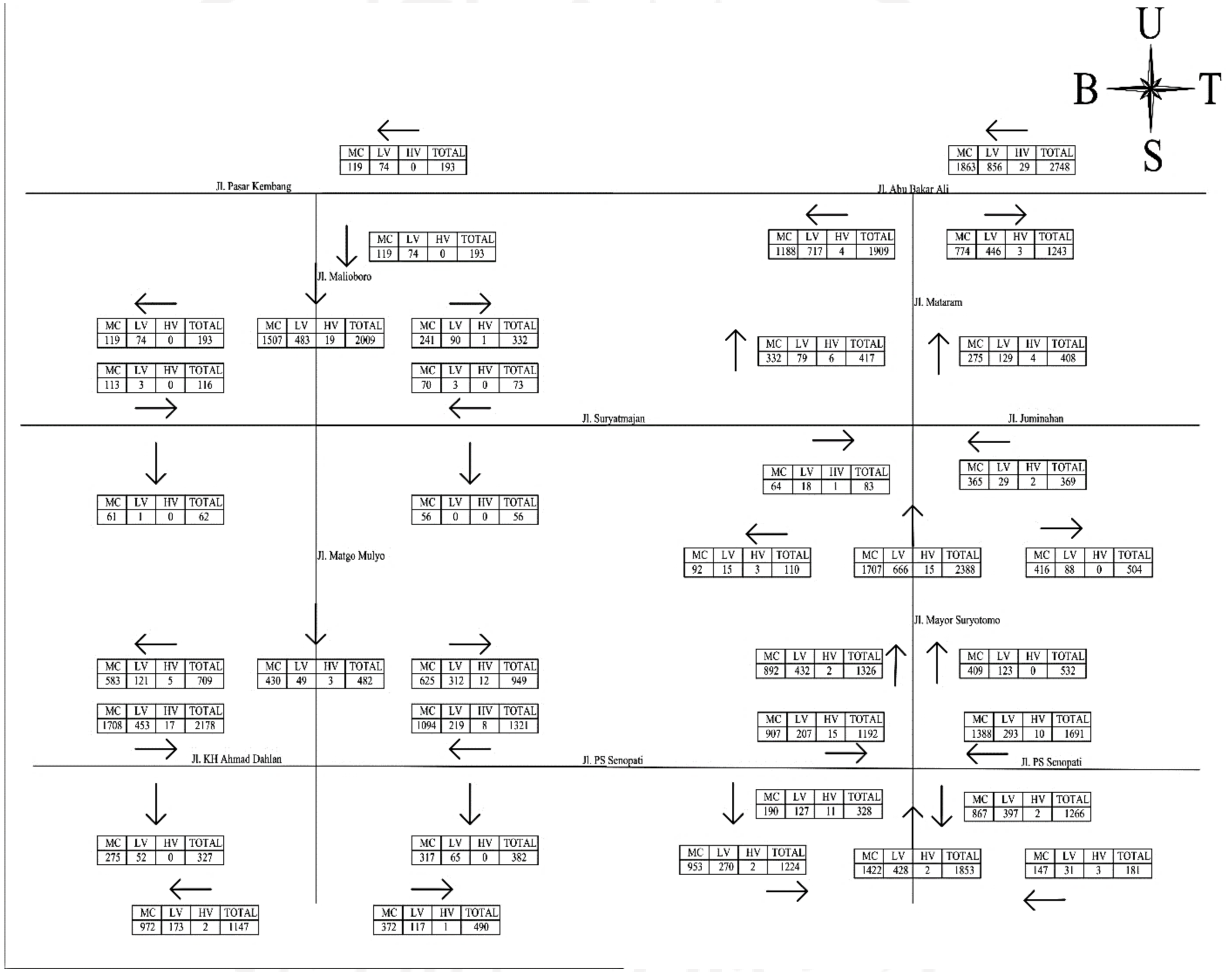


Figure 5.2 Traffic Volume Distribution

From the results of the vehicle survey at the intersection, the results of the recap of the volume of the segment can be seen in Figures 5.3 to 5.10 below.

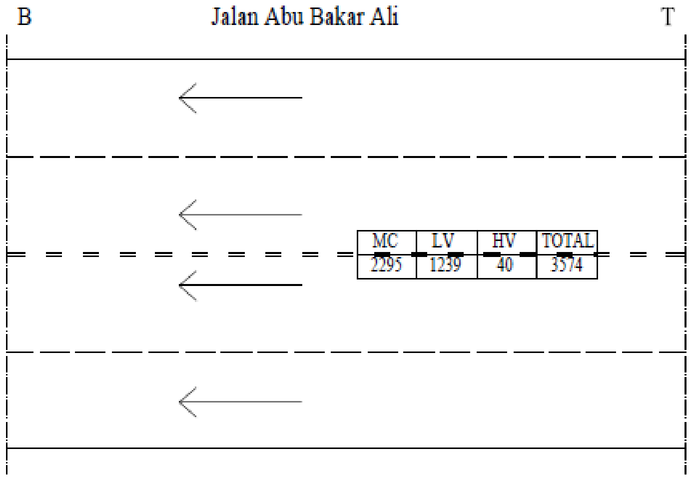


Figure 5.3 Abu Bakar Ali Street Traffic Volume at Peak Hours

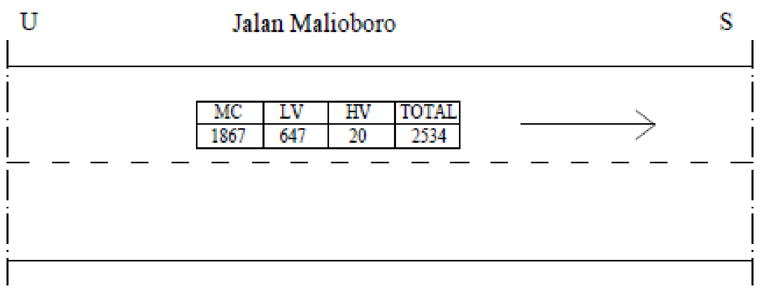


Figure 5.4 Malioboro Street Traffic Volume at Peak Hours

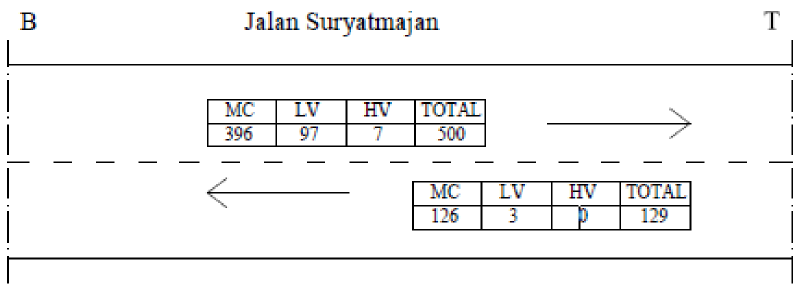


Figure 5.5 Suryatmajan Street Traffic Volume at Peak Hours

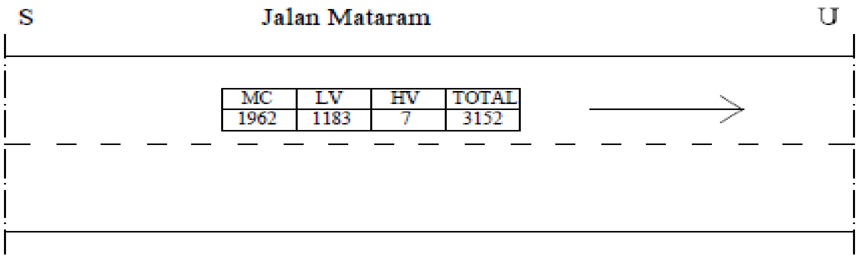


Figure 5.6 Mataram Street Traffic Volume at Peak Hours

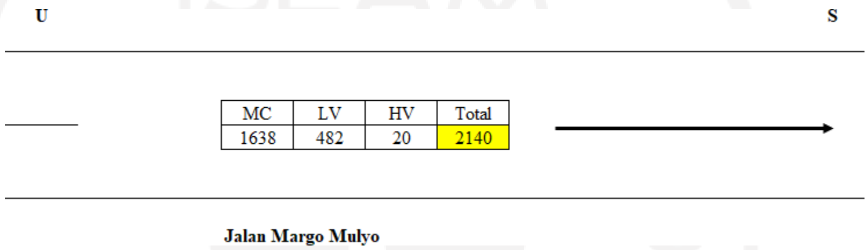


Figure 5.7 Mataram Street Traffic Volume at Peak Hours

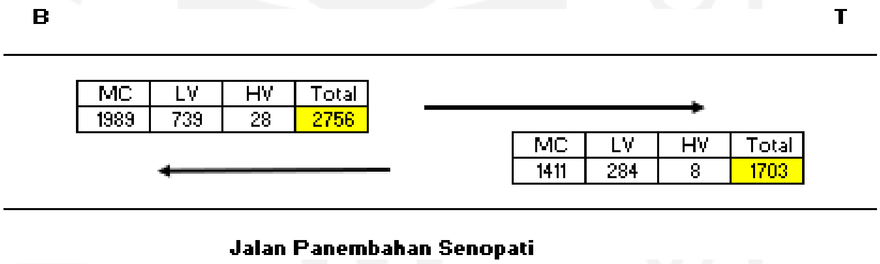


Figure 5.8 PS Senopati Road Traffic Volume at Peak Hours

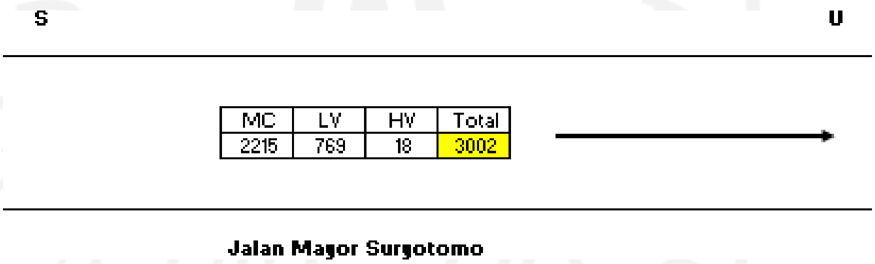


Figure 5.9 Major Suryotomo Road Traffic Volume at Peak Hour

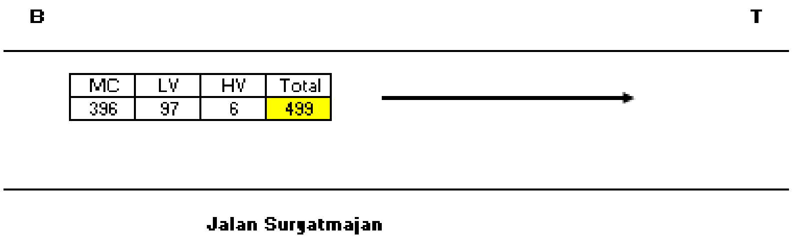


Figure 5.10 Suryatmajan Road Traffic Volume at Peak Hours

2. Road Section Geometry Data

Road section geometry data provides the width of the pavement, the median dimension (if any), and the dimensions of the shoulder at the research location in order to examine the road segment's performance. The geometric data of the road sections around Malioboro are included in the results of the geometric observations in this study. Cross section of each road can be found in Figure 5.11 - Figure 5.14, while the road data are presented in table 5.3 – Table 5.6.

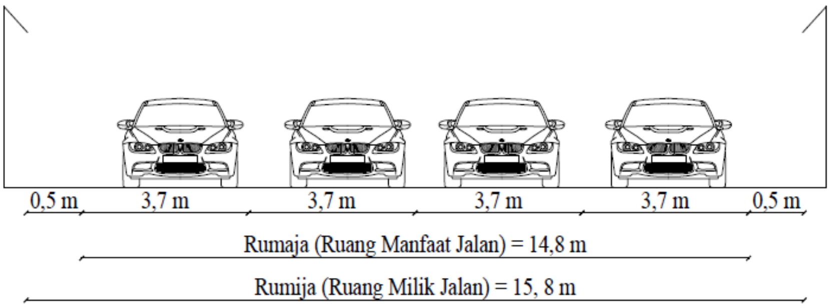


Figure 5.11 Cross Section of Abu Bakar Ali Road

Table 5.3 Abu Bakar Ali Road Data

Road Section Data				
Road Section	Type	Road Width (m)	Lane Width (m)	Shoulder Width (m)
Abu Bakar Ali	4/1	14,8	3,7	0,5

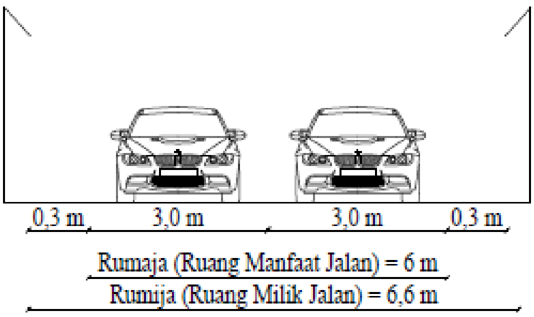


Figure 5.12 Cross Section of Malioboro Street

Table 5.4 Malioboro Street Data

Road Section Data				
Road Section	Type	Road Width (m)	Lane Width (m)	Shoulder Width (m)
Malioboro	2/1	6	3	0,3

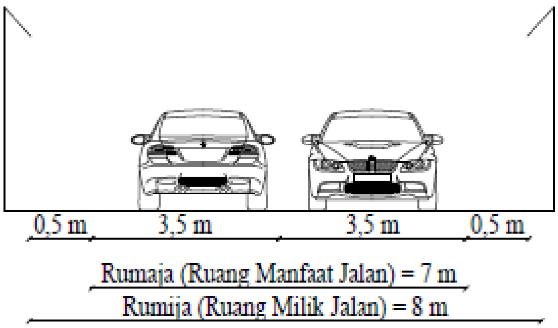


Figure 5.13 Cross Section of Suryatmajan Road Section

Table 5.5 Suryatmajan Street Data

Road Section Data				
Road Section	Type	Road Width (m)	Lane Width (m)	Shoulder Width (m)
Suryatmajan	2/2 UD	7	3,5	0,4

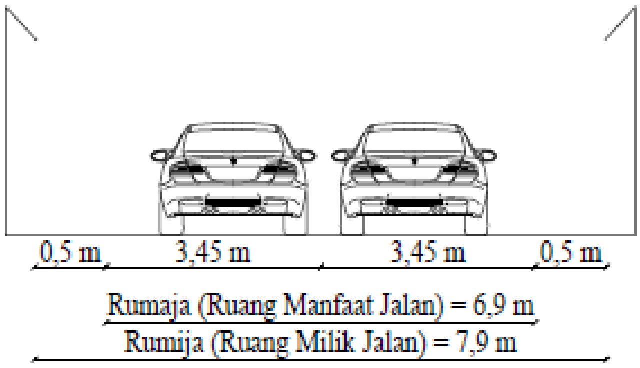


Figure 5.14 Cross Section of Road Section Mataram

Table 5.6 Mataram Street Data

Road Section Data				
Road Section	Type	Road Width (m)	Lane Width (m)	Shoulder Width (m)
Mataram	4/1	6,9	3,45	0,5

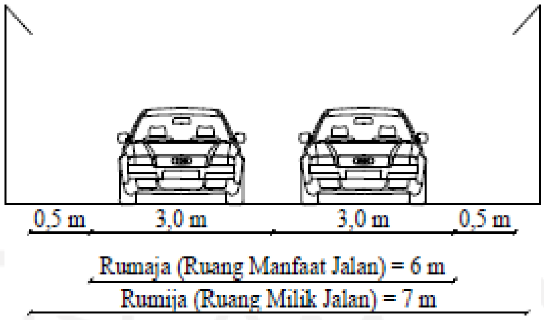


Figure 5.15 Cross Sections of Jalan Margo Mulyo

Table 5.7 Margo Mulyo Street data

Road Section Data				
Road Section	Type	Road Width (m)	Lane Width (m)	Shoulder Width (m)
Margo Mulyo	2/2 UD	6	3	0,5

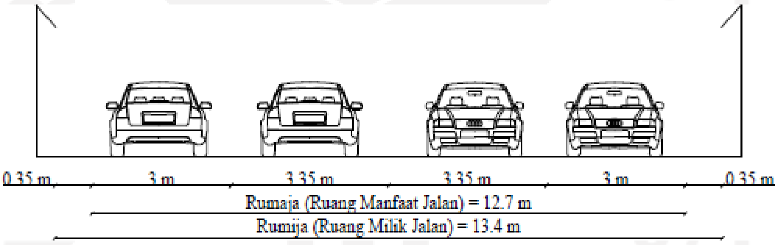


Figure 5.16 Cross Sections of the Panembahan Senopati Road

Table 5.8 Panembahan Senopati Street data

Road Section Data				
Road Section	Type	Road Width (m)	Lane Width (m)	Shoulder Width (m)
PS Senopati	4/2 UD	12,7	3,35	0,35

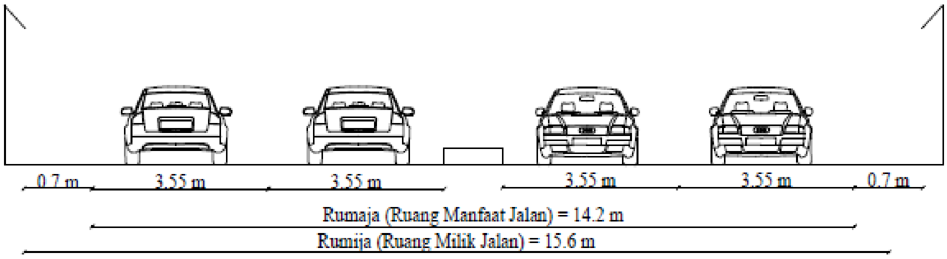


Figure 5.17 Cross Sections of the Mayor Suryotomo Street

Table 5.9 Mayor Suryotomo Street data

Road Section Data				
Road Section	Type	Road Width (m)	Lane Width (m)	Shoulder Width (m)
Mayor Suryotomo	4/2 UD	14,2	3,55	0,7

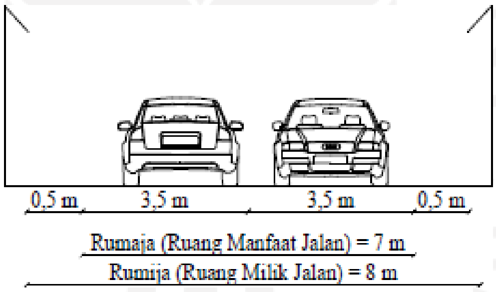


Figure 5.18 Cross Sections of Jalan Suryatmajan

Table 5.10 Suryatmajan Street data

Road Section Data				
Road Section	Type	Road Width (m)	Lane Width (m)	Shoulder Width (m)
Suryatmajan	2/2 UD	7	3,5	0,5

3. Side Friction Data

   Side Friction data is gathered by observing and assessing the situation at the research site and then calculated and analyzed based on table 3.5. The data for Side Friction may be found in Table 5.11 on the following page.

Table 5.11 Side Friction Data

Road Section	Direction	Side Friction
Abu Bakar Ali	East - West	High
Malioboro	North - South	Very High
Suryatmajan	West – East	High
	East - West	High
Mataram	South - North	High
Margo Mulyo	East - West	Very High
PS Senopati	North - South	High
Mayor Suryotomo	East - West	High

4. Traffic Signaling Phase Data

   The data on traffic signaling phases is obtained by observing the signalized intersections covered at the research site. To obtain all green, yellow, and red Time data, signal phase data is calculated using a stopwatch. The signaling phase data of signal phase data can be seen below. The figure of signals data are shown in Figure 5.19 – Figure 5.23 and the data table are shown in Table 5.12 – Table 5.16 below.

Table 5.12 Abu Bakar Ali Intersection Signaling Data

Approach code	Time (Second)				Cycle Time (Second)
	Green	Amber	All Red	Red	
South	27	3	3	48	81
East	18	3	3	57	81
North	18	3	3	57	81

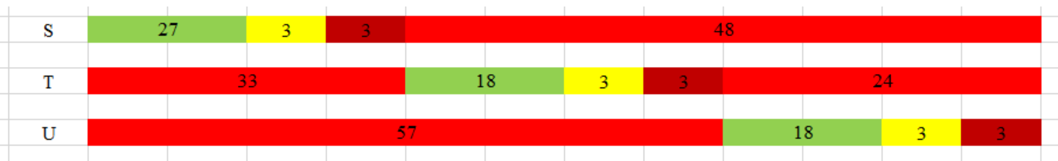


Figure 5.19 Diagram Abu Bakar Ali Intersection Signaling Data

Table 5.13 Juminahan Intersection Signaling Data

Approach code	Time (Second)				Time Siklus (Second)
	Green	Amber	All Red	Red	
West	14	3	3	62	81
South	27	3	3	49	81
East	23	3	3	53	81

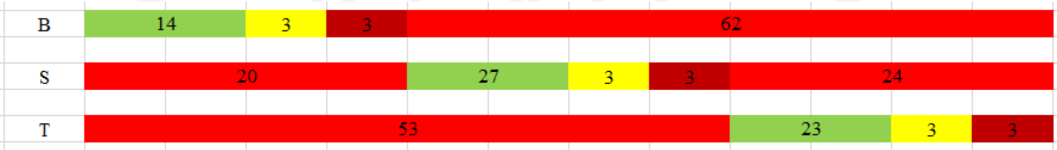


Figure 5.20 Juminahan Intersection Traffic Signal Diagram

Table 5.14 KM 0 Intersection Phase Data

Approach code	Time (Second)				Cycle Time (Second)
	Green	Amber	Red	Allred	
North – West	20	3	77	3	103
North – South	44	3	53	3	103
East	18	3	79	3	103
South	16	3	81	3	103
West	25	3	72	3	103

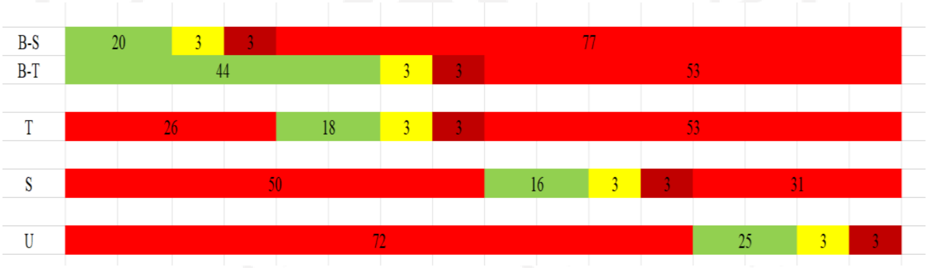


Figure 5. 21 KM 0 Intersection Phase Figure

Table 5.15 Gondomanan Intersection Phase Data

Approach code	Time (Second)				Cycle Time (Second)
	Green	Amber	Red	Allred	
East	23	3	83	3	112
South	40	3	66	3	112
West	31	3	75	3	112

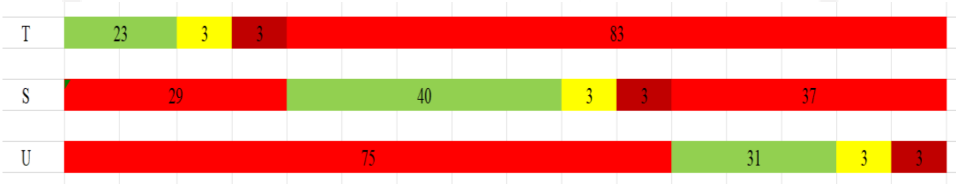


Figure 5. 22 Gondomanan Intersection Phase Figure

5. Vehicle Speed Data

   Vehicle speed data is obtained by measuring the travel time of light vehicles (Light Vehicles) passing through a 50 m long segment of the Road Section - Road Section under study. The results of observations of travel speed are shown in Table 5.17.

Table 5.16 Speed Data

Road Section	Observed Segment Length (m)	Average Travel Speed (km/h)
Abu Bakar Ali	50	36,269
Malioboro	50	32,946
Suryatmajan	50	35,931
	50	36,988
Mataram	50	33,600
Margo Mulyo	50	25,858
Panembahan Senopati	50	25,792
Mayor Suryotomo	50	29,775

6. *Driving Behaviour* Data

   Driving Behavior is a parameter in VISSIM PTV modeling that regulates the behavior of vehicles. The data on driving behavior can be found in Table 5.18.

Table 5. 17 *Driving Behaviour* Data

Parameter	Distance Front - Rear Walking Vehicle (meters)	Distance Front - Rear Vehicle Stop (meters)	Vehicle Side Distance Walking (meters)	Vehicle Stop Side Distance (meters)
Average Observation Result Value	1,07	0,73	1,06	0,64

5.1.2 Secondary Data

1. 2019 Volume Data

   As a comparison of primary data obtained by means of field surveys, secondary data is needed. Secondary data is obtained from the 2019 Traffic Performance Updating Survey Report which can be seen in Table 5.19 as follows.

Table 5.18 2019 Road Section Peak Hour Volume

No	Road Section	Volume (Pcu/Hour)
1	Malioboro	1081
2	Mataram	1766
3	Suryatmajan	420
4	Abu Bakar Ali	2417
5	Margo Mulyo	869
6	Panembahan Senopati	2265
7	Mayor Suryotomo	2228

Source: Dinas Perhubungan Kota Yogyakarta 2019

2. Capacity Data 2019

   Secondary capacity data is obtained from the 2019 Traffic Performance Updating Survey Report. The following is vehicle capacity data for 2019 in Table 5.20 on the next page.

Table 5.19 Road Section Capacity in 2019

No	Street name	Classification	Basic Capacity (pcu/hour)	Road Width (m)	LaneWidth (m)	*FCw*	Split (%)	*FCsp*	Category	*FCsf*	*FCcs*	Capacity (pcu/hour)
1	Abu Bakar Ali	4/1 UD	6600	14.8	3.7	1	50-50	1	H	0,82	0.9	4871
2	Malioboro	2/1 UD	2900	6	3	0.87	50-50	1	H	0,82	0.9	1862
3	Suryatmajan	2/1 UD	2900	7	3.5	1	50-50	1	VH	0,73	0.9	2141
4	Panembahan Senopati	4/2 D	6600	16.2	4	1.08	55-45	0,97	M	0.89	0.9	5538
5	Mayor Suryotomo	4/1 D	6600	14.2	3.55	1.14	50-50	1	H	0,82	0.9	5553
6	Mataram	2/1 UD	2900	6.9	3.45	1	55-45	0.97	H	0,82	0.9	2076
7	Margo Mulyo	2/1 UD	3300	6	3	0,92	-	1	VH	0,73	0,9	1995

3. Data *V/C Ratio* 2019

   After the capacity is known, the next step is to calculate the V/C ratio for the 4 main road sections using the previously forecasted volume. The following is an example of the calculation and recapitulation of the V/C ratio for the 7 main road sections in Table 5.21.

Table 5.20 The Degree of Saturation of the Peak Hours 2019

Road Section	Volume (pcu/hour)	Capacity (pcu)	*VC Ratio*
Malioboro	1081	1862	0,58
Mataram	1766	2076	0,85
Suryatmajan	420	2141	0,21
Abu Bakar Ali	2417	4871	0,50
Margo Mulyo	869	1995	0,43
Panembahan Senopati	2265	5538	0,49
Mayor Suryotomo	2228	5553	0,41

4. 2019 Speed Calculation

   In contrast to the volume data written directly in the 2019 Traffic Performance Updating Survey, there is no speed data written directly in the 2019 Traffic Performance Updating Survey. The graph of the relationship between the degree of saturation and speed in the 1997 IHCM in Figures 3.1 and 3.2 can be used to obtain speed data. Secondary speed can be obtained by connecting FV with DS; however, in order to obtain secondary speed, FV must be calculated on each road section being reviewed. The following is an example of calculating the free flow speed of Malioboro and the secondary speed recapitulation in Table 5.13. Equation 3.1 and the provisions in Tables 3.3 to 3.5 can be used to calculate the free flow velocity and Side Friction for the road section.

   An example of calculating the secondary speed of the Malioboro road section with the following data.

   Road Type : One Way

   Road Width : 6 meters

Side Frictions : Very High

Based on field conditions and the provisions in IHCM, the values above can be determined as follows.

FV0 = 57

FVW = -4

FFVSF = 0,73

FFVCS = 0,93

So that the value of the free flow velocity for the Malioboro section can be calculated as follows.

FV = (57 + (-4)) x 0,68 x 0,93

= 33,57 km/hour

The calculation result from the equation above can be seen in table 5.22 below.

Table 5.21 *FV* Malioboro and Surrounding Section

Road Section	***V/C***	***FV0***	***FVW***	***FFVSF***	***FFVCS***	***FV***
Abu Bakar Ali	0.78	57	1,6	0,89	0,93	48,50
Malioboro	0.88	57	-4	0,73	0,93	35,98
Mataram	0.851	44	-0,3	0,82	0,93	33,36
Margo Mulyo	0,89	57	-4	0,73	0,93	33,57
Panembahan Senopati	0,8	53	-4	0,87	0,93	39,64
Mayor Suryotomo	0,94	57	0,4	0,90	0,93	48,36
Suryatmajan	0,71	44	0	0,82	0,93	33,55

After the FV value is obtained, the next step is to determine the travel speed by using a graph of the relationship between DS and FV. The steps for determining travel speed and recapitulation of travel speed can be seen in Figure 5.24 and Table 5.23 as follows on the next page.

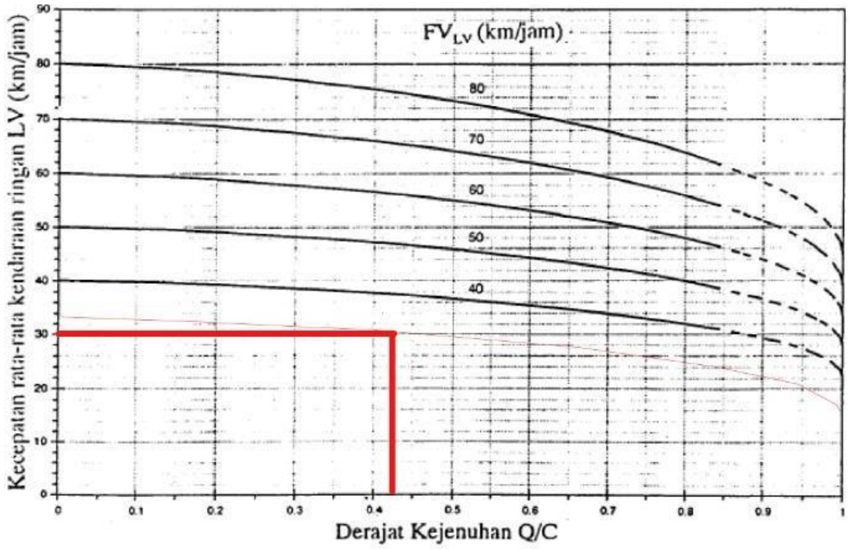


Figure 5.23 Determination of Travel Speed for Malioboro Road

Table 5.22 Travel Speeds for Malioboro and Surrounding Roads in 2019

Road Section	***V/C Ratio***	***FV* (km/h)**	***V* (km/h)**
Abu Bakar Ali	0,49	48,50	33,5
Malioboro	0,58	35,98	30,56
Mataram	0,85	33,36	41,8
Margo Mulyo	0,43	33,57	30,56
Panembahan Senopati	0,49	39,64	39,15
Mayor Suryotomo	0,41	48,36	45,90
Suryatmajan	0,19	33,55	31,95

5.2 Analysis

Stages of analysis were carried out to determine the impact of the application of the one Direction system in the Malioboro area on the Malioboro Road Section as the main Road Section in this study. The analysis was carried out using PTV VISSIM as software for modelling and Microsoft Excel as software for processing data.

5.2.1 Traffic Analysis Using *PTV VISSIM*

Traffic analysis using PTV VISSIM can be done through several stages as follows.

1. Input Network Development

   PTV VISSIM is a software made in Germany which by default the lane used for driving is the right lane. Figure 5.25 shows the change in the use of the right lane to the left lane to match the existing conditions.

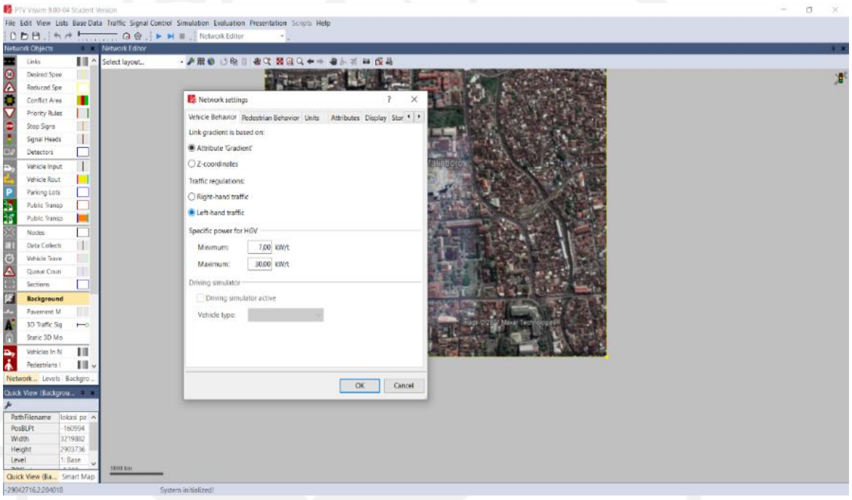


Figure 5.24 Relationship between Average Speed and Degree of Saturation on One Direction Road Type and Multi Lane Road

2. Input Background Image

   As illustrated in Figure 5.26, the backdrop image is used to model on PTV VISSIM according to the study location. To begin, click on the network object's background images, then right-click on the network editor, select add new background picture, and then select the figure to use.

   The figure is a screen shot from Google Earth that has been scaled as displayed in Figure 5.27 by comparing the original Road Width with the map on Google Earth by right-clicking on the figure and then setting the scale. After that, create a reference line and input the length of it.

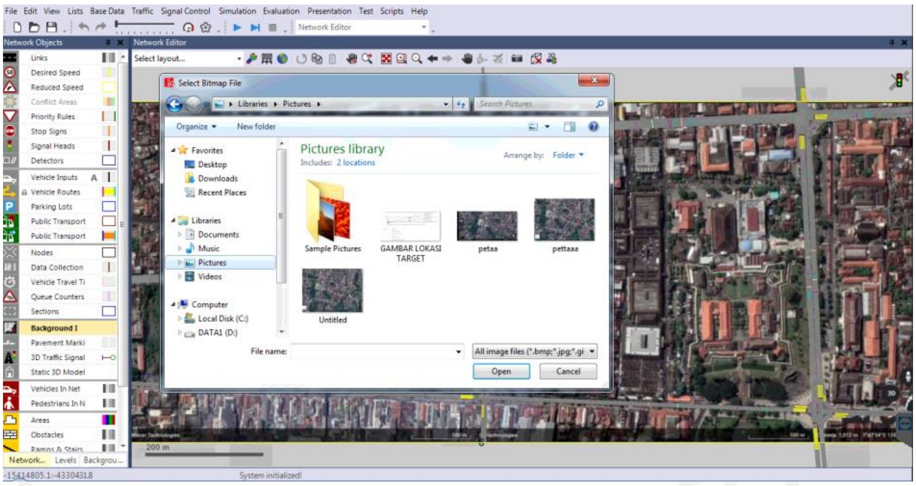


Figure 5.25 Input Background Image

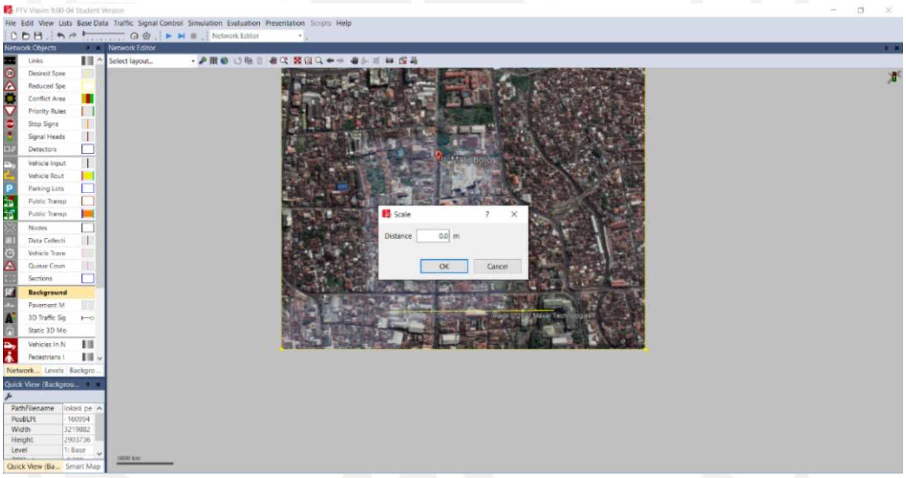


Figure 5.26 Setting the Scale on the Background Image

3. Input link and connectors creation parameters

   After inputting the background image and setting the scale, the next step is to create a road lane or link as shown in Figure 5.28. The making of lanes and their widths is adjusted to the conditions at the research site. The process of creating lanes can be done by clicking on the network object and then selecting the link and specifying the first lane to be created by pressing the shift key on the keyboard and right-clicking the mouse. After the link creation is complete, the next step is to create a connector or link between links. Making the connector can be seen in Figure 5.29. Making a connector is the same as making a link, namely by pressing right click on the mouse from the link to the desired link.

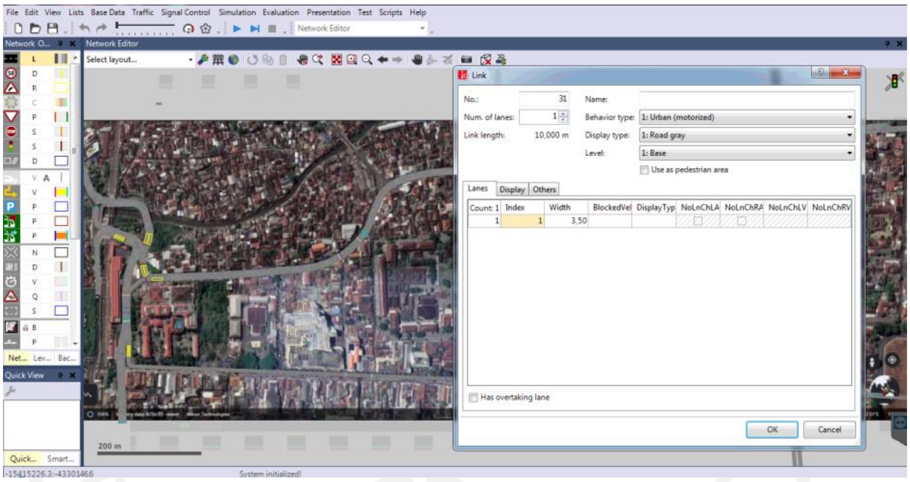


Figure 5.27 Input Parameter link or lane.

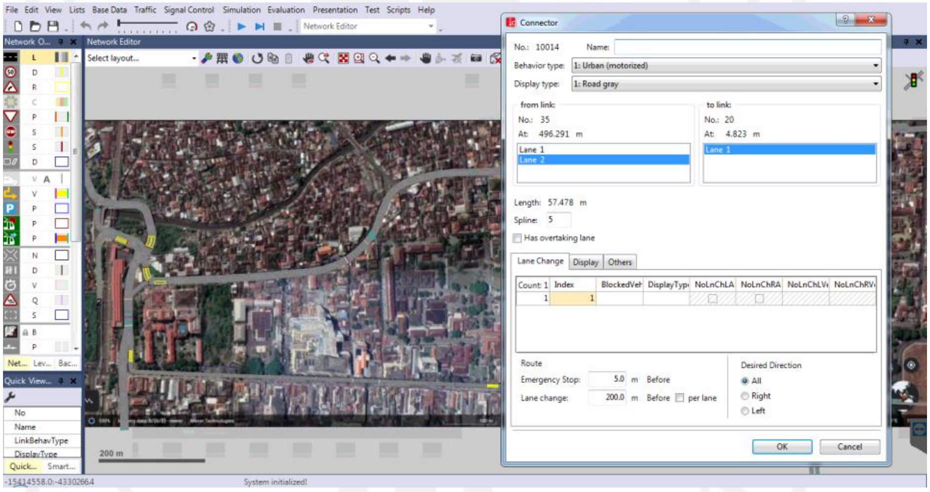


Figure 5.28 Input Parameter connector

4. Input traffic volume (vehicle input), traffic composition (vehicle composition), and traffic routes (vehicle routes)

   Creating a vehicle input can be done by clicking vehicle input on network objects and entering the volume for each Road Section as shown in Figure 5.30 on the next page.

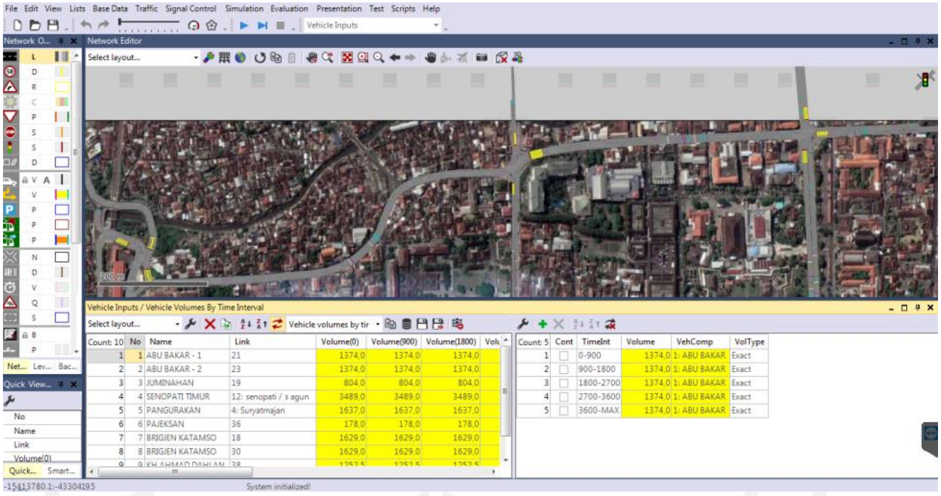


Figure 5.29 Input traffic volume

Making a vehicle composition can be done by clicking on traffic then selecting vehicle composition on the menu bar listed on the PTV VISSIM software and entering the vehicle composition for each Road Section as shown in Figure 5.31. In this modeling, 4 types of vehicles are made, namely car, bike, bus, and heavy good vehicle (HGV). Each Road Section is filled with the number of vehicles during peak hours and the speed of motorbikes is 17-37 km/hour, light vehicles 14-30 km/hour, and heavy vehicles (HGV and buses) 15-25 km/hour.

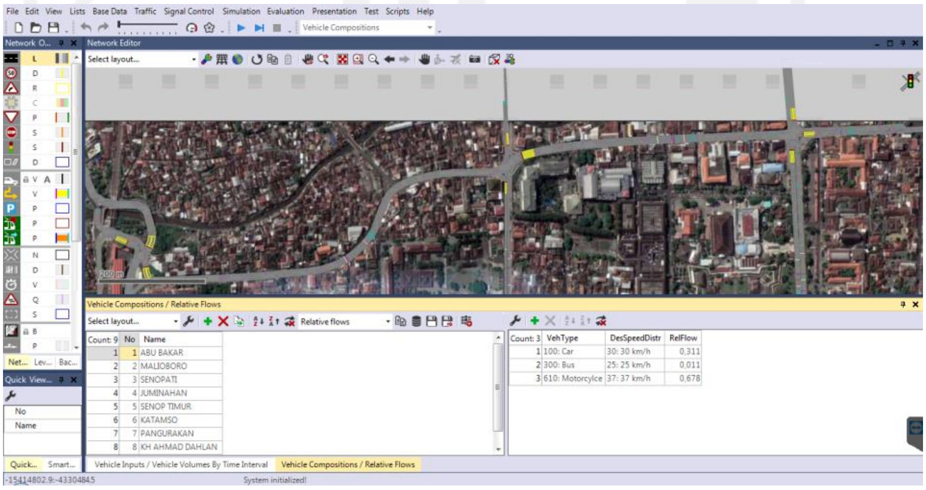


Figure 5.30 Input Vehicle Composition Per Road Section

Creating vehicle routes can be done by clicking on vehicle routes on the network object and then inputting the vehicle movement ratio in the vehicle routes for each Road Section as shown in Figure 5.32 below.

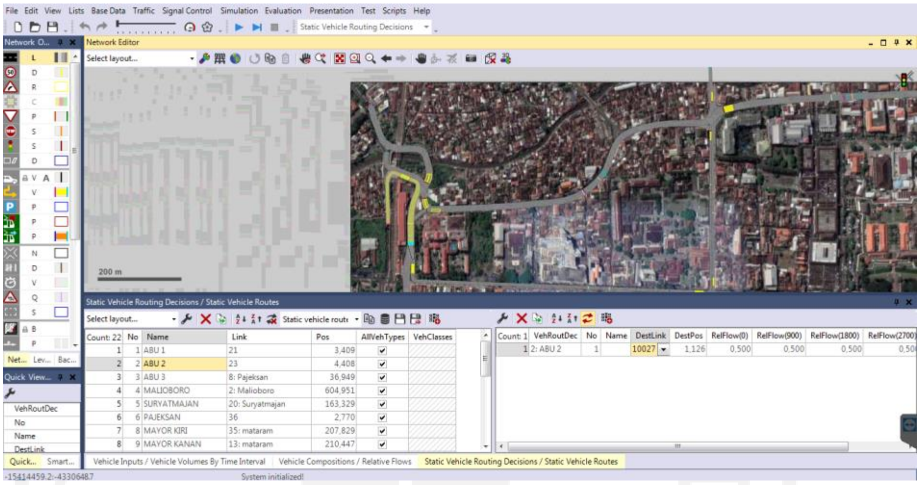


Figure 5.31 Route Creation

5. Traffic signal input

   The traffic signaling cycle at the signalized intersection at the research site can be modeled on VISSIM PTV software. Traffic signal generation can be done on the signal control menu and then select signal controllers. Figure 5.33 shows the initial screen for setting the signal controller and then selecting fixed time signal control and then editing signal control to enter the next screen. Next, in the control signal, enter the number of arms with each signal time (all red, amber, and green) as shown in Figure 5.34 on the next page.

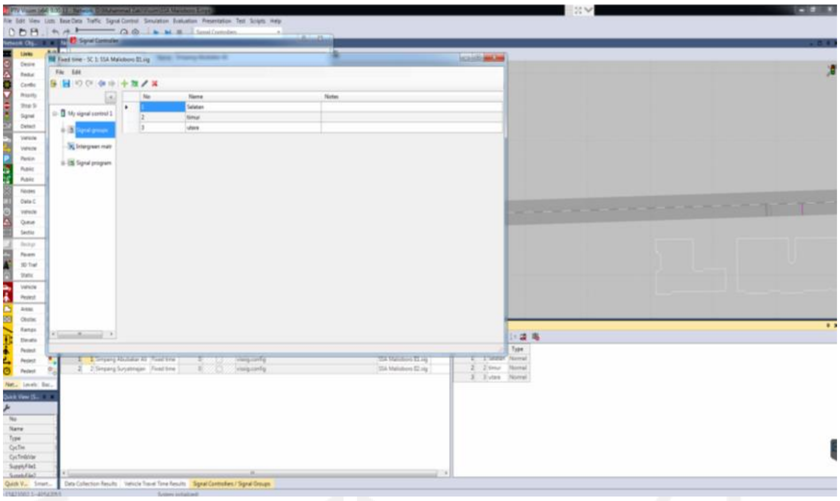


Figure 5.32 Traffic Signal Settings

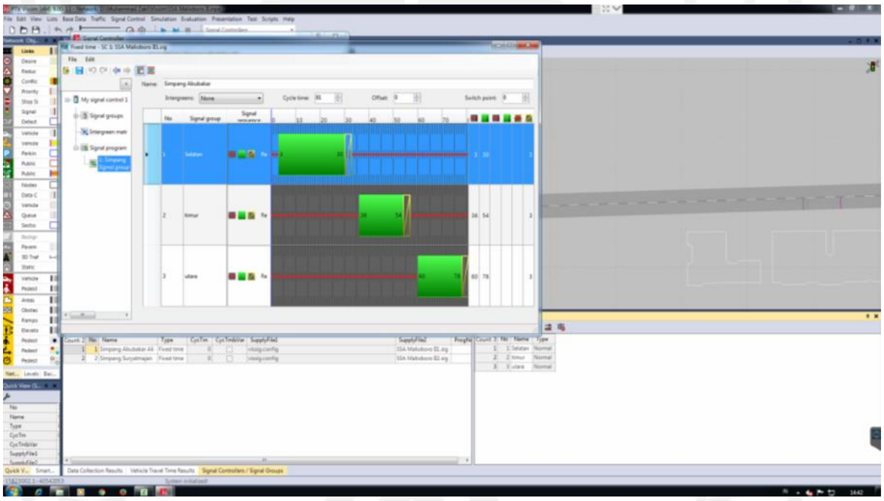


Figure 5.33 Traffic Signal Phase Setting

After setting the traffic signal, input the signaling at the signalized intersection according to the research location by clicking the signal head on the network object and adjusting the signal head to be installed with the signal controller that has been set as shown in Figure 5.35 on the next page.

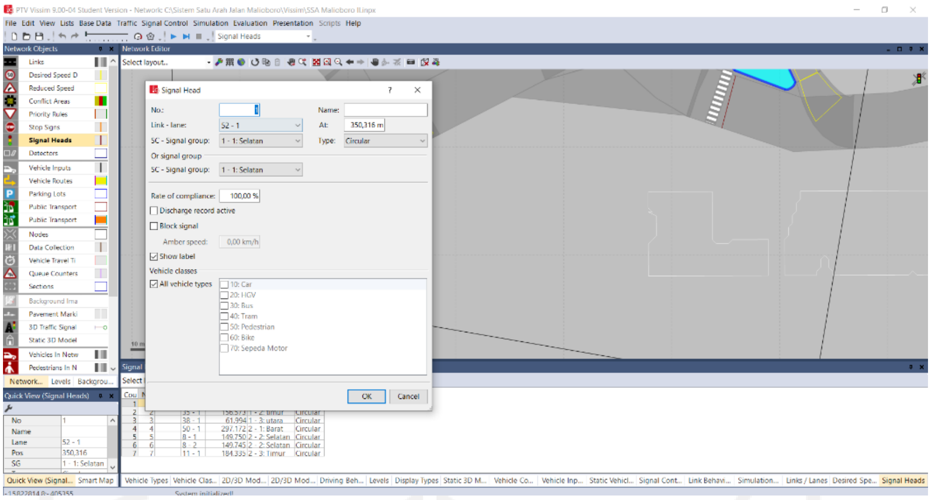


Figure 5.34 Input Signal Head

6. Reduced speed areas Settings

   Reduced speed areas are areas located around intersections where passing vehicles will reduce their speed due to the intersection. The reduced speed areas setting can be done by clicking the reduced speed areas menu in the network object section and placing it on the reduced speed areas on the arm at each intersection as shown in Figure 5.36 as follows.

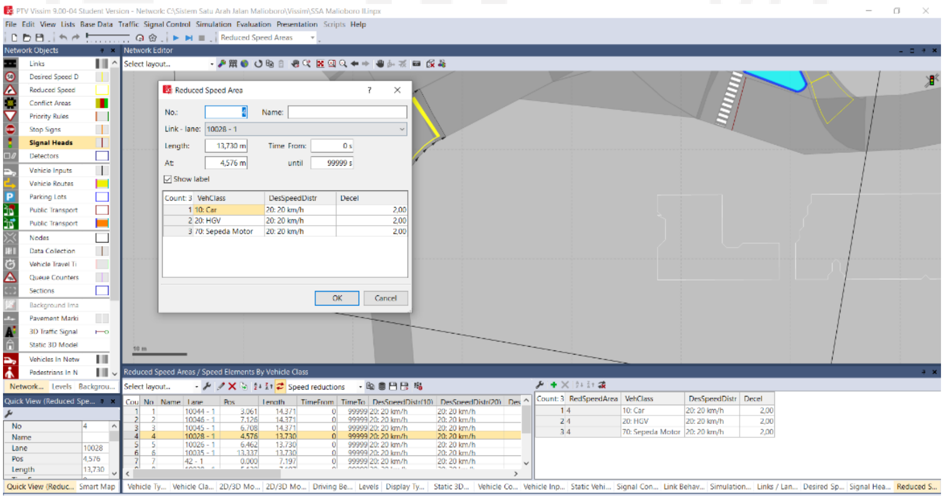


Figure 5.35 Reduced Speed Areas Settings

7. Settings conflict area

   The conflict area setting aims to control vehicles so that they do not collide with each other and can also be used to prioritize vehicles so that they go according to our wishes first, as shown in Figure 5.37 as follows.

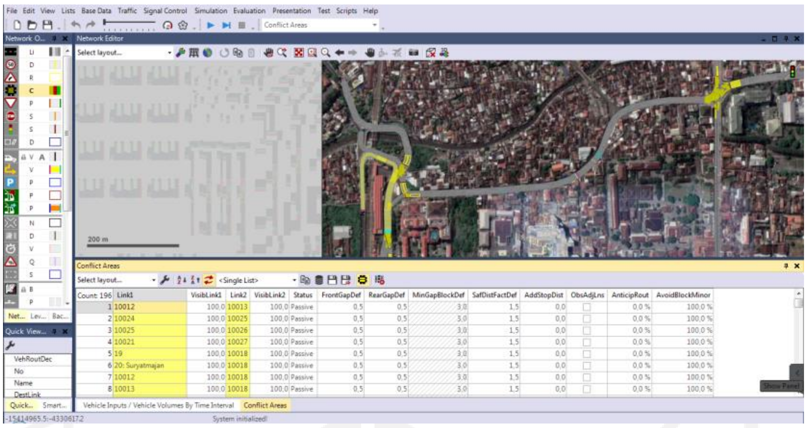


Figure 5.36 Settings Conflict Areas

8. Input data collection point

   In this modeling the type of evaluation used is data collection point because the output used in this study is in the form of volume and speed data. The step for setting the data collection point is to click the data collection point icon and then position the counter point on the desired link as shown in Figure 5.38 as follows.

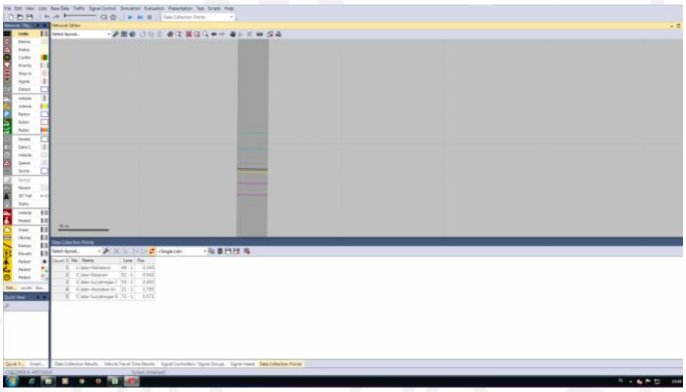


Figure 5.37 Input *Data Collection Point*

9. *Evaluation component* settings

   After the placement of the data collection point is complete, the next step is to set the data collection measurements (DCM) by clicking on the data collection measurement on the evaluation menu. Next, the DCM dialog box will appear and enter a name and adjust it to the data collection point that has been inputted as shown in Figure 5.39 as follows. After setting the data collection measurements, it is continued by setting the evaluation as shown in Figure 5.40.

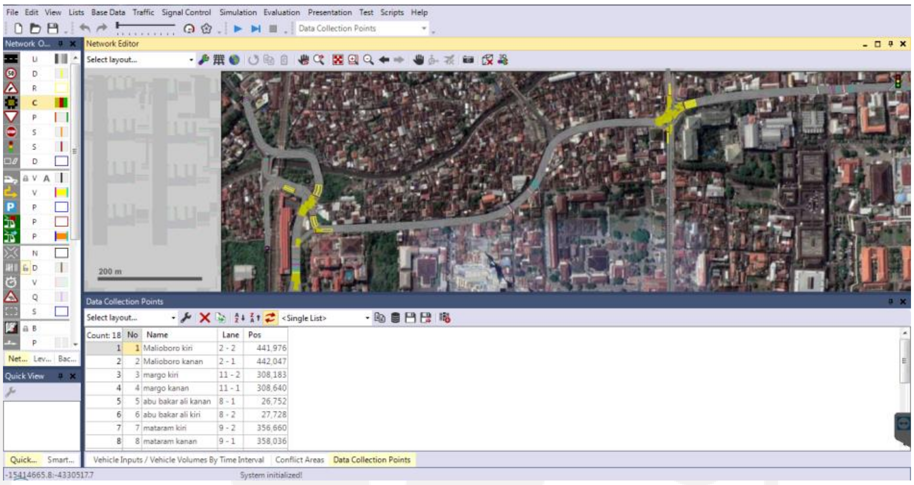


Figure 5.38 Setting Data Collection Measurements

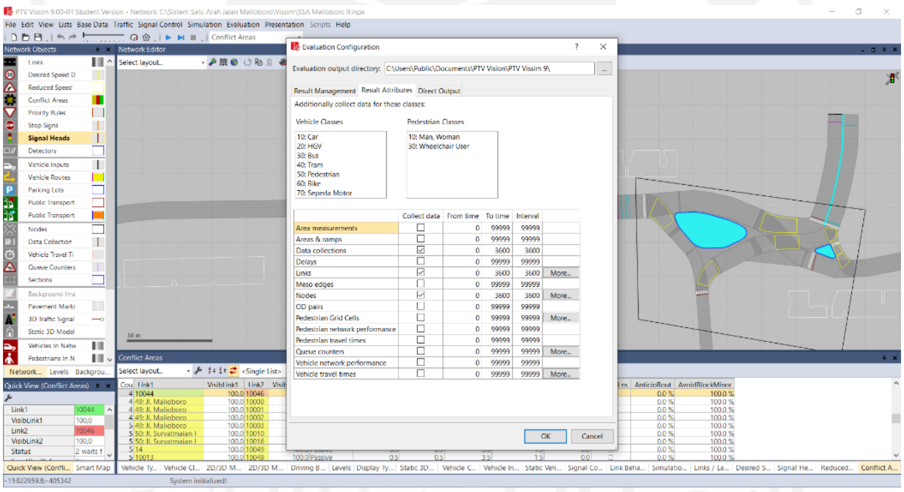


Figure 5.39 Menu *Evaluation Configuration*

10. Input *Driving Behaviour*

    Input driving behavior aims to determine the behavior of road users based on the characteristics of road users according to their respective areas as shown in Figure 5.41, Figure 5.42, Figure 5.43, and Figure 5.44 as follows.

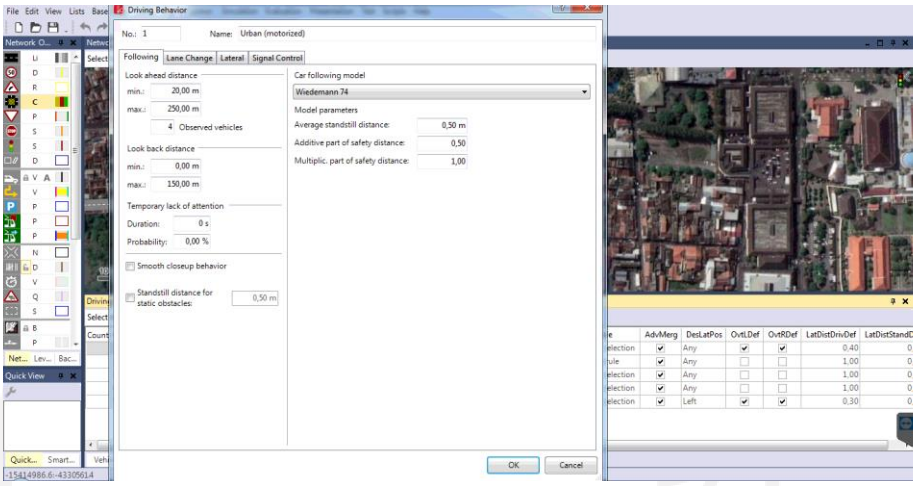


Figure 5.40 Following Parameter Settings in the Driving Behavior Menu

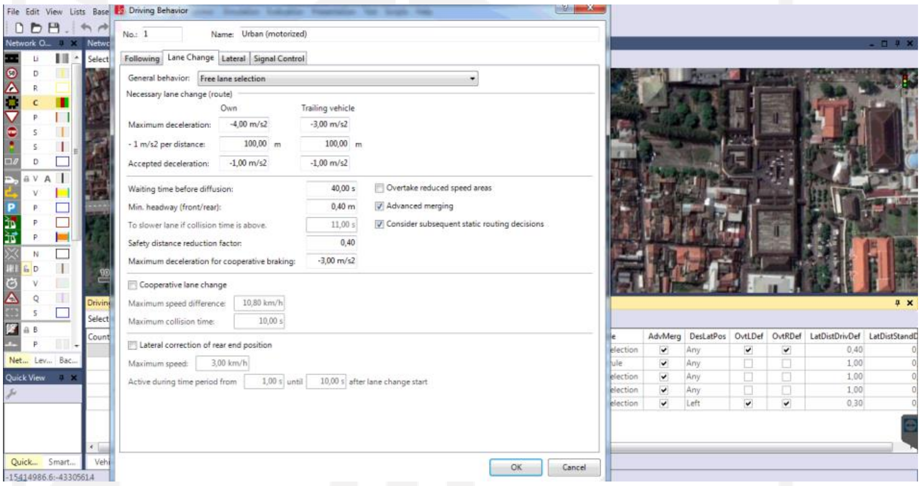


Figure 5.41 Setting Lane Change Parameters in the Driving Behavior Menu

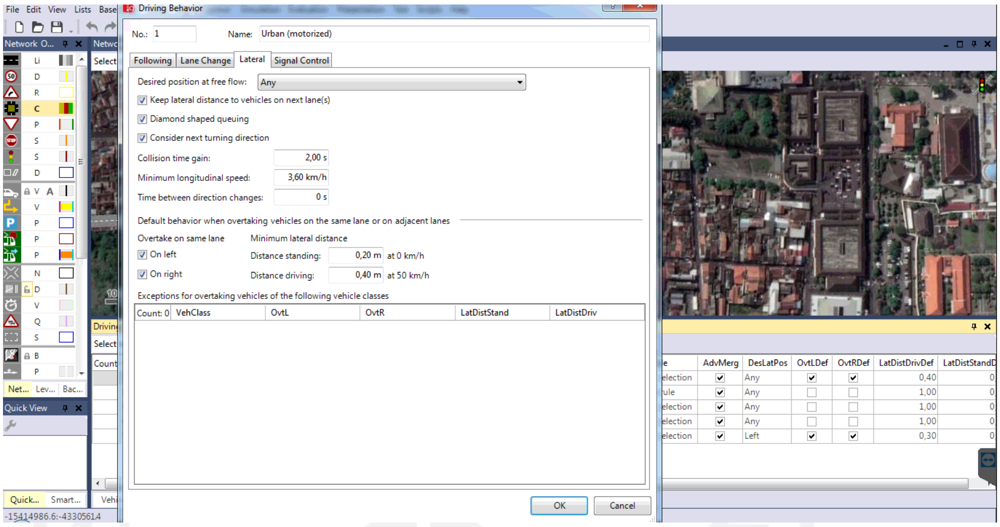


Figure 5.42 Setting Lateral Parameters in the Driving Behavior Menu

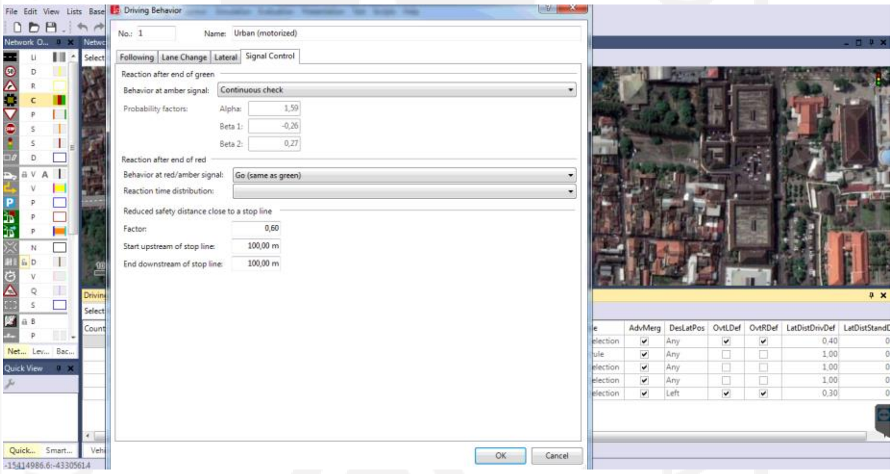


Figure 5.43 Setting Signal Control Parameters in the Driving Behavior Menu

11. Simulation

After setting up the driving behavior, it is continued with running modeling for 1 (one) hour. How to run the simulation, by clicking the simulation menu, the simulation parameters dialog box will appear and enter the desired number. The simulation parameters can be seen in Figure 5.45 on the next page. Then click the play button on the tool bar and the display during the simulation can be seen in Figure 5.46 and the display of the simulation results can be seen in Figure 5.47.

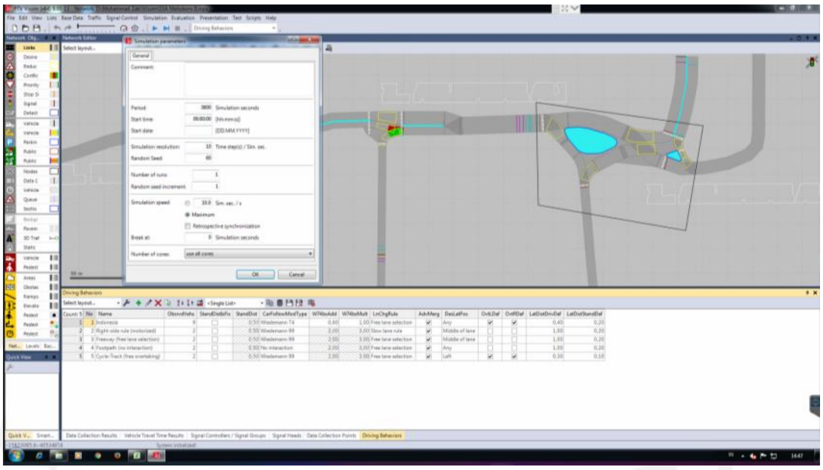


Figure 5.44 Simulation Parameters

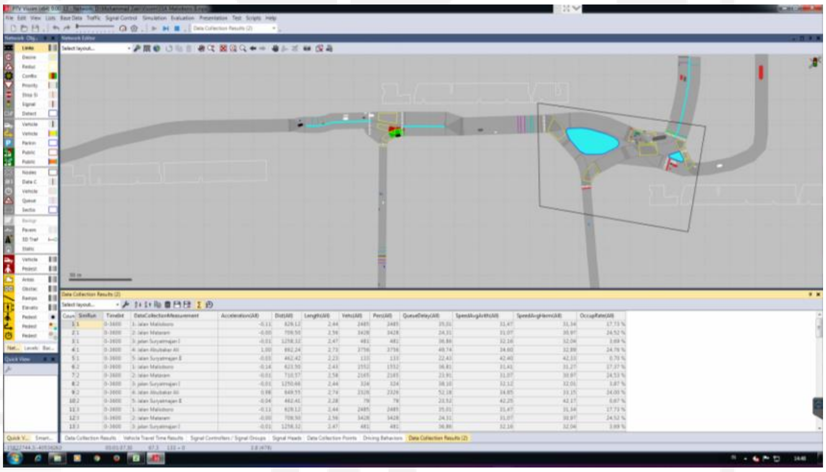


Figure 5.45 Display of Running Process on PTV VISSIM

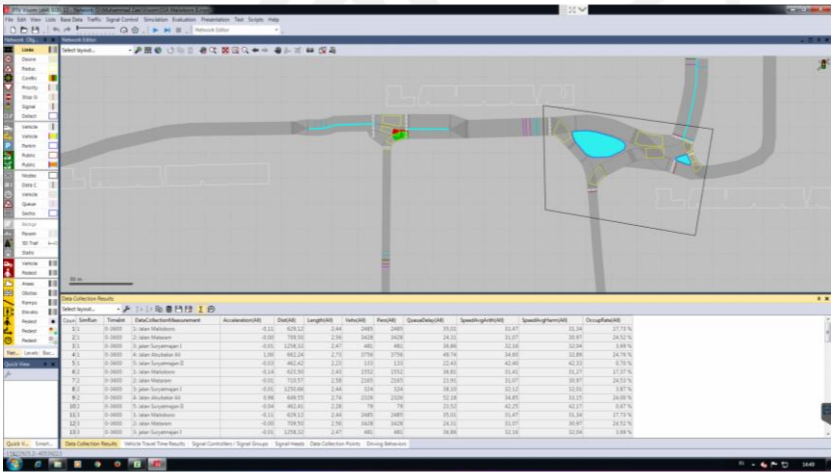


Figure 5.46 Display data collection results

5.2.2 VISSIM PTV Modeling Results Before Calibration

The simulation results for 1 (one) hour in the form of speed and volume that pass through the Road Section - Road Section that passes through the Road Section. Comparison of the volume can be seen in Table 5.24 and for comparison of vehicle speed values can be seen in Table 5.25. The modelling validation parameter used is the GEH (Geoffery E. Havers) Statistical Test. GEH statistical test results have a range of values to measure the level of testing are as follows.

1. GEH value below 5 (condition is met: no problem).
2. GEH values between 5 and 10 (attention, may need to be investigated further. It can be said that this condition is an error model).
3. GEH value above 10 (does not meet GEH requirements, indicates a problem).

Table 5.23 Volume Evaluation Results Before Calibrating Existing Conditions

Road Section	Direction	Field Volume (vehicle)	VISSIM PTV volume (vehicle)	GEH value
Malioboro	South	2534	1377	26,164
Mataram	North	3152	770	53,790
Suryatmajan	East	500	258	12,407
	West	129	41	9,600
Abu Bakar Ali	West	3574	1386	43,931
Margo Mulyo	South	2140	940	30,578
P Senopati	West	1703	531	32,357
	East	2846	1299	35,067
Mayor Suryotomo	North	3002	1105	53,565

The GEH value in the volume evaluation results before calibration shows a value between 5 to 10 and above which indicates that there is still an error in the modelling and does not meet the GEH requirements.

Table 5.24 Speed Results Before Calibration in Existing Conditions

Road Section	Direction	Existing Vehicle Speed (km/h)	VISSIM PTV Vehicle Speed (km/h)	Difference (%)
Malioboro	South	32,946	27,660	5,286
Mataram	North	33,600	24,320	9,280
Suryatmajan	East	35,931	32,402	3,529
	West	36,988	42,260	5,272
Abu Bakar Ali	West	36,269	36,684	0,415
Margo Mulyo	South	18,239	22,64	0,973
Panembahan Senopati	West	26,835	28,29	0,277
	East	21,267	36,42	2,821
Mayor Suryotomo	North	28,264	38,22	1,726

5.2.3 Calibration and Validation

The calibration process is carried out so that the modeling results on PTV VISSIM can represent conditions in the field. Calibration is done by changing the driving behavior which is still set by default according to the behavior conditions of the driver in Germany, for example the distance of the vehicle is up to 2 m and the level of aggressiveness of the driver is lower when compared to drivers in Indonesia. The behavior of drivers in Indonesia tends to be close to the distance between stops between vehicles and has the behavior of drivers with high aggressiveness. The driving behavior components calibrated are Car Following, Lateral, Lane Change, and Signal Control parameters. The driving behavior components that are changed in the calibration step can be seen in Table 5.26 as follows.

Table 5.25 Changes to Driving Behavior Components

Calibration to-	Changed parameters	Changed components	Value	
			Before	After
1	Car Following	Average Standstill Distance	2 m	0,6 m
		Additive Part of Safety Distance	2 m	0,6 m
		Multiplicative Part of Safety Distance	3 m	1 m
2	Lateral	Desired Position at Free Flow	Middle of Lane	Any
		Minimum Distance Standing	1 m	0,2 m
		Minimum Distance Driving	1 m	0,4 m
		Overtake on Same Lane	None	On Left
				On Right
3	Signal Controller	Behaviour at Red/Amber Signal	Stop (Same as Red)	Go (Same as Green)

The first calibration step is to change the Average Standstill Distance value on the Car Following component or the average stopping distance between vehicles from the default 2-meter setting to 0.6 meters. This is because the majority of vehicles at the research site are motorcycles which have very close stopping distances.

The second calibration is to change the Additive Part of Safety Distance component, which is the value used for the safe distance between vehicles. Based on field observations, the safe distance value is 0.6 meters. The third calibration is to change the Multiplicative Part of Safety Distance component, which is the multiple value of the safe distance from the tail of the vehicle. Based on field observations, the multiples of the safe distance value are 1 meter.

The next calibration is to change the value of the Lateral component by changing the Desired Position at Free Flow to Any from the original Middle of Lane to increase the aggressiveness of the driver, which aims to vary the position of the vehicle in the lane. The next calibration is to change the Minimum Distance Standing, namely the distance between drivers' side by side when stopped to 0.2 meters so that a closer distance is obtained between adjoining vehicles. The next calibration is to change the Minimum Driving Distance, which is the distance between drivers' side by side at regular intervals to 0.4 meters. The next calibration is to change the behavior of getting ready in the same lane when the opportunity arises. The last calibration of the signal controller parameters with behavior when the Amber signal is on, the vehicle will continue to drive. This is in accordance with the conditions at the research location with the amber signal, the vehicle continues to act like the green signal. Visually, the simulation modeling results before and after calibration are shown in Figure 5.48 and Figure 5.49 as follows.

Figure 5.47 Before Calibration

Figure 5.48 After Calibration

5.2.4 *PTV VISSIM* Results After Calibration

After the calibration process is complete, the modelling is run again and a comparison of the volume after calibration is obtained, which can be seen in Table 5.27 and in Table 5.28 as follows.

Table 5.26 Volume Evaluation Results After Calibration in Existing Conditions

Road Section	Direction	Field Volume (vehicle)	VISSIM PTV volume (vehicle)	GEH Value
Malioboro	South	2534	2723	3,686
Mataram	North	3152	3053	1,777
Suryatmajan	East	500	512	0,533
	West	129	117	1,082
Abu Bakar Ali	West	3574	3687	1,875
Margo Mulyo	South	2140	2098	0,912
Panembahan Senopati	East	1703	1854	3,581
	West	2846	2934	1,637
Mayor Suryotomo	North	3002	2849	2,829

The GEH value in the volume evaluation results after calibration shows a value below 5 which indicates that the conditions are met and there are no problems in the modelling.

Table 5.27 Speed Results After Calibration in Existing Conditions

Road Section	Direction	Existing Speed (km/h)	VISSIM PTV Speed (km/h)	GEH
Malioboro	South	32,946	20,2	2,513
Mataram	North	33,600	24,8	1,629
Suryatmajan	East	35,931	23,60	2,621
	West	36,988	25,24	2,107
Abu Bakar Ali	West	34,680	23,22	2,129
Margo Mulyo	South	35,09	16,17	3,736
Panembahan Senopati	West	26,835	23,28	0,709
	East	21,267	22,53	0,270
Mayor Suryotomo	North	28,264	24,18	0,797

5.2.5 Capacity Analysis After One Direction System Implementation

The capacity value can be calculated using Equation 3.2. The determination of the capacity contained in Form UR-3 of the 1997 Indonesian Highway Capacity Manual (IHCM)can be seen in Table 5.29.

Table 5.28 Calculation of Road Section Capacity UR-3 Indonesian Road Capacity Manual (IHCM)1997

Direction	Basic Capacity C0 Table 3.1 (Pcu/Hour)	Adjustment factor for capacity				Capacity C (Pcu/Hour) C0 x FCW x FCSP x FCSF x FCCS
		Lane Width FCW Table 3.2	Directional Separation FCSP Table 3.3	Side Friction FCSF Table 3.4	City Size FCCS Table 3.5	
1	3300	0,84	1	0,86	1,04	1453

With the same calculation method, the results of the calculation of the capacity of the Mataram Road Section and the supporting Road Sections (Abu Bakar Ali Road Section, Malioboro Road Section, and Suryatmajan Road Section) are obtained after the application of the one Direction system in the Malioboro area. The thing that distinguishes the 2014 capacity calculation is the Type of Jalan Abu Bakar Ali and Jalan Mataram. In 2014, the Type of Jalan Abu Bakar Ali was 4/2 D and the Type of Jalan Mataram was 2/2 UD. Meanwhile, in 2021, the Type of Jalan Abu Bakar Ali is 4/1 and the Type of Jalan Mataram is 2/1. The recapitulation of the calculation of the capacity of the Road Section can be seen in Table 5.30 as follows.

Table 5.29 Recapitulation of Road Section Capacity Calculation Results

Road Section	Capacity (Pcu/Hour)
Abu Bakar Ali	5628
Malioboro	2151
Suryatmajan	2648
Mataram	2399
Margo Mulyo	2241
Panembahan Senopati	6400
Mayor Suryotomo	6416

5.2.6 Analysis of Degree of Saturation After Application of One Direction System

The value of the degree of saturation can be calculated using Equation 3.3. The following is a calculation of the degree of saturation in the Mataram Road Section after the application of the One Direction system in the Malioboro Area.

$$DS = \frac{Q}{C}$$

$$= \frac{2009}{2141}$$

$$= 0{,}93$$

In the same way, the results of the calculation of the degree of saturation for the other Road Sections after the application of the One Direction system in the Malioboro area are obtained, which can be seen in Table 5.31 as follows.

Table 5.30 Recapitulation of the Calculation of the Degree of Saturation of the Road Section

Road Section	Degree of Saturation (DS)
Abu Bakar Ali	0,66
Malioboro	0,93
Suryatmajan	0,23
Mataram	1,27
Margo Mulyo	0,94
Panembahan Senopati	0,75
Mayor Suryotomo	0,44

5.3 Discussion

The data from this analysis are in the form of volume value (Q), degree of saturation (DS), and velocity. The results of the analysis carried out in the form of a comparison of the degree of saturation and a comparison of speed can be seen in Table 5.28 and Table 5.29 and in Figure 5.50 and Figure 5.51 on the next page.

Table 5.31 Comparison of Degrees of Saturation in 2019 and 2021

Name of Road Section	Degree of Saturation before One Direction	Degree of Saturation After One Direction	Difference (%)
Abu Bakar Ali	0,49	0,66	34
Malioboro	0,58	0,93	61
Suryatmajan	0,19	0,23	23
Mataram	0,85	1,27	50
Margo Mulyo	0,43	0,94	118
Panembahan Senopati	0,49	0,75	53
Mayor Suryotomo	0,41	0,44	8

Table 5.32 Comparison of Speed Values in 2019 and 2021

Name of Road Section	Average Before One Direction	Average After One Direction	Difference (km/h)	Difference (%)	Level of Service
Abu Bakar Ali	32,00	20,20	11,80	58	F
Malioboro	22,00	24,80	2,80	11	F
Suryatmajan	28,00	23,60	4,40	19	F
Mataram	26,10	25,24	0,86	3	F
Margo Mulyo	25,86	23,22	2,64	11	F
Panembahan Senopati	25,79	16,17	9,62	60	F
Mayor Suryotomo	29,78	23,28	6,50	28	F

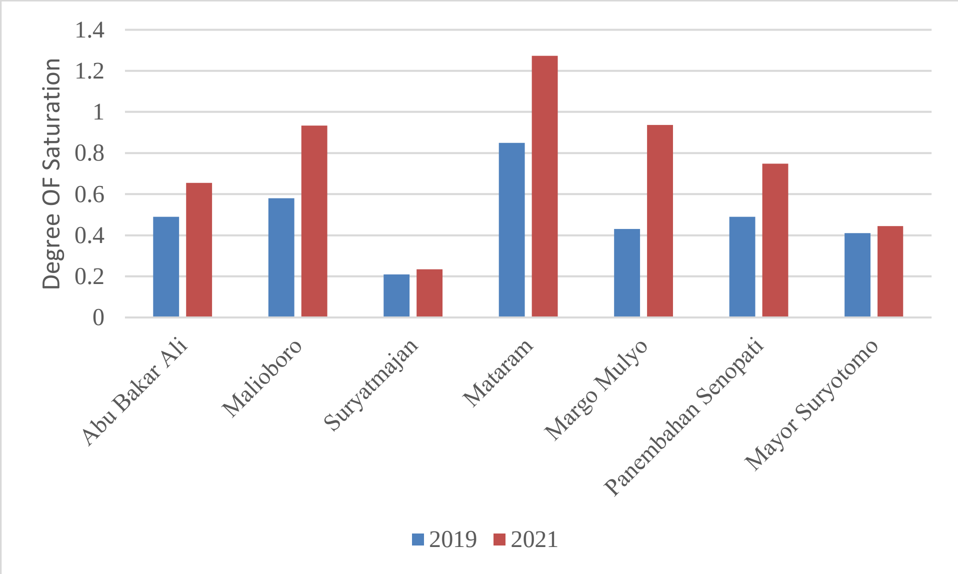


Figure 5.49 Comparison Diagram of Degrees of Saturation in 2019 and 2021

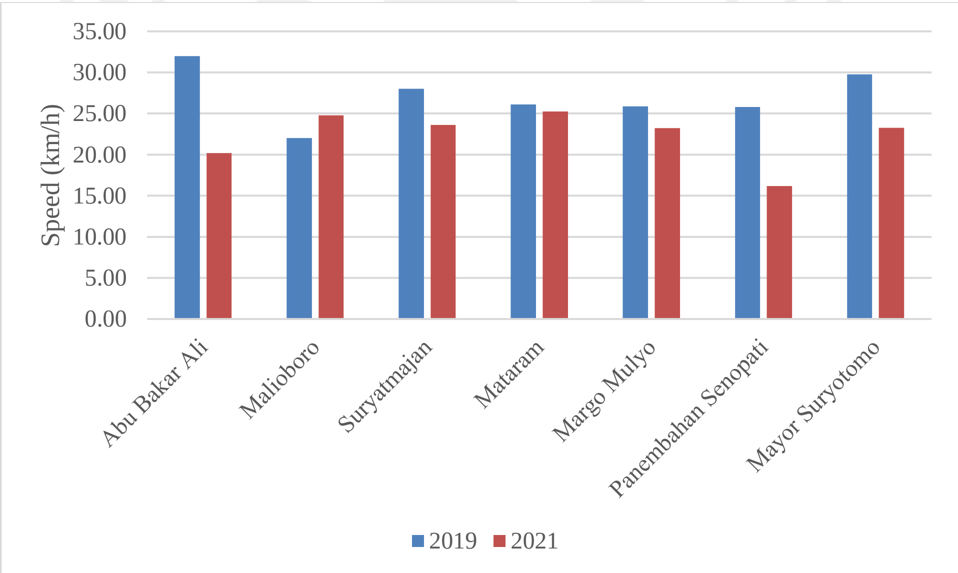


Figure 5.50 Speed Comparison Diagram Before and After One Direction Implementation

According to the calculation results, the value of the degree of saturation for the Malioboro Road Section is 0,49 before the application of the one-way system in the Malioboro area and 0,93 after the application of the one-way system, indicating that the Malioboro Road Section has incresed the value of the degree of saturation by 61%.

For the Suryatmajan Road Section, the value of the degree of saturation before the application of the one Direction system in the Malioboro Area was 0,19 and the value of the degree of saturation after the application of the one Direction system was 0,23, meaning that the Suryatmajan Road Section experienced an increase in the value of the degree of saturation by 23%.

For the Mataram Road Section before the application of the One Direction system in the Malioboro Area was 0,85 and the value of the degree of saturation after the application of the One Direction system was 1,27, meaning that the Mataram Road Section experienced an increase in the value of the degree of saturation by 50%. For the Abu Bakar Ali Road Section, the value of the degree of saturation before the application of the one Direction system in the Malioboro Area is 0,49 and the value of the degree of saturation after the application of the one Direction system is 0,66, meaning that the Abu Bakar Ali Road Section has the value of the degree of saturation increased by 34%.

The average speed for the Mataram Road Section before the implementation of the one Direction system in the Malioboro area was 26,10 km/hour and the average speed after the implementation of the one Direction system was 25,24 km/hour, meaning that the Mataram Road Section has decreased. average speed of 3%. The average speed for the Abu Bakar Ali Road Section before the implementation of the one Direction system in the Malioboro area was 32,00 km/hour and the average speed after the implementation of the one Direction system was 20,20 km/hour, meaning Road Section Abu Bakar Ali experienced an average speed decrease of 58%%. The average speed for the Malioboro Road Section before the implementation of the one Direction system in the Malioboro area was 22,00 km/hour and the average speed after the implementation of the one Direction system was 24,80 km/hour, meaning that the Malioboro Road Section has increased average speed of 11%%. The average speed for the Suryatmajan Road Section before the application of the one Direction system in the Malioboro Area was 28,00 km/hour and the average speed after the application of the one Direction system was 23,6 km/hour, meaning the Suryatmajan Road Section experienced an average speed decrease of 19%.

Based on the statement above, it can be concluded that the Road Section under study, namely the Mataram Road Section, Abu Bakar Ali Road Section, Malioboro Road Section, and Suryatmajan Road Section remain at Service Level F. This is based on the Regulation of Transportation Minister (2015) which states that the Level of Service Service E with the following conditions.

a. The flow is blocked and there is a long queue of vehicles with a speed of less than 30 kilometers/hour,
b. Very high traffic density and low volume and congestion occurs for quite a long time;
c. In the queue state, speed and volume down to 0.

Suhadi, et al (2016) published research on the performance of the One Direction system in Bogor City and concluded that the results of the analysis showed that changes in traffic flow in the One Direction system in the Road Section that surrounds the Bogor Presidential Palace and Bogor Botanical Gardens provide an increase in road performance and also the level of road service, as evidenced by the change in the degree of saturation on Jalan Pajajaran down from 0,61 to 0,59, Jalan Otto Iskandardinata down from 0,77 to 0,73, Jalan Ir. H. Djuanda decreased from 0,79 to 0,67 and Jalan Jalak Harupat decreased from 0,76 to 0,65, as well as the comparison of Level of Service after and before the implementation of SSA in the segment of Jalan Otto Iskandardinata, Jalan Ir. H. Djuanda and Jalan Jalak Harupat increased from D to C, while Jalan Pajajaran remained at service level C. Comparison of research results with previous studies can be seen in Table 5.34 as follows.

Table 5.33 Comparison of Research Results with Previous Research

Researcher	Researched Road Section	Level Of Service (Before)	Level Of Service *(*After*)*
Suhadi (2016)	Pajajaran	C	C
Tanza (2021)	Malioboro	F	F

From the table 5.34 above, the value of the service level in the Padanaram Road Section before the application of the one Direction system was C and after the implementation of the one Direction system the value remained at the service level of C. In the Malioboro Road Section, before the implementation of the one Direction system it was F and after the implementation of the one Direction system the value was increased to service level C based on the travel speed obtained. From the two studies above, it can be concluded that the implementation of the one Direction system can increase the performance of the Road Section or the performance of the Road Section at the same level based on the regulations made by the Ministry of Transportation (2015)

CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

In the research conducted, there are several conclusions from the results of the analysis that have been carried out in the previous chapter, which are as follows.

1. The Malioboro Road Section before the implementation of the One Direction system in the Malioboro Area had a degree of saturation of 0,58. After the implementation of the One Direction system in the Malioboro Area, the degree of saturation decreases to 0,93, a 61 percent decrease. The condition of the level of service of the Malioboro Road Section changes after the implementation of one direction. Before the implementation of the one direction system in the Malioboro Area, the value of the Malioboro Road Section level of service was at level F with an average speed of 22 km/hour, and after the application of the one direction system, the average speed of the Malioboro Road Section increased with an average speed of 24,8 km/hour but still on level F
2. The impact due to the application of the one Direction system on the Malioboro Road Section on the surrounding Road section has a significant impact. The speed of the Abu Bakar Ali Road Section has decreased by 58% and remains at level F with a decrease in the degree of saturation by 34%, the speed at The Malioboro Road Section experienced an average speed increase of 11% and still remains at level F with a decrease in the degree of saturation by %, and the speed of the Suryatmajan Road Section decreased by 19% with the degree of saturation decreased by 23%.

6.2 Recommendation

Several suggestions can be made based on the conclusions above for future research using the PTV VISSIM software to achieve better results, as follows.

1. Observation of side resistance, so that the side resistance used can be based on the weight of events per hour. This will make the calculation of performance components more precise.
2. In addition to implement the one-way system to improve service and speed, further researchers are advised to re-examine the cycle time at the intersection of Jalan Abu Bakar Ali and Jalan Suryatmajan in order to facilitate the flow of vehicles that pass through it.
3. Further researchers can expand the one-way traffic engineering simulation system around the Malioboro Road Section to find the most effective engineering and increase the level of service in all Road Sections.

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APPENDIX

APPENDIX 1 SURVEY FORM

Appendix 1 Survey Form

FORMULIR SURVEY SIMPANG

Lengan Simpang :
Lokasi Survei :
Surveyor :
Jumlah Lajur :
Lebar Lajur :
Median :
Belok Kiri : Langsung/Tidak Langsung
Waktu/Cuaca :

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15												
2	06:15-06:30												
3	06:30-06:45												
4	06:45-07:00												
5	07:00-07:15												
6	07:15-07:30												
7	07:30-07:45												
8	07:45-08:00												

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

APPENDIX 2 MORNING WORK DAY SURVEY DATA (06:00 – 08:00)

Appendix 2 Data Survey at Intersection A Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Timur	Jumlah Lajur	: 2	Belok Kiri	: -
Lokasi Survei	: Simpang 3 Abu Bakar Ali	Lebar Lajur	: 8,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Ikmal	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15					313	180	5	6				
2	06:15-06:30					256	137	5	3				
3	06:30-06:45					311	175	4	5				
4	06:45-07:00					251	147	5	2				
5	07:00-07:15					338	166	5	2				
6	07:15-07:30					350	201	4	2				
7	07:30-07:45					310	237	3	2				
8	07:45-08:00					338	163	3	3				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection A Working Day Session 1 (06:00 – 08:00 WIB)

<u>FORMULIR SURVEY SIMPANG</u>

Lengan Simpang	: Selatan	Jumlah Lajur	: 2	Belok Kiri	: Tidak Langsung
Lokasi Survei	: Simpang 3 Abu Bakar Ali	Lebar Lajur	: 3,4 m	Waktu/Cuaca	: Cerah
Surveyor	: Ikmal	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	139	103	1	21					145	122	1	22
2	06:15-06:30	140	75	1	5					155	86	2	23
3	06:30-06:45	115	68	2	7					125	79	3	22
4	06:45-07:00	125	71	0	6					136	88	1	5
5	07:00-07:15	99	75	0	12					120	89	2	9
6	07:15-07:30	126	89	2	10					144	96	2	6
7	07:30-07:45	106	50	1	11					131	68	0	11
8	07:45-08:00	32	41	0	15					46	55	1	19

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection B Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 2
Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Pasar Kembang
Lebar Lajur : 3,7 m
Waktu/Cuaca : Cerah

Surveyor : Anggi
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	165	5	7	30	52	20	0	4				
2	06:15-06:30	142	41	5	27	70	18	0	2				
3	06:30-06:45	145	45	3	0	83	23	1	1				
4	06:45-07:00	151	48	5	46	110	28	1	3				
5	07:00-07:15	160	50	4	33	134	29	1	5				
6	07:15-07:30	182	56	7	34	151	45	1	2				
7	07:30-07:45	194	50	9	28	125	36	1	2				
8	07:45-08:00	218	78	4	27	187	48	0	7				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection C Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Utara	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Suryatmajan	Lebar Lajur	: 3 m	Waktu/Cuaca	: Cerah
Surveyor	: Adul	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	19	3	0	5	85	18	3	51	6	1	0	0
2	06:15-06:30	24	3	0	1	92	23	6	20	6	3	0	0
3	06:30-06:45	36	4	0	0	102	24	3	21	22	4	0	6
4	06:45-07:00	37	3	0	3	123	25	5	23	21	1	0	1
5	07:00-07:15	57	5	0	3	142	40	3	19	24	2	0	1
6	07:15-07:30	60	17	0	3	182	30	4	11	10	6	0	3
7	07:30-07:45	56	9	0	0	221	33	8	11	12	4	0	4
8	07:45-08:00	75	14	0	4	211	47	3	16	14	3	0	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection C Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Timur	Jumlah Lajur	: 1	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Suryatmajan	Lebar Lajur	: 3,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Adul	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	7	0	0	2	13	0	0	4				
2	06:15-06:30	7	0	0	2	10	0	0	5				
3	06:30-06:45	17	0	0	1	9	0	0	2				
4	06:45-07:00	6	0	0	3	13	0	0	6				
5	07:00-07:15	1	0	0	3	4	0	0	1				
6	07:15-07:30	4	0	0	1	12	0	0	1				
7	07:30-07:45	12	0	0	4	4	0	0	1				
8	07:45-08:00	8	0	0	0	7	0	0	2				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection C Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat | Jumlah Lajur : 1 | Belok Kiri : -

Lokasi Survei : Simpang 4 Suryatmajan | Lebar Lajur : 3,5 m | Waktu/Cuaca : Cerah

Surveyor : Adul | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15					10	0	0	1	3	0	0	1
2	06:15-06:30					29	0	0	1	7	0	0	2
3	06:30-06:45					19	1	0	1	16	0	0	4
4	06:45-07:00					11	1	0	2	15	0	0	3
5	07:00-07:15					23	1	0	4	10	0	0	2
6	07:15-07:30					31	3	0	5	10	0	0	3
7	07:30-07:45					30	2	0	2	13	0	0	0
8	07:45-08:00					15	2	0	2	10	1	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection D Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang	: Utara	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Kantor Pos Besar	Lebar Lajur	: 3 m	Waktu/Cuaca	: Cerah
Surveyor	: Apil	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	26	14	4	3	37	3	0	28	52	7	2	2
2	06:15-06:30	48	13	4	5	56	5	0	20	59	8	3	3
3	06:30-06:45	101	12	3	12	63	14	0	20	34	3	1	2
4	06:45-07:00	87	16	3	3	72	7	0	27	71	15	3	5
5	07:00-07:15	65	21	3	9	91	8	0	22	65	12	0	4
6	07:15-07:30	115	17	2	6	103	14	0	11	97	11	3	4
7	07:30-07:45	117	18	3	1	112	12	0	9	109	15	2	4
8	07:45-08:00	57	13	1	2	78	8	0	10	56	15	0	3

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection D Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 2
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Kantor Pos Besar
Lebar Lajur : 6,35 m
Waktu/Cuaca : Cerah
Surveyor : Apil
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	13	2	1	3	86	16	5	3				
2	06:15-06:30	23	1	0	4	94	11	3	3				
3	06:30-06:45	26	2	0	5	137	15	2	1				
4	06:45-07:00	39	6	0	2	194	30	3	4				
5	07:00-07:15	55	6	0	2	228	27	2	1				
6	07:15-07:30	74	7	0	2	266	39	4	2				
7	07:30-07:45	63	3	0	2	258	31	1	4				
8	07:45-08:00	52	1	0	0	295	40	3	0				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection D Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang	: Selatan	Jumlah Lajur	: 1	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Kantor Pos Besar	Lebar Lajur	: 3 m	Waktu/Cuaca	: Cerah
Surveyor	: Apil	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	51	6	0	12					46	4	0	3
2	06:15-06:30	59	8	0	10					78	9	0	6
3	06:30-06:45	103	14	1	7					83	7	0	6
4	06:45-07:00	115	20	2	4					86	14	0	3
5	07:00-07:15	134	30	2	8					100	23	0	1
6	07:15-07:30	186	24	1	5					136	20	0	1
7	07:30-07:45	217	35	3	6					152	10	0	1
8	07:45-08:00	210	26	1	5					125	22	0	10

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection D Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Barat Jumlah Lajur : 2 Belok Kiri : -

Lokasi Survei : Simpang 4 Kantor Pos Besar Lebar Lajur : 3 m Waktu/Cuaca : Cerah

Surveyor : Apil Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15					177	17	1	2	10	2	0	0
2	06:15-06:30					202	32	1	3	17	3	0	0
3	06:30-06:45					295	28	1	5	26	0	0	0
4	06:45-07:00					294	58	1	4	39	8	0	0
5	07:00-07:15					420	50	3	7	42	13	0	0
6	07:15-07:30					462	57	2	10	47	8	0	0
7	07:30-07:45					486	48	3	12	68	6	0	0
8	07:45-08:00					515	65	4	6	60	3	0	1

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection E Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 2
Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Gondomanan
Lebar Lajur : 4,05 m
Waktu/Cuaca : Cerah

Surveyor : Adit
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	105	65	1	5	239	43	1	9	72	24	0	3
2	06:15-06:30	99	55	1	4	230	31	1	6	69	17	0	3
3	06:30-06:45	128	43	0	4	194	54	3	4	71	15	0	3
4	06:45-07:00	109	48	1	6	218	30	3	3	71	20	0	3
5	07:00-07:15	146	55	0	12	225	53	0	5	65	20	0	4
6	07:15-07:30	128	54	1	9	241	48	2	6	74	21	0	3
7	07:30-07:45	131	54	0	8	232	44	0	4	78	15	0	5
8	07:45-08:00	135	53	2	9	209	46	0	3	70	17	0	3

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection E Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Selatan
Lokasi Survei : Simpang 4 Gondomanan
Surveyor : Adit

Jumlah Lajur : 2
Lebar Lajur : 3,5 m
Median : Ada

Belok Kiri : Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	19	7	0	3	233	59	0	10	151	23	0	0
2	06:15-06:30	17	3	0	2	254	73	2	4	169	47	1	0
3	06:30-06:45	29	9	1	2	203	59	0	9	119	25	0	0
4	06:45-07:00	19	4	1	2	258	72	0	2	173	38	0	0
5	07:00-07:15	34	5	1	3	242	54	0	6	167	21	0	0
6	07:15-07:30	27	7	1	3	258	66	1	7	173	31	0	0
7	07:30-07:45	17	5	1	1	249	59	0	5	165	23	0	0
8	07:45-08:00	23	3	1	3	226	61	1	10	142	29	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection E Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang	: Barat	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Gondomanan	Lebar Lajur	: 3,35 m	Waktu/Cuaca	: Cerah
Surveyor	: Adit	Median	: Ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	122	60	1	5	137	37	3	0	145	32	3	0
2	06:15-06:30	116	51	1	4	144	48	3	0	162	44	3	0
3	06:30-06:45	145	36	0	4	132	38	3	0	145	35	3	0
4	06:45-07:00	143	43	1	6	142	37	3	0	116	33	2	0
5	07:00-07:15	163	50	0	12	116	48	3	0	158	45	3	0
6	07:15-07:30	162	49	1	9	91	35	1	0	107	34	1	0
7	07:30-07:45	165	55	0	8	108	17	3	0	124	18	3	0
8	07:45-08:00	169	59	2	9	77	16	0	0	85	17	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection F Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur — Jumlah Lajur : 1 — Belok Kiri : -

Lokasi Survei : Simpang 4 Juminahan — Lebar Lajur : 3,5 m — Waktu/Cuaca : Cerah

Surveyor : Hendro — Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15					16	2	0	0	15	0	0	2
2	06:15-06:30					18	2	1	1	16	0	0	0
3	06:30-06:45					29	3	0	1	22	1	0	1
4	06:45-07:00					30	1	1	1	24	0	0	0
5	07:00-07:15					31	2	0	0	18	2	0	0
6	07:15-07:30					32	1	1	2	19	3	1	0
7	07:30-07:45					35	3	0	0	22	2	1	0
8	07:45-08:00					41	5	0	0	50	1	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection F Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan | Jumlah Lajur : 4 | Belok Kiri : Tidak Langsung

Lokasi Survei : Simpang 4 Juminahan | Lebar Lajur : 3,55 m | Waktu/Cuaca : Cerah

Surveyor : Hendro | Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	13	1	0	2	125	48	2	5	49	1	0	0
2	06:15-06:30	14	1	0	2	155	56	1	0	55	5	1	1
3	06:30-06:45	18	0	1	1	221	59	2	1	54	9	0	2
4	06:45-07:00	20	2	2	0	235	60	3	2	59	5	1	2
5	07:00-07:15	23	3	1	0	241	63	2	15	60	4	0	1
6	07:15-07:30	24	2	0	0	264	75	1	10	66	8	1	0
7	07:30-07:45	29	1	0	0	284	86	0	4	68	6	1	1
8	07:45-08:00	30	2	0	0	361	88	0	6	78	5	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 2 Data Survey at Intersection F Working Day Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat
Lokasi Survei : Simpang 4 Juminahan
Surveyor : Hendro

Jumlah Lajur : 2
Lebar Lajur : 3,5 m
Median : Tidak ada

Belok Kiri : Tidak Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	22	15	0	1	15	0	0	2				
2	06:15-06:30	15	17	1	1	19	1	0	0				
3	06:30-06:45	24	18	1	1	25	2	0	1				
4	06:45-07:00	26	25	2	2	30	5	0	2				
5	07:00-07:15	39	27	1	0	35	2	0	3				
6	07:15-07:30	47	36	0	0	39	1	0	2				
7	07:30-07:45	48	35	0	2	40	4	0	1				
8	07:45-08:00	75	38	0	3	45	2	0	0				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

APPENDIX 3 AFTERNOON WORK DAY SURVEY DATA (11:00 – 13:00)

Appendix 3 Survey Data at Intersection A Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur Jumlah Lajur : 2 Belok Kiri : -

Lokasi Survei : Simpang 3 Abu Bakar Ali Lebar Lajur : 8,5 m Waktu/Cuaca : Cerah

Surveyor : Ikmal Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15					348	200	5	7				
2	11:15-11:30					284	152	6	3				
3	11:30-11:45					346	194	4	5				
4	11:45-12:00					279	163	5	2				
5	12:00-12:15					375	184	5	2				
6	12:15-12:30					389	223	4	2				
7	12:30-12:45					344	263	3	2				
8	12:45-13:00					375	181	3	3				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection A Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Selatan	Jumlah Lajur	: 2	Belok Kiri	: Tidak Langsung
Lokasi Survei	: Simpang 3 Abu Bakar Ali	Lebar Lajur	: 3,4 m	Waktu/Cuaca	: Cerah
Surveyor	: Ikmal	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	154	114	1	23					166	125	2	29
2	11:15-11:30	156	83	1	5					178	99	2	9
3	11:30-11:45	128	76	2	8					144	79	4	11
4	11:45-12:00	139	79	0	7					146	82	1	13
5	12:00-12:15	110	83	0	13					121	96	0	18
6	12:15-12:30	140	99	2	11					155	120	1	19
7	12:30-12:45	118	55	1	12					128	66	0	20
8	12:45-13:00	35	45	0	17					49	67	0	22

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection B Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Timur	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Pasar Kembang	Lebar Lajur	: 3,7 m	Waktu/Cuaca	: Cerah
Surveyor	: Anggi	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	229	122	7	7	159	67	1	4				
2	11:15-11:30	245	130	7	12	174	56	0	2				
3	11:30-11:45	235	134	6	10	179	58	2	2				
4	11:45-12:00	243	138	7	14	142	53	2	6				
5	12:00-12:15	200	152	9	11	132	51	2	0				
6	12:15-12:30	223	147	8	12	157	65	1	0				
7	12:30-12:45	236	136	6	9	154	66	3	3				
8	12:45-13:00	248	132	8	7	172	68	2	0				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection C Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Utara
Lokasi Survei : Simpang 4 Suryatmajan
Surveyor : Adul

Jumlah Lajur : 2
Lebar Lajur : 3 m
Median : Tidak ada

Belok Kiri : Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	49	25	0	6	137	69	3	7	31	9	0	1
2	11:15-11:30	55	16	0	4	156	52	5	7	29	9	0	2
3	11:30-11:45	47	16	0	3	191	62	6	8	39	14	0	0
4	11:45-12:00	46	10	1	2	158	58	3	4	27	9	0	1
5	12:00-12:15	53	20	0	4	144	70	4	10	24	11	0	2
6	12:15-12:30	63	19	0	1	172	67	6	11	19	3	0	3
7	12:30-12:45	37	22	1	9	153	53	3	7	19	12	0	1
8	12:45-13:00	66	28	0	3	138	46	2	5	21	4	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection C Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur | Jumlah Lajur : 1 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Suryatmajan | Lebar Lajur : 3,5 m | Waktu/Cuaca : Cerah

Surveyor : Adul | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	21	0	0	0	13	0	0	2				
2	11:15-11:30	9	0	0	0	9	0	0	2				
3	11:30-11:45	14	0	0	1	18	0	0	2				
4	11:45-12:00	13	0	0	2	4	0	0	1				
5	12:00-12:15	14	0	0	2	10	0	0	1				
6	12:15-12:30	21	2	1	0	12	0	0	0				
7	12:30-12:45	7	0	0	1	13	0	0	0				
8	12:45-13:00	5	0	0	0	13	0	0	1				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection C Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat | Jumlah Lajur : 1 | Belok Kiri : -

Lokasi Survei : Simpang 4 Suryatmajan | Lebar Lajur : 3,5 m | Waktu/Cuaca : Cerah

Surveyor : Adul | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15					30	1	0	2	9	0	0	5
2	11:15-11:30					22	0	0	4	14	0	0	4
3	11:30-11:45					32	0	0	3	38	1	0	0
4	11:45-12:00					16	0	0	5	31	2	0	3
5	12:00-12:15					22	1	0	1	18	0	0	0
6	12:15-12:30					25	0	0	1	11	1	0	3
7	12:30-12:45					18	0	0	0	20	0	0	5
8	12:45-13:00					13	1	0	1	12	0	0	1

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection D Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Utara
Jumlah Lajur : 2
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Kantor Pos Besar
Lebar Lajur : 3 m
Waktu/Cuaca : Cerah
Surveyor : Apil
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	107	30	3	3	121	22	0	3	119	27	3	2
2	11:15-11:30	87	38	3	8	153	11	0	7	167	24	1	6
3	11:30-11:45	99	47	2	6	127	20	0	1	124	42	1	3
4	11:45-12:00	86	43	3	5	151	24	1	9	138	22	4	2
5	12:00-12:15	104	35	2	2	117	21	0	3	153	24	1	5
6	12:15-12:30	155	36	2	5	123	29	0	1	140	33	3	3
7	12:30-12:45	129	57	4	9	113	22	0	3	102	19	2	1
8	12:45-13:00	95	33	1	6	122	22	0	7	148	33	2	3

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection D Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 2
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Kantor Pos Besar
Lebar Lajur : 6,35 m
Waktu/Cuaca : Cerah
Surveyor : Apil
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	46	12	0	2	138	45	8	0				
2	11:15-11:30	53	10	1	0	181	48	6	1				
3	11:30-11:45	58	10	1	1	166	51	6	4				
4	11:45-12:00	52	16	0	0	167	52	2	0				
5	12:00-12:15	39	14	0	0	163	47	8	0				
6	12:15-12:30	43	13	0	0	159	41	3	1				
7	12:30-12:45	51	6	0	0	155	42	5	0				
8	12:45-13:00	44	13	0	0	185	42	5	0				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection D Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan | Jumlah Lajur : 1 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Kantor Pos Besar | Lebar Lajur : 3 m | Waktu/Cuaca : Cerah

Surveyor : Apil | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	167	48	5	4					85	16	0	5
2	11:15-11:30	172	49	2	0					81	23	1	3
3	11:30-11:45	176	43	5	3					82	18	0	1
4	11:45-12:00	162	38	3	0					75	14	2	5
5	12:00-12:15	140	40	3	1					95	15	1	6
6	12:15-12:30	137	35	4	2					72	20	0	6
7	12:30-12:45	85	35	1	1					87	17	4	6
8	12:45-13:00	35	34	1	3					120	19	0	3

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection D Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat | Jumlah Lajur : 2 | Belok Kiri : -

Lokasi Survei : Simpang 4 Kantor Pos Besar | Lebar Lajur : 3 m | Waktu/Cuaca : Cerah

Surveyor : Apil | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15					288	54	4	3	58	12	1	0
2	11:15-11:30					172	61	8	6	55	12	0	0
3	11:30-11:45					83	65	1	4	55	11	0	0
4	11:45-12:00					205	64	7	6	57	10	1	0
5	12:00-12:15					185	53	2	1	47	8	0	0
6	12:15-12:30					218	69	5	2	65	12	1	0
7	12:30-12:45					288	81	8	2	48	11	0	0
8	12:45-13:00					312	47	3	5	50	9	0	1

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection E Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Timur
Lokasi Survei : Simpang 4 Gondomanan
Surveyor : Adit

Jumlah Lajur : 2
Lebar Lajur : 4,05 m
Median : Tidak ada

Belok Kiri : Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	112	63	1	5	253	42	1	10	77	28	0	3
2	11:15-11:30	105	56	1	5	243	35	1	6	73	21	0	4
3	11:30-11:45	136	45	0	5	205	57	4	5	76	19	0	4
4	11:45-12:00	115	48	1	6	230	30	4	4	76	23	0	4
5	12:00-12:15	155	58	0	13	239	59	0	5	68	24	0	5
6	12:15-12:30	135	59	1	9	256	58	2	6	78	25	0	4
7	12:30-12:45	139	49	0	8	246	61	0	5	83	19	0	5
8	12:45-13:00	143	48	2	10	221	48	0	4	74	21	0	4

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection E Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang	: Selatan	Jumlah Lajur	: 2
Lokasi Survei	: Simpang 4 Gondomanan	Lebar Lajur	: 3,5 m
Surveyor	: Adit	Median	: Ada
Belok Kiri	: Langsung	Waktu/Cuaca	: Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	20	7	0	4	227	49	0	11	160	25	0	0
2	11:15-11:30	18	4	0	2	249	52	2	5	179	47	1	0
3	11:30-11:45	31	9	1	2	205	51	0	9	126	26	0	0
4	11:45-12:00	20	5	1	2	253	55	0	2	184	41	0	0
5	12:00-12:15	36	5	1	3	237	48	0	6	176	23	0	0
6	12:15-12:30	29	7	1	4	254	47	1	7	184	33	0	0
7	12:30-12:45	18	5	1	1	244	53	0	5	175	23	0	0
8	12:45-13:00	24	4	1	3	219	56	1	11	150	32	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection E Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang	: Barat	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Gondomanan	Lebar Lajur	: 3,35 m	Waktu/Cuaca	: Cerah
Surveyor	: Adit	Median	: Ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	130	58	1	5	145	38	4	0	154	34	3	0
2	11:15-11:30	123	51	1	5	152	47	4	0	171	48	4	0
3	11:30-11:45	154	31	0	5	140	38	4	0	153	37	3	0
4	11:45-12:00	151	47	1	6	150	35	3	0	122	35	2	0
5	12:00-12:15	173	57	0	13	122	42	4	0	167	47	4	0
6	12:15-12:30	171	48	1	9	96	39	1	0	113	36	1	0
7	12:30-12:45	175	58	0	8	114	18	4	0	131	20	4	0
8	12:45-13:00	179	59	2	10	82	17	0	0	90	17	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection F Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur Jumlah Lajur : 1 Belok Kiri : -

Lokasi Survei : Simpang 4 Juminahan Lebar Lajur : 3,5 m Waktu/Cuaca : Cerah

Surveyor : Hendro Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15					110	2	1	1	67	23	1	1
2	11:15-11:30					110	9	0	2	50	14	0	1
3	11:30-11:45					110	6	0	1	57	23	0	2
4	11:45-12:00					108	6	1	3	47	23	2	1
5	12:00-12:15					104	5	0	2	39	15	3	3
6	12:15-12:30					98	8	1	1	35	11	4	2
7	12:30-12:45					103	4	1	1	58	14	0	1
8	12:45-13:00					116	10	0	2	53	11	3	1

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection F Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan | Jumlah Lajur : 4 | Belok Kiri : Tidak Langsung

Lokasi Survei : Simpang 4 Juminahan | Lebar Lajur : 3,55 m | Waktu/Cuaca : Cerah

Surveyor : Hendro | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	37	3	1	1	300	123	5	6	255	51	0	2
2	11:15-11:30	38	6	0	0	302	118	5	7	257	55	0	3
3	11:30-11:45	38	11	1	2	326	119	4	6	266	44	0	4
4	11:45-12:00	27	11	0	2	238	121	4	4	268	48	1	2
5	12:00-12:15	29	13	0	0	301	121	1	4	277	55	1	2
6	12:15-12:30	27	6	0	1	312	138	4	5	280	51	0	2
7	12:30-12:45	33	8	1	2	309	134	3	4	291	45	0	1
8	12:45-13:00	23	15	0	0	294	107	3	8	270	40	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 3 Survey Data at Intersection F Working Day Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Barat	Jumlah Lajur	: 1	Belok Kiri	: Tidak Langsung
Lokasi Survei	: Simpang 4 Juminahan	Lebar Lajur	: 3,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Hendro	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	86	41	1	2	25	4	1	2				
2	11:15-11:30	77	14	0	1	22	2	0	2				
3	11:30-11:45	82	18	2	2	34	3	1	1				
4	11:45-12:00	88	15	0	3	33	5	1	3				
5	12:00-12:15	83	30	0	0	43	6	0	2				
6	12:15-12:30	104	33	1	2	33	9	1	1				
7	12:30-12:45	74	14	0	5	45	4	0	0				
8	12:45-13:00	72	30	0	2	77	8	0	1				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

APPENDIX 4 WEEKDAYS AFTERNOON SURVYE DATA (16:00 – 18:00)

Appendix 4 Survey Data at Intersection A Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Timur	Jumlah Lajur	: 2	Belok Kiri	: -
Lokasi Survei	: Simpang 3 Abu Bakar Ali	Lebar Lajur	: 8,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Ikmal	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15					387	222	5	8				
2	16:15-16:30					315	169	7	3				
3	16:30-16:45					384	216	4	5				
4	16:45-17:00					310	181	6	2				
5	17:00-17:15					417	204	5	2				
6	17:15-17:30					432	248	4	2				
7	17:30-17:45					382	292	3	2				
8	17:45-18:00					417	201	3	3				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection A Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan
Lokasi Survei : Simpang 3 Abu Bakar Ali
Surveyor : Ikmal

Jumlah Lajur : 2
Lebar Lajur : 3,4 m
Median : Tidak ada

Belok Kiri : Tidak Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	171	127	1	26					188	155	2	29
2	16:15-16:30	173	92	1	5					189	121	2	12
3	16:30-16:45	142	84	2	9					155	99	1	13
4	16:45-17:00	154	88	0	8					159	101	2	14
5	17:00-17:15	122	92	0	14					134	112	0	2
6	17:15-17:30	156	110	2	12					174	89	0	3
7	17:30-17:45	131	61	1	13					144	78	1	5
8	17:45-18:00	39	50	0	19					66	64	2	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection B Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Timur	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Pasar Kembang	Lebar Lajur	: 3,7 m	Waktu/Cuaca	: Cerah
Surveyor	: Anggi	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	244	95	5	17	261	79	0	4				
2	16:15-16:30	346	148	4	30	281	74	0	3				
3	16:30-16:45	328	126	5	27	207	77	3	3				
4	16:45-17:00	315	134	6	32	257	89	1	2				
5	17:00-17:15	334	145	4	33	284	92	0	4				
6	17:15-17:30	350	148	6	35	157	51	1	5				
7	17:30-17:45	361	152	6	41	189	57	1	1				
8	17:45-18:00	366	162	7	42	261	87	1	1				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection C Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Utara
Lokasi Survei : Simpang 4 Suryatmajan
Surveyor : Adul

Jumlah Lajur : 2
Lebar Lajur : 3 m
Median : Tidak ada

Belok Kiri : Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	75	10	0	2	280	79	4	26	24	5	0	2
2	16:15-16:30	48	19	2	2	335	73	5	25	17	4	0	0
3	16:30-16:45	61	21	0	5	338	92	3	15	34	5	0	2
4	16:45-17:00	61	18	0	1	355	76	3	25	30	3	0	6
5	17:00-17:15	80	12	0	2	372	63	3	39	19	7	0	2
6	17:15-17:30	58	12	0	1	353	72	5	27	27	6	0	3
7	17:30-17:45	48	15	0	4	285	70	5	15	17	4	0	1
8	17:45-18:00	31	4	2	18	216	60	2	18	19	4	0	4

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection C Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur
Lokasi Survei : Simpang 4 Suryatmajan
Surveyor : Adul

Jumlah Lajur : 1
Lebar Lajur : 3,5 m
Median : Tidak ada

Belok Kiri : Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	17	1	0	1	13	0	0	1				
2	16:15-16:30	14	0	0	2	8	0	0	0				
3	16:30-16:45	25	0	0	3	13	0	0	2				
4	16:45-17:00	16	0	0	4	24	0	0	1				
5	17:00-17:15	34	0	0	6	19	0	0	2				
6	17:15-17:30	19	0	0	2	14	0	0	0				
7	17:30-17:45	11	1	0	0	15	0	0	0				
8	17:45-18:00	11	1	0	3	15	0	0	0				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection C Working Day Session 3 (16:00 – 18:00 WIB)

<u>FORMULIR SURVEY SIMPANG</u>

Lengan Simpang	: Barat	Jumlah Lajur	: 1	Belok Kiri	: -
Lokasi Survei	: Simpang 4 Suryatmajan	Lebar Lajur	: 3,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Adul	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15					22	0	0	3	21	1	0	6
2	16:15-16:30					30	1	0	2	11	4	0	3
3	16:30-16:45					11	0	0	3	23	0	0	3
4	16:45-17:00					11	0	0	4	14	0	0	5
5	17:00-17:15					27	0	0	8	22	0	0	3
6	17:15-17:30					20	0	0	6	17	1	0	3
7	17:30-17:45					29	0	0	1	12	1	0	9
8	17:45-18:00					21	0	0	3	13	1	0	4

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection D Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Utara | Jumlah Lajur : 2 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Kantor Pos Besar | Lebar Lajur : 3 m | Waktu/Cuaca : Cerah

Surveyor : Apil | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	120	50	1	3	208	25	0	10	128	29	2	22
2	16:15-16:30	142	47	3	7	212	20	0	19	132	27	3	10
3	16:30-16:45	116	46	3	6	172	22	0	13	95	27	2	8
4	16:45-17:00	126	38	2	7	205	22	1	20	114	25	0	6
5	17:00-17:15	123	34	2	9	221	18	0	18	97	21	3	12
6	17:15-17:30	118	30	2	9	204	29	0	14	101	23	1	5
7	17:30-17:45	99	33	3	7	167	17	0	5	100	22	3	1
8	17:45-18:00	88	25	1	6	145	20	0	8	91	18	2	5

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection D Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur   Jumlah Lajur : 2   Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Kantor Pos Besar   Lebar Lajur : 6,35 m   Waktu/Cuaca : Cerah
Surveyor : Apil   Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	65	5	0	1	232	36	4	11				
2	16:15-16:30	87	17	0	1	259	47	3	7				
3	16:30-16:45	65	6	0	1	203	48	3	16				
4	16:45-17:00	75	9	1	5	252	43	2	7				
5	17:00-17:15	88	12	0	4	281	50	4	8				
6	17:15-17:30	85	14	1	4	209	48	1	1				
7	17:30-17:45	72	13	0	3	195	37	2	0				
8	17:45-18:00	57	11	0	0	196	38	2	1				

Keterangan:

MC: *MotorCycle*   LV: *Light Vehicle*   HV: *Heavy Vehicle*   UM: *UnMotorized*

Appendix 4 Survey Data at Intersection D Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Selatan	Jumlah Lajur	: 1	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Kantor Pos Besar	Lebar Lajur	: 3 m	Waktu/Cuaca	: Cerah
Surveyor	: Apil	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	82	36	1	3					88	11	0	1
2	16:15-16:30	89	41	3	6					92	19	0	4
3	16:30-16:45	83	24	0	4					102	20	0	2
4	16:45-17:00	93	25	1	9					100	28	0	3
5	17:00-17:15	96	25	2	3					99	23	0	5
6	17:15-17:30	97	28	1	4					97	20	0	5
7	17:30-17:45	99	24	3	10					89	13	0	7
8	17:45-18:00	100	26	0	7					98	14	1	3

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection D Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat	Jumlah Lajur : 2	Belok Kiri : -
Lokasi Survei : Simpang 4 Kantor Pos Besar	Lebar Lajur : 3 m	Waktu/Cuaca : Cerah
Surveyor : Apil	Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15					292	64	3	8	81	14	0	0
2	16:15-16:30					300	68	6	3	90	11	0	2
3	16:30-16:45					307	65	5	9	73	13	0	0
4	16:45-17:00					304	66	2	8	92	9	0	0
5	17:00-17:15					293	71	1	6	74	11	0	0
6	17:15-17:30					302	74	1	8	73	13	0	0
7	17:30-17:45					288	62	2	2	62	10	0	0
8	17:45-18:00					280	60	0	7	55	8	0	0

Keterangan:

MC: *MotorCycle*	LV: *Light Vehicle*	HV: *Heavy Vehicle*	UM: *UnMotorized*

Appendix 4 Survey Data at Intersection E Working Day Session 3 (16:00 – 18:00 WIB)

<u>FORMULIR SURVEI SIMPANG</u>

Lengan Simpang : Timur | Jumlah Lajur : 2 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Gondomanan | Lebar Lajur : 4,05 m | Waktu/Cuaca : Cerah

Surveyor : Adit | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	124	76	1	6	281	51	1	11	85	28	0	3
2	16:15-16:30	117	65	1	5	270	37	1	7	81	20	0	4
3	16:30-16:45	151	50	0	5	228	64	4	5	84	18	0	4
4	16:45-17:00	128	57	1	7	256	35	4	4	84	23	0	4
5	17:00-17:15	172	65	0	14	265	62	0	6	76	24	0	5
6	17:15-17:30	150	63	1	10	284	56	2	7	87	25	0	4
7	17:30-17:45	154	64	0	9	273	52	0	5	92	18	0	6
8	17:45-18:00	159	62	2	11	246	54	0	4	82	20	0	4

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection E Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Selatan
Lokasi Survei : Simpang 4 Gondomanan
Surveyor : Adit

Jumlah Lajur : 2
Lebar Lajur : 3,5 m
Median : Ada

Belok Kiri : Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	22	8	0	4	274	69	0	12	178	27	0	0
2	16:15-16:30	20	4	0	2	299	86	2	5	199	55	1	0
3	16:30-16:45	34	10	1	2	239	69	0	10	140	29	0	0
4	16:45-17:00	22	5	1	2	303	85	0	2	204	45	0	0
5	17:00-17:15	40	6	1	3	285	63	0	7	196	25	0	0
6	17:15-17:30	32	8	1	4	304	78	1	8	204	36	0	0
7	17:30-17:45	20	6	1	1	293	69	0	6	194	27	0	0
8	17:45-18:00	27	4	1	3	266	72	1	12	167	34	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection E Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Barat
Lokasi Survei : Simpang 4 Gondomanan
Surveyor : Adit

Jumlah Lajur : 2
Lebar Lajur : 3,35 m
Median : Ada

Belok Kiri : Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	144	70	1	6	161	43	4	0	171	38	3	0
2	16:15-16:30	137	60	1	5	169	57	4	0	190	52	4	0
3	16:30-16:45	171	42	0	5	155	45	4	0	170	41	3	0
4	16:45-17:00	168	50	1	7	167	43	3	0	136	39	2	0
5	17:00-17:15	192	59	0	14	136	57	4	0	186	53	4	0
6	17:15-17:30	190	58	1	10	107	41	1	0	126	40	1	0
7	17:30-17:45	194	65	0	9	127	20	4	0	146	21	4	0
8	17:45-18:00	199	69	2	11	91	19	0	0	100	20	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection F Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur   Jumlah Lajur : 1   Belok Kiri : -

Lokasi Survei : Simpang 4 Juminahan   Lebar Lajur : 3,5 m   Waktu/Cuaca : Cerah

Surveyor : Hendro   Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15					74	1	0	7	71	19	0	1
2	16:15-16:30					82	2	0	3	70	14	0	5
3	16:30-16:45					71	4	0	3	54	10	0	2
4	16:45-17:00					98	5	0	8	48	11	1	1
5	17:00-17:15					59	3	0	2	48	13	2	0
6	17:15-17:30					54	3	0	3	55	10	1	2
7	17:30-17:45					67	4	1	4	50	9	1	0
8	17:45-18:00					60	7	0	1	32	8	0	0

Keterangan:

MC: *MotorCycle*   LV: *Light Vehicle*   HV: *Heavy Vehicle*   UM: *UnMotorized*

Appendix 4 Survey Data at Intersection F Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan — Jumlah Lajur : 4 — Belok Kiri : Tidak Langsung

Lokasi Survei : Simpang 4 Juminahan — Lebar Lajur : 3,55 m — Waktu/Cuaca : Cerah

Surveyor : Hendro — Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	27	6	0	3	393	110	2	10	254	75	0	0
2	16:15-16:30	34	8	0	4	390	144	4	8	243	74	0	1
3	16:30-16:45	22	5	1	0	378	122	5	11	235	72	0	2
4	16:45-17:00	23	0	0	5	442	121	2	22	222	54	0	1
5	17:00-17:15	13	3	0	2	388	103	2	8	232	50	0	3
6	17:15-17:30	15	4	0	1	358	102	1	9	249	26	0	2
7	17:30-17:45	20	1	0	1	293	86	4	9	251	24	0	1
8	17:45-18:00	13	2	0	2	149	52	4	7	256	20	0	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 4 Survey Data at Intersection F Working Day Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Barat	Jumlah Lajur	: 1	Belok Kiri	: Tidak Langsung
Lokasi Survei	: Simpang 4 Juminahan	Lebar Lajur	: 3,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Hendro	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	94	35	1	3	14	1	0	0				
2	16:15-16:30	71	22	0	3	15	2	0	1				
3	16:30-16:45	67	23	0	2	12	1	0	2				
4	16:45-17:00	93	16	1	8	12	2	1	1				
5	17:00-17:15	99	13	0	2	14	5	0	0				
6	17:15-17:30	56	9	0	4	15	1	0	0				
7	17:30-17:45	59	14	1	2	21	2	1	0				
8	17:45-18:00	34	5	0	0	21	3	0	0				

APPENDIX 5 WEEKEND MORNING SURVEY DATA (06:00 – 08:00)

Appendix 5 Survey Data at Intersection A Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur   Jumlah Lajur : 2   Belok Kiri : -

Lokasi Survei : Simpang 3 Abu Bakar Ali   Lebar Lajur : 8,5 m   Waktu/Cuaca : Cerah

Surveyor : Ferdi   Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15					429	210	6	9				
2	06:15-06:30					349	160	8	3				
3	06:30-06:45					427	204	4	6				
4	06:45-07:00					345	171	7	2				
5	07:00-07:15					462	193	6	2				
6	07:15-07:30					479	234	5	2				
7	07:30-07:45					424	275	3	2				
8	07:45-08:00					462	190	3	3				

Keterangan:

MC: *MotorCycle*   LV: *Light Vehicle*   HV: *Heavy Vehicle*   UM: *UnMotorized*

Appendix 5 Survey Data at Intersection A Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Selatan	Jumlah Lajur	: 2	Belok Kiri	: Tidak Langsung
Lokasi Survei	: Simpang 3 Abu Bakar Ali	Lebar Lajur	: 3,4 m	Waktu/Cuaca	: Cerah
Surveyor	: Ferdi	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	190	141	1	29					207	151	3	33
2	06:15-06:30	193	102	1	6					236	160	0	21
3	06:30-06:45	158	94	2	10					254	146	3	22
4	06:45-07:00	171	99	0	9					275	150	0	20
5	07:00-07:15	136	102	0	16					218	153	1	9
6	07:15-07:30	173	122	2	14					216	132	0	9
7	07:30-07:45	145	68	1	14					160	68	0	18
8	07:45-08:00	43	55	0	20					69	64	1	21

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection B Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 2
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Pasar Kembang
Lebar Lajur : 3,7 m
Waktu/Cuaca : Cerah
Surveyor : Anggi
Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	101	32	10	119	55	20	2	19				
2	06:15-06:30	139	38	8	155	79	20	1	8				
3	06:30-06:45	130	34	5	132	74	24	0	43				
4	06:45-07:00	180	39	9	149	97	20	2	6				
5	07:00-07:15	158	73	4	149	105	20	1	22				
6	07:15-07:30	171	52	7	154	94	34	0	6				
7	07:30-07:45	205	71	6	103	188	45	2	12				
8	07:45-08:00	246	66	12	84	171	37	1	15				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection C Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Utara	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Suryatmajan	Lebar Lajur	: 3 m	Waktu/Cuaca	: Cerah
Surveyor	: Adul	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	9	5	1	15	101	18	8	75	5	1	0	2
2	06:15-06:30	17	2	0	25	108	28	5	74	11	1	0	3
3	06:30-06:45	46	6	0	12	132	96	19	132	16	2	0	4
4	06:45-07:00	40	6	0	10	123	20	7	105	18	2	0	4
5	07:00-07:15	38	7	0	30	119	31	6	105	13	5	0	4
6	07:15-07:30	36	7	0	10	135	38	5	95	13	3	0	3
7	07:30-07:45	37	7	0	25	165	37	3	66	12	4	0	4
8	07:45-08:00	60	10	1	12	140	33	3	40	24	3	0	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection C Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur
Lokasi Survei : Simpang 4 Suryatmajan
Surveyor : Adul

Jumlah Lajur : 1
Lebar Lajur : 3,5 m
Median : Tidak ada

Belok Kiri : Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	3	0	0	0	11	0	0	1				
2	06:15-06:30	3	0	0	1	10	0	0	2				
3	06:30-06:45	3	0	0	2	8	0	0	4				
4	06:45-07:00	6	0	0	2	13	0	1	3				
5	07:00-07:15	11	1	0	3	8	0	0	1				
6	07:15-07:30	11	0	0	0	9	0	1	4				
7	07:30-07:45	5	0	0	2	10	0	0	3				
8	07:45-08:00	8	0	0	0	13	0	0	5				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection C Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat
Lokasi Survei : Simpang 4 Suryatmajan
Surveyor : Adul

Jumlah Lajur : 1
Lebar Lajur : 3,5 m
Median : Tidak ada

Belok Kiri : Tidak Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15					13	0	0	1	2	1	0	1
2	06:15-06:30					13	0	0	4	9	0	0	0
3	06:30-06:45					13	0	0	2	5	0	0	3
4	06:45-07:00					16	0	0	2	10	0	0	1
5	07:00-07:15					17	1	0	1	12	1	0	1
6	07:15-07:30					19	2	0	6	18	0	0	0
7	07:30-07:45					20	0	0	5	9	1	0	1
8	07:45-08:00					33	0	0	3	16	1	0	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection D Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Utara Jumlah Lajur : 2 Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Kantor Pos Besar Lebar Lajur : 3 m Waktu/Cuaca : Cerah

Surveyor : Apil Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	20	11	5	3	57	5	0	71	44	12	5	21
2	06:15-06:30	36	8	3	3	60	9	0	69	48	14	5	9
3	06:30-06:45	51	9	2	16	85	8	0	74	48	5	2	13
4	06:45-07:00	112	13	3	7	97	4	0	100	69	9	3	12
5	07:00-07:15	63	15	3	11	81	9	1	101	65	13	3	12
6	07:15-07:30	105	15	2	15	92	15	0	108	58	13	4	12
7	07:30-07:45	62	19	3	20	106	20	0	96	96	10	1	10
8	07:45-08:00	72	19	4	15	115	18	1	61	81	9	0	11

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection D Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Timur	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Kantor Pos Besar	Lebar Lajur	: 6,35 m	Waktu/Cuaca	: Cerah
Surveyor	: Apil	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	19	2	0	7	66	14	3	16				
2	06:15-06:30	11	1	0	4	98	11	3	8				
3	06:30-06:45	16	1	1	13	98	19	3	13				
4	06:45-07:00	21	6	0	10	118	25	2	7				
5	07:00-07:15	40	1	0	7	174	24	3	7				
6	07:15-07:30	45	8	0	9	171	31	3	9				
7	07:30-07:45	64	5	0	14	246	34	41	13				
8	07:45-08:00	52	5	0	7	228	3	3	6				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection D Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan | Jumlah Lajur : 1 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Kantor Pos Besar | Lebar Lajur : 3 m | Waktu/Cuaca : Cerah

Surveyor : Apil | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	93	11	0	16					41	4	0	2
2	06:15-06:30	105	13	0	21					72	5	1	5
3	06:30-06:45	142	21	1	13					80	5	0	5
4	06:45-07:00	135	22	0	17					89	10	0	1
5	07:00-07:15	175	25	0	14					65	7	0	1
6	07:15-07:30	214	34	1	13					75	6	0	4
7	07:30-07:45	243	33	0	12					105	18	1	4
8	07:45-08:00	220	23	0	6					85	15	4	15

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection D Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat
Jumlah Lajur : 2
Belok Kiri : -
Lokasi Survei : Simpang 4 Kantor Pos Besar
Lebar Lajur : 3 m
Waktu/Cuaca : Cerah
Surveyor : Apil
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15					165	14	1	1	12	4	0	2
2	06:15-06:30					192	27	0	5	15	5	0	2
3	06:30-06:45					253	21	0	3	20	6	0	1
4	06:45-07:00					276	61	3	3	39	3	0	0
5	07:00-07:15					175	23	0	2	35	9	0	4
6	07:15-07:30					235	40	2	2	36	7	0	2
7	07:30-07:45					320	50	4	7	48	8	0	7
8	07:45-08:00					285	35	2	20	51	7	0	6

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection E Weekend Session 1 (06:00 – 08:00 WIB)

<u>FORMULIR SURVEI SIMPANG</u>

Lengan Simpang	: Timur	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Gondomanan	Lebar Lajur	: 4,05 m	Waktu/Cuaca	: Cerah
Surveyor	: Adit	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	162	66	1	7	323	62	1	12	92	33	0	3
2	06:15-06:30	213	106	1	6	311	46	1	8	87	25	0	4
3	06:30-06:45	157	59	0	6	266	80	4	6	89	23	0	4
4	06:45-07:00	151	58	1	8	297	44	3	3	90	28	0	4
5	07:00-07:15	216	115	0	15	306	79	0	7	82	29	0	6
6	07:15-07:30	158	72	1	10	326	80	2	8	94	31	0	5
7	07:30-07:45	230	81	0	9	315	101	0	6	98	23	0	7
8	07:45-08:00	235	82	2	12	285	70	0	3	88	25	0	5

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection E Weekend Session 1 (06:00 – 08:00 WIB))

FORMULIR SURVEI SIMPANG

Lengan Simpang : Selatan
Jumlah Lajur : 2
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Gondomanan
Lebar Lajur : 3,5 m
Waktu/Cuaca : Cerah
Surveyor : Adit
Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	24	9	0	4	294	81	0	13	171	38	0	0
2	06:15-06:30	21	3	0	2	321	111	2	6	236	83	1	0
3	06:30-06:45	37	10	1	2	257	82	0	10	167	34	0	0
4	06:45-07:00	24	6	1	2	325	98	0	2	168	38	0	0
5	07:00-07:15	43	7	1	3	306	75	0	8	238	74	0	0
6	07:15-07:30	34	9	1	3	326	93	1	9	169	50	0	0
7	07:30-07:45	22	7	1	1	315	82	0	7	230	39	0	0
8	07:45-08:00	29	3	1	3	285	86	1	13	200	43	0	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection E Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Barat — Jumlah Lajur : 2 — Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Gondomanan — Lebar Lajur : 3,35 m — Waktu/Cuaca : Cerah

Surveyor : Adit — Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	165	92	1	7	189	49	3	0	33	20	1	0
2	06:15-06:30	157	81	1	6	210	64	3	0	60	30	3	0
3	06:30-06:45	195	61	0	6	193	52	3	0	31	22	2	0
4	06:45-07:00	190	70	1	8	136	49	3	0	29	20	1	0
5	07:00-07:15	216	79	0	15	232	65	3	0	52	36	3	0
6	07:15-07:30	226	78	1	10	126	47	1	0	32	18	1	0
7	07:30-07:45	230	86	0	9	157	25	4	0	33	19	1	0
8	07:45-08:00	235	85	2	12	109	24	0	0	35	16	1	0

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection F Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 1
Belok Kiri : -
Lokasi Survei : Simpang 4 Juminahan
Lebar Lajur : 3,5 m
Waktu/Cuaca : Cerah
Surveyor : Hendro
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15					15	2	0	2	12	0	0	6
2	06:15-06:30					23	1	1	5	13	0	0	11
3	06:30-06:45					22	4	0	6	16	0	0	6
4	06:45-07:00					24	1	0	9	17	1	1	5
5	07:00-07:15					26	1	0	5	20	4	0	10
6	07:15-07:30					30	2	0	4	23	1	1	2
7	07:30-07:45					31	4	0	3	30	6	0	2
8	07:45-08:00					33	3	0	8	47	4	2	10

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection F Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan | Jumlah Lajur : 4 | Belok Kiri : Tidak Langsung

Lokasi Survei : Simpang 4 Juminahan | Lebar Lajur : 3,55 m | Waktu/Cuaca : Cerah

Surveyor : Hendro | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	13	1	0	1	103	52	0	26	50	5	1	15
2	06:15-06:30	18	1	1	2	155	52	1	47	42	8	1	18
3	06:30-06:45	15	0	0	6	189	47	2	121	48	1	0	25
4	06:45-07:00	14	1	1	2	223	57	2	79	50	2	0	30
5	07:00-07:15	19	0	0	1	217	47	0	36	54	4	0	21
6	07:15-07:30	18	1	0	0	266	51	0	28	62	4	0	15
7	07:30-07:45	12	0	0	1	261	53	0	30	69	5	1	10
8	07:45-08:00	14	1	0	2	348	66	1	27	70	8	0	33

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 5 Survey Data at Intersection F Weekend Session 1 (06:00 – 08:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat
Jumlah Lajur : 1
Belok Kiri : Tidak Langsung
Lokasi Survei : Simpang 4 Juminahan
Lebar Lajur : 3,5 m
Waktu/Cuaca : Cerah
Surveyor : Hendro
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	06:00-06:15	22	4	1	3	15	0	0	1				
2	06:15-06:30	15	5	0	1	18	0	0	2				
3	06:30-06:45	24	4	0	3	19	0	0	0				
4	06:45-07:00	26	9	0	3	16	1	0	1				
5	07:00-07:15	30	8	0	8	17	2	0	2				
6	07:15-07:30	33	6	0	9	14	1	0	1				
7	07:30-07:45	39	7	0	6	18	2	0	3				
8	07:45-08:00	45	6	0	8	20	1	0	4				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

APPENDIX 6 WEEKEND DAYTIME SURVEY DATA (11:00 – 13:00)

Appendix 6 Survey Data at Intersection A Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 2
Belok Kiri : -
Lokasi Survei : Simpang 3 Abu Bakar Ali
Lebar Lajur : 8,5 m
Waktu/Cuaca : Cerah
Surveyor : Ferdi
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15					455	222	6	9				
2	11:15-11:30					370	169	8	4				
3	11:30-11:45					452	216	5	6				
4	11:45-12:00					365	181	7	2				
5	12:00-12:15					490	204	6	2				
6	12:15-12:30					508	248	5	2				
7	12:30-12:45					449	292	4	2				
8	12:45-13:00					490	201	4	4				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection A Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan   Jumlah Lajur : 2   Belok Kiri : Tidak Langsung

Lokasi Survei : Simpang 3 Abu Bakar Ali   Lebar Lajur : 3,4 m   Waktu/Cuaca : Cerah

Surveyor : Ferdi   Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	201	149	1	31					220	160	3	25
2	11:15-11:30	204	108	1	6					234	169	0	20
3	11:30-11:45	167	99	2	11					211	155	3	5
4	11:45-12:00	181	104	0	9					231	159	0	4
5	12:00-12:15	144	108	0	17					211	162	1	15
6	12:15-12:30	183	129	2	14					229	140	0	18
7	12:30-12:45	154	72	1	15					169	72	0	22
8	12:45-13:00	46	59	0	22					84	68	1	23

Keterangan:

MC: *MotorCycle*   LV: *Light Vehicle*   HV: *Heavy Vehicle*   UM: *UnMotorized*

Appendix 6 Survey Data at Intersection B Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur | Jumlah Lajur : 2 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Pasar Kembang | Lebar Lajur : 3,7 m | Waktu/Cuaca : Cerah

Surveyor : Anggi | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	230	150	6	18	138	78	2	2				
2	11:15-11:30	246	162	10	21	135	59	2	4				
3	11:30-11:45	240	170	6	8	160	51	0	4				
4	11:45-12:00	269	201	9	11	155	65	6	1				
5	12:00-12:15	206	179	4	9	113	62	5	0				
6	12:15-12:30	230	163	5	8	151	80	2	2				
7	12:30-12:45	237	162	5	8	152	89	3	0				
8	12:45-13:00	243	168	4	9	131	69	1	1				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection C Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Utara	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Suryatmajan	Lebar Lajur	: 3 m	Waktu/Cuaca	: Cerah
Surveyor	: Adul	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	59	13	1	3	226	122	5	42	15	8	0	1
2	11:15-11:30	77	25	1	7	295	126	5	43	25	5	1	1
3	11:30-11:45	71	19	0	1	263	121	6	29	15	10	0	1
4	11:45-12:00	68	17	0	8	248	147	6	19	25	12	0	2
5	12:00-12:15	49	15	1	6	237	125	4	26	26	11	0	0
6	12:15-12:30	49	17	0	2	251	119	5	26	22	11	0	0
7	12:30-12:45	63	14	0	2	246	134	1	22	22	9	0	1
8	12:45-13:00	14	10	0	16	175	85	2	26	19	11	0	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection C Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur — Jumlah Lajur : 1 — Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Suryatmajan — Lebar Lajur : 3,5 m — Waktu/Cuaca : Cerah

Surveyor : Adul — Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	13	0	0	2	17	0	0	5				
2	11:15-11:30	16	0	0	1	4	0	0	1				
3	11:30-11:45	20	1	0	1	7	1	0	2				
4	11:45-12:00	14	0	0	2	11	0	0	4				
5	12:00-12:15	14	0	0	1	13	0	0	0				
6	12:15-12:30	8	0	1	1	10	0	0	1				
7	12:30-12:45	18	1	0	3	11	0	0	0				
8	12:45-13:00	7	0	0	2	12	0	0	3				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection C Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Barat	Jumlah Lajur	: 1	Belok Kiri	: -
Lokasi Survei	: Simpang 4 Suryatmajan	Lebar Lajur	: 3,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Adul	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15					15	0	0	1	19	1	0	8
2	11:15-11:30					21	3	0	2	21	2	0	7
3	11:30-11:45					21	0	0	4	13	2	0	10
4	11:45-12:00					29	2	0	0	16	5	0	6
5	12:00-12:15					25	0	0	1	12	0	0	7
6	12:15-12:30					25	0	0	8	18	1	0	6
7	12:30-12:45					18	2	0	4	11	1	0	7
8	12:45-13:00					16	1	0	3	12	0	0	6

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection D Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Utara | Jumlah Lajur : 2 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Kantor Pos Besar | Lebar Lajur : 3 m | Waktu/Cuaca : Cerah

Surveyor : Apil | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	74	41	5	7	122	23	1	10	110	38	2	10
2	11:15-11:30	129	66	2	6	132	20	0	23	149	33	1	15
3	11:30-11:45	138	73	3	9	127	27	0	9	122	27	3	3
4	11:45-12:00	137	75	4	9	149	22	1	7	121	42	2	7
5	12:00-12:15	140	82	5	2	116	17	0	5	161	54	2	15
6	12:15-12:30	99	71	1	6	118	32	0	5	109	40	2	4
7	12:30-12:45	109	68	3	5	132	35	0	5	150	42	2	9
8	12:45-13:00	78	46	2	4	146	24	0	3	146	36	2	6

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection D Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Timur	Jumlah Lajur	: 2	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Kantor Pos Besar	Lebar Lajur	: 6,35 m	Waktu/Cuaca	: Cerah
Surveyor	: Apil	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	58	7	0	2	190	49	5	2				
2	11:15-11:30	59	8	0	1	205	52	3	8				
3	11:30-11:45	54	11	0	2	151	57	2	2				
4	11:45-12:00	53	7	0	0	138	56	5	2				
5	12:00-12:15	49	7	0	1	170	72	3	2				
6	12:15-12:30	57	15	0	0	180	62	3	2				
7	12:30-12:45	45	4	0	0	175	55	4	5				
8	12:45-13:00	68	8	0	0	202	70	6	1				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection D Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan | Jumlah Lajur : 1 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Kantor Pos Besar | Lebar Lajur : 3 m | Waktu/Cuaca : Cerah

Surveyor : Apil | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	144	48	4	2					59	11	0	1
2	11:15-11:30	174	70	1	4					117	24	1	13
3	11:30-11:45	180	58	0	9					101	22	0	6
4	11:45-12:00	155	42	2	2					65	19	0	3
5	12:00-12:15	179	49	2	7					69	32	0	3
6	12:15-12:30	121	36	0	2					63	36	0	5
7	12:30-12:45	185	47	2	7					96	22	2	5
8	12:45-13:00	205	37	1	8					125	39	0	5

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection D Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat | Jumlah Lajur : 2 | Belok Kiri : -

Lokasi Survei : Simpang 4 Kantor Pos Besar | Lebar Lajur : 3 m | Waktu/Cuaca : Cerah

Surveyor : Apil | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15					179	61	3	2	41	16	0	0
2	11:15-11:30					268	154	4	10	47	6	2	2
3	11:30-11:45					265	91	7	6	29	10	0	1
4	11:45-12:00					303	111	4	3	46	9	0	1
5	12:00-12:15					286	97	2	4	59	23	1	1
6	12:15-12:30					198	93	5	5	39	8	0	0
7	12:30-12:45					211	88	2	5	31	15	1	0
8	12:45-13:00					253	100	2	6	33	10	0	1

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection E Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 2
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Gondomanan
Lebar Lajur : 4,05 m
Waktu/Cuaca : Cerah
Surveyor : Adit
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	171	70	1	7	342	66	1	13	97	35	0	3
2	11:15-11:30	225	113	1	6	329	49	1	8	92	26	0	5
3	11:30-11:45	167	62	0	6	282	85	5	6	95	24	0	5
4	11:45-12:00	160	61	1	8	314	47	4	4	95	30	0	5
5	12:00-12:15	229	122	0	16	324	84	0	7	86	31	0	6
6	12:15-12:30	167	77	1	11	345	85	2	8	99	32	0	5
7	12:30-12:45	243	86	0	10	333	107	0	6	104	24	0	7
8	12:45-13:00	249	86	2	13	302	74	0	4	93	26	0	5

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection E Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Selatan	Jumlah Lajur : 2	Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Gondomanan	Lebar Lajur : 3,5 m	Waktu/Cuaca : Cerah

Surveyor : Adit	Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	25	9	0	5	311	86	0	14	181	41	0	0
2	11:15-11:30	23	4	0	2	340	117	2	6	250	88	1	0
3	11:30-11:45	39	11	1	2	272	86	0	11	177	36	0	0
4	11:45-12:00	25	6	1	2	344	104	0	2	178	41	0	0
5	12:00-12:15	46	7	1	3	324	79	0	8	252	78	0	0
6	12:15-12:30	36	9	1	4	345	98	1	9	179	53	0	0
7	12:30-12:45	23	7	1	1	333	86	0	7	243	41	0	0
8	12:45-13:00	31	4	1	3	302	91	1	14	212	46	0	0

Keterangan:

MC: *MotorCycle*	LV: *Light Vehicle*	HV: *Heavy Vehicle*	UM: *UnMotorized*

Appendix 6 Survey Data at Intersection E Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Barat
Jumlah Lajur : 2
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Gondomanan
Lebar Lajur : 3,35 m
Waktu/Cuaca : Cerah
Surveyor : Adit
Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	175	97	1	7	200	52	4	0	35	22	1	2
2	11:15-11:30	167	86	1	6	222	68	4	0	59	32	4	1
3	11:30-11:45	206	65	0	6	204	55	4	0	32	23	2	2
4	11:45-12:00	202	74	1	8	144	52	3	0	31	22	1	1
5	12:00-12:15	229	84	0	16	246	68	4	0	50	38	4	1
6	12:15-12:30	239	83	1	11	133	50	1	0	34	19	1	1
7	12:30-12:45	243	91	0	10	167	26	5	0	35	20	1	2
8	12:45-13:00	249	90	2	13	115	25	0	0	37	17	1	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection F Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur | Jumlah Lajur : 1 | Belok Kiri : -

Lokasi Survei : Simpang 4 Juminahan | Lebar Lajur : 3,5 m | Waktu/Cuaca : Cerah

Surveyor : Hendro | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15					111	29	0	2	39	19	1	1
2	11:15-11:30					72	7	0	4	40	23	1	2
3	11:30-11:45					84	10	0	3	30	17	2	2
4	11:45-12:00					79	25	0	5	41	22	1	3
5	12:00-12:15					82	8	1	2	24	18	1	2
6	12:15-12:30					112	24	0	4	34	24	2	2
7	12:30-12:45					116	14	0	3	43	19	2	1
8	12:45-13:00					121	32	1	4	45	28	2	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 6 Survey Data at Intersection F Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan   Jumlah Lajur : 4   Belok Kiri : Tidak Langsung

Lokasi Survei : Simpang 4 Juminahan   Lebar Lajur : 3,55 m   Waktu/Cuaca : Cerah

Surveyor : Hendro   Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	25	4	0	2	265	147	3	8	225	52	0	2
2	11:15-11:30	30	5	0	3	281	150	9	13	221	50	0	3
3	11:30-11:45	31	3	0	3	278	152	8	9	210	51	0	2
4	11:45-12:00	24	2	0	2	250	145	3	10	215	45	0	1
5	12:00-12:15	28	5	1	2	274	155	7	11	225	47	1	0
6	12:15-12:30	25	7	0	3	280	156	8	13	234	45	0	1
7	12:30-12:45	30	5	1	4	286	160	4	15	238	55	0	1
8	12:45-13:00	34	6	1	4	292	162	9	18	241	61	0	1

Keterangan:

MC: *MotorCycle*   LV: *Light Vehicle*   HV: *Heavy Vehicle*   UM: *UnMotorized*

Appendix 6 Survey Data at Intersection F Weekend Session 2 (11:00 – 13:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Barat	Jumlah Lajur	: 1	Belok Kiri	: Tidak Langsung
Lokasi Survei	: Simpang 4 Juminahan	Lebar Lajur	: 3,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Hendro	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	11:00-11:15	84	38	0	2	14	1	1	2				
2	11:15-11:30	74	25	1	2	12	3	0	1				
3	11:30-11:45	68	20	0	1	10	2	1	0				
4	11:45-12:00	82	24	0	2	8	1	0	1				
5	12:00-12:15	86	34	1	3	14	4	0	0				
6	12:15-12:30	72	41	2	2	12	1	0	1				
7	12:30-12:45	82	40	1	2	18	2	0	0				
8	12:45-13:00	88	42	0	1	20	2	0	1				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

APPENDIX 7 WEEKEND AFTERNOON SURVEY DATA (16:00 – 18:00)

Appendix 7 Survey Data at Intersection A Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 2
Belok Kiri : -
Lokasi Survei : Simpang 3 Abu Bakar Ali
Lebar Lajur : 8,5 m
Waktu/Cuaca : Cerah
Surveyor : Ikmal
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15					505	247	7	10				
2	16:15-16:30					411	188	9	4				
3	16:30-16:45					502	240	5	7				
4	16:45-17:00					406	201	8	2				
5	17:00-17:15					544	227	7	2				
6	17:15-17:30					564	275	6	2				
7	17:30-17:45					499	324	4	2				
8	17:45-18:00					544	223	4	4				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection A Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan
Lokasi Survei : Simpang 3 Abu Bakar Ali
Surveyor : Ikmal

Jumlah Lajur : 2
Lebar Lajur : 3,4 m
Median : Tidak ada

Belok Kiri : Tidak Langsung
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	223	166	1	34					244	178	3	39
2	16:15-16:30	227	120	1	7					296	188	0	25
3	16:30-16:45	186	110	2	12					301	172	3	26
4	16:45-17:00	201	116	0	10					335	177	0	24
5	17:00-17:15	160	120	0	19					256	180	1	10
6	17:15-17:30	203	143	2	16					254	155	0	11
7	17:30-17:45	171	80	1	17					188	80	0	21
8	17:45-18:00	51	65	0	24					195	75	1	25

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection B Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur | Jumlah Lajur : 2 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Pasar Kembang | Lebar Lajur : 3,7 m | Waktu/Cuaca : Cerah

Surveyor : Anggi | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	355	229	5	21	283	112	3	5				
2	16:15-16:30	234	182	15	25	304	133	3	3				
3	16:30-16:45	230	172	4	14	336	141	4	4				
4	16:45-17:00	255	172	1	23	320	146	4	3				
5	17:00-17:15	237	148	5	33	379	145	4	2				
6	17:15-17:30	338	196	8	38	342	152	5	5				
7	17:30-17:45	257	154	4	32	275	139	2	3				
8	17:45-18:00	162	123	2	28	265	140	6	5				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection C Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Utara
Jumlah Lajur : 2
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Suryatmajan
Lebar Lajur : 3 m
Waktu/Cuaca : Cerah
Surveyor : Adul
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	75	25	1	9	420	120	6	40	26	21	0	8
2	16:15-16:30	69	17	1	6	415	138	7	54	23	25	0	5
3	16:30-16:45	48	26	0	10	393	117	8	65	28	20	0	9
4	16:45-17:00	66	34	0	8	415	108	2	54	40	11	0	7
5	17:00-17:15	58	13	0	2	284	120	2	46	28	18	0	11
6	17:15-17:30	61	15	0	8	389	98	5	71	26	13	0	11
7	17:30-17:45	52	29	0	3	382	107	5	43	26	12	0	10
8	17:45-18:00	55	13	0	7	210	89	2	32	11	14	0	9

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection C Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Timur	Jumlah Lajur	: 1	Belok Kiri	: Langsung
Lokasi Survei	: Simpang 4 Suryatmajan	Lebar Lajur	: 3,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Adul	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	11	1	0	9	21	0	0	0				
2	16:15-16:30	16	2	0	6	17	0	0	1				
3	16:30-16:45	12	0	0	7	13	0	0	1				
4	16:45-17:00	23	0	0	1	13	0	0	3				
5	17:00-17:15	19	1	0	5	13	0	0	0				
6	17:15-17:30	16	0	0	3	19	0	0	6				
7	17:30-17:45	14	0	0	1	14	0	0	1				
8	17:45-18:00	7	0	0	2	14	0	0	0				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection C Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat
Lokasi Survei : Simpang 4 Suryatmajan
Surveyor : Adul

Jumlah Lajur : 1
Lebar Lajur : 3,5 m
Median : Tidak ada

Belok Kiri : -
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraaan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15					26	0	0	6	15	2	0	8
2	16:15-16:30					28	1	0	12	16	0	0	6
3	16:30-16:45					26	1	0	8	15	0	0	6
4	16:45-17:00					20	1	0	13	7	0	0	7
5	17:00-17:15					39	0	0	7	23	1	0	4
6	17:15-17:30					14	0	0	4	22	0	0	5
7	17:30-17:45					31	2	0	3	15	3	0	4
8	17:45-18:00					19	0	0	3	9	3	0	7

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection D Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Utara Jumlah Lajur : 2 Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Kantor Pos Besar Lebar Lajur : 3 m Waktu/Cuaca : Cerah

Surveyor : Apil Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	202	84	3	11	49	2	0	10	195	37	1	10
2	16:15-16:30	163	104	5	18	109	3	0	12	175	39	1	25
3	16:30-16:45	183	63	3	7	67	15	1	7	170	28	2	15
4	16:45-17:00	103	65	3	10	205	16	1	8	137	27	0	17
5	17:00-17:15	176	80	1	17	49	15	1	13	101	27	2	15
6	17:15-17:30	152	72	2	29	176	5	1	22	99	21	2	5
7	17:30-17:45	169	46	5	17	187	44	1	13	55	20	1	9
8	17:45-18:00	110	42	1	10	60	32	0	9	56	18	1	7

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection D Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur | Jumlah Lajur : 2 | Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Kantor Pos Besar | Lebar Lajur : 6,35 m | Waktu/Cuaca : Cerah

Surveyor : Apil | Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	72	13	0	1	250	68	7	7				
2	16:15-16:30	55	15	0	1	288	50	1	5				
3	16:30-16:45	89	8	0	2	256	48	1	8				
4	16:45-17:00	84	22	0	5	303	62	3	5				
5	17:00-17:15	89	20	0	5	247	59	3	3				
6	17:15-17:30	86	8	0	0	218	68	1	1				
7	17:30-17:45	65	15	0	5	230	56	3	5				
8	17:45-18:00	43	10	1	0	167	66	3	3				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection D Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan
Jumlah Lajur : 1
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Kantor Pos Besar
Lebar Lajur : 3 m
Waktu/Cuaca : Cerah
Surveyor : Apil
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	171	41	1	15					99	24	0	12
2	16:15-16:30	232	48	2	12					98	38	0	6
3	16:30-16:45	305	51	0	7					98	33	1	10
4	16:45-17:00	243	41	0	13					80	16	0	10
5	17:00-17:15	192	33	0	13					96	30	0	9
6	17:15-17:30	242	38	0	15					84	16	0	4
7	17:30-17:45	201	47	0	7					97	19	0	13
8	17:45-18:00	191	40	0	5					151	35	0	5

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection D Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Barat	Jumlah Lajur : 2	Belok Kiri : -

Lokasi Survei : Simpang 4 Kantor Pos Besar	Lebar Lajur : 3 m	Waktu/Cuaca : Cerah

Surveyor : Apil	Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15					337	115	5	4	66	16	0	0
2	16:15-16:30					418	102	4	5	55	10	0	5
3	16:30-16:45					402	98	3	4	59	14	0	1
4	16:45-17:00					360	117	3	8	85	16	0	1
5	17:00-17:15					528	136	7	6	76	12	0	0
6	17:15-17:30					325	114	1	3	65	7	0	0
7	17:30-17:45					373	94	5	7	66	19	0	0
8	17:45-18:00					271	79	1	5	42	8	0	0

Keterangan:

MC: *MotorCycle*	LV: *Light Vehicle*	HV: *Heavy Vehicle*	UM: *UnMotorized*

Appendix 7 Survey Data at Intersection E Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Timur
Jumlah Lajur : 2
Belok Kiri : Langsung
Lokasi Survei : Simpang 4 Gondomanan
Lebar Lajur : 4,05 m
Waktu/Cuaca : Cerah
Surveyor : Adit
Median : Tidak ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	190	78	1	8	380	73	1	14	108	39	0	3
2	16:15-16:30	250	125	1	7	366	54	1	9	102	29	0	5
3	16:30-16:45	185	69	0	7	313	94	5	7	105	27	0	5
4	16:45-17:00	178	68	1	9	349	52	4	4	106	33	0	5
5	17:00-17:15	254	135	0	18	360	93	0	8	96	34	0	7
6	17:15-17:30	186	85	1	12	383	94	2	9	110	36	0	6
7	17:30-17:45	270	95	0	11	370	119	0	7	115	27	0	8
8	17:45-18:00	277	96	2	14	335	82	0	4	103	29	0	6

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection E Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Selatan
Jumlah Lajur : 2
Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Gondomanan
Lebar Lajur : 3,5 m
Waktu/Cuaca : Cerah

Surveyor : Adit
Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	28	10	0	5	346	95	0	15	201	45	0	4
2	16:15-16:30	25	4	0	2	378	130	2	7	278	98	1	1
3	16:30-16:45	43	12	1	2	302	96	0	12	197	40	0	2
4	16:45-17:00	28	7	1	2	382	115	0	2	198	45	0	3
5	17:00-17:15	51	8	1	3	360	88	0	9	280	87	0	2
6	17:15-17:30	40	10	1	4	383	109	1	10	199	59	0	4
7	17:30-17:45	26	8	1	1	370	96	0	8	270	46	0	1
8	17:45-18:00	34	4	1	3	335	101	1	15	235	51	0	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection E Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEI SIMPANG

Lengan Simpang : Barat   Jumlah Lajur : 2   Belok Kiri : Langsung

Lokasi Survei : Simpang 4 Gondomanan   Lebar Lajur : 3,35 m   Waktu/Cuaca : Cerah

Surveyor : Adit   Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	194	108	1	8	222	58	4	2	39	24	1	1
2	16:15-16:30	185	95	1	7	247	75	4	5	70	41	4	4
3	16:30-16:45	229	72	0	7	227	61	4	1	36	26	2	3
4	16:45-17:00	224	82	1	9	160	58	3	2	34	24	1	2
5	17:00-17:15	254	93	0	18	273	76	4	4	61	47	4	5
6	17:15-17:30	266	92	1	12	148	55	1	3	38	21	1	2
7	17:30-17:45	270	101	0	11	185	29	5	2	39	22	1	1
8	17:45-18:00	277	100	2	14	128	28	0	2	41	19	1	3

Keterangan:

MC: *MotorCycle*   LV: *Light Vehicle*   HV: *Heavy Vehicle*   UM: *UnMotorized*

Appendix 7 Survey Data at Intersection F Weekend Session 3 (16:00 – 18:00 WIB))

FORMULIR SURVEY SIMPANG

Lengan Simpang : Timur
Lokasi Survei : Simpang 4 Juminahan
Surveyor : Hendro

Jumlah Lajur : 1
Lebar Lajur : 3,5 m
Median : Tidak ada

Belok Kiri : -
Waktu/Cuaca : Cerah

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15					99	3	1	1	57	36	1	7
2	16:15-16:30					103	3	0	2	69	34	2	8
3	16:30-16:45					89	6	0	1	74	32	0	3
4	16:45-17:00					103	11	0	2	62	23	0	5
5	17:00-17:15					70	9	2	0	70	40	2	4
6	17:15-17:30					78	3	0	0	51	34	3	4
7	17:30-17:45					52	6	0	2	60	31	2	2
8	17:45-18:00					53	16	1	1	64	32	2	2

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Survey Data at Intersection F Weekend Session 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang : Selatan
Jumlah Lajur : 4
Belok Kiri : Tidak Langsung

Lokasi Survei : Simpang 4 Juminahan
Lebar Lajur : 3,55 m
Waktu/Cuaca : Cerah

Surveyor : Hendro
Median : Ada

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	30	8	1	3	382	162	2	10	266	80	0	2
2	16:15-16:30	35	2	0	2	444	175	4	32	221	79	0	2
3	16:30-16:45	15	6	1	3	427	169	3	20	209	26	0	4
4	16:45-17:00	21	1	2	4	434	160	4	30	278	70	0	2
5	17:00-17:15	21	6	0	2	402	162	4	27	308	53	0	1
6	17:15-17:30	22	6	1	1	441	178	3	31	318	59	0	2
7	17:30-17:45	20	2	0	2	447	180	3	27	308	44	0	0
8	17:45-18:00	20	5	2	1	451	202	4	25	264	28	0	1

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*

Appendix 7 Data Survey Simpang Akhir Pekan Sesi 3 (16:00 – 18:00 WIB)

FORMULIR SURVEY SIMPANG

Lengan Simpang	: Barat	Jumlah Lajur	: 1	Belok Kiri	: Tidak Langsung
Lokasi Survei	: Simpang 4 Juminahan	Lebar Lajur	: 3,5 m	Waktu/Cuaca	: Cerah
Surveyor	: Hendro	Median	: Tidak ada		

No.	Periode Waktu	Jenis kendaraan											
		Belok Kiri				Lurus				Belok Kanan			
		MC	LV	HV	UM	MC	LV	HV	UM	MC	LV	HV	UM
1	16:00-16:15	71	30	0	3	16	1	0	0				
2	16:15-16:30	99	13	0	2	14	3	0	1				
3	16:30-16:45	87	24	4	3	13	3	1	2				
4	16:45-17:00	72	28	2	5	14	7	0	1				
5	17:00-17:15	74	14	0	8	23	5	0	3				
6	17:15-17:30	62	16	0	10	13	1	1	2				
7	17:30-17:45	57	30	0	9	26	1	0	1				
8	17:45-18:00	42	15	0	7	32	1	0	0				

Keterangan:

MC: *MotorCycle* LV: *Light Vehicle* HV: *Heavy Vehicle* UM: *UnMotorized*