Study of Traffic Safety, Orderliness, and Smoothness (*Kamseltibcarlantas*) In Integrated and Coordinated Region of Makassar City

Lambang Basri SAID [a], Rani Bastari ALKAM [b]

[a,b] *Lecturer of Civil Engineering Department, Moslem University of Indonesia Makassar South Sulawesi, Indonesia*
[a] *E-mail: elbasri_umi@yahoo.com*
[b] *E-mail: ranibastari@gmail.com*

Abstract: Central Region Urban Development will have a direct impact on the movement of traffic on the existing road network system and would cause traffic generation and attraction of the region. Traffic Impact Assessment is analysis of land-use development influence on the movement of traffic flow system which can lead to generation of new traffic. In each space activities will generate movement and pull movement whose intensity will depend on the type of land use. This study was designed in three (3) years. The first year focused on establishing *Kamseltibcarlantas* region and optimizing the street function in the area and the possibility of applying one direction systems management. The second year will focus on the intersection of control and canalization of the various openings in the median. And the third year will be implemented a control system Integrated and Coordinated Area Management of Makassar on the use of perspective until 2025.

Keywords: Region, Traffic, Integrated, Coordinated

1. INTRODUCTION

The development of urban centers, superblocks, and several other activity centers that have been done recently have a direct impact on the movement of traffic in the existing road network system both to the road and to the intersection. Development cause increasing of trip generation and attraction by the activities of that area. The successful of design and development has been able to seen with the increasing growth in various fields, which in turn also demands an increase in transportation needs with the implementation of the development of the area.

From this phenomenon, Makkassar city, as capital city of South Sulawesi, require for the improvement of safe, orderly, smooth, fast and convenient transportation services especially in better traffic arrangement in traffic order area as one of integrated and coordinated areas. This reflects with the existence of centers of trade activities, shopping, offices, banking, hospitals, apartments and others. This area is connected to a road network system whose node points are 14 intersections that can be formulated in a unified and coordinated system.

A primary issue in this analysis is to analyze safety, order, and smoothness in traffic condition and to evaluate the traffic performance around the integrated traffic orderly region of Makassar and analyze the impact of traffic generated such as congestion and traffic safety. This research purposes are to know and evaluate the traffic volume and speed occurs and evaluate the openings as well as one-way system and to determine the technical engineering and traffic management integrated traffic orderly region of Makassar.

Kamseltibcarlantas Analysis studies to evaluate the performance of the main road AP Pettarani, Abdullah Dg.Sirua, Boulevard, Pengayoman, Hertasning, Bau Mangga, Ance Dg

ngoyo, Adyaksa, Adyaksa Baru as an integrated and coordinated regional Kamseltibcarlantas in Makassar. This has several objectives: a) Formulate a regional development pattern on economic activity in the central zone of the city of Makassar, b). Analyzing the performance of traffic on the existing road network system around the center of the activity, c). Analyzing the road network management system which are located around the area of study, and d). Identifying forms of handling aspects of traffic impact and intersection control optimization.

This research is expected to provide diversification benefits to identify problems in Kamseltibcarlantas area of integrated and coordinated Makassar City by conducting surveys of road infrastructure, road users, vehicles, traffic conditions, environmental conditions of the area that could potentially cause side friction, compilation and analysis of data, design and development of Low Cost Traffic Management (LCTM). Implementation of LCTM is ranging from socialization formulation to permanent and legislated application including testing, legality, monitoring, evaluation and improvement. This study is also expected to benefit the development of science and technology with the use of many existing theories as well as a reference for the various parties involved.

In general, kamseltibcarlantas that exist in big cities patterned based on the phenomenon of the road while the intersection is less considered as the barometer and not based on the region. In Makassar, for example, kamseltibcarlantas include A.P.Pettarani Road, Abdullah Dg.Sirua, Boulevard, Pengayoman, Hertasning, Bau Mangga, Ance Dg Ngoyo, Adyaksa, Adyaksa Baru and all roads and 14 intersections that must be integrated. However, the road segments and intersections among those mentioned do not enter as areas observed in our system. The study is expected to contribute the identification of the problem of Kamseltibcarlantas integrated and coordinated areas by conducting in-depth study, road users, activities that lead to side barriers, vehicles, traffic conditions and compilations as well as data and design analysis and Development of Low Cost Traffic Management (LCTM).

The findings were targeted in this research are to get the feasibility of traffic technical/ engineering in the region Kamseltibcarlantas with Systems Management Control in Integrated and Coordinated region as the main element in the analysis of capacity building of roads and intersections, the application of the one way system and the system of canalization and various openings on median necessary, time efficiency, delay in service until 2025 perspective. While the outcome is to obtain the results of research which is expected to provide technical feasibility and traffic engineering by focusing on integrated and coordinated Management Area control system in Makassar City, and can be published in accredited national and/or international journals and publications in the form of posters.

This activity is part of the comprehensive research roadmap with the primary objective is to improve Kamseltibcarlantas on the Integrated and Coordinated Region in Makassar. (Lambang Basri Said and Ariani, 2011), examines the Infrastructure Development and the impact to Mamminasata Growth Center region in Sulawesi Economic Corridor. Then Lambang Basri Said, *et al*. (2013), have researched about the performance and characteristics of the existing infrastructure and how to formulate traffic congestion alleviation along the main corridor of Makassar city. Lambang Basri Said, *et al.* (2014, HB Year I), provide information and an overview of the intersection performance of Maros Road, Perintis Kemerdekaan Road, Reformasi Highway, and Sultan Hasanuddin Airport access Road with the use of roundabout, underpass, and Traffic Light facilities at the intersection. Resumed in 2015 (HB Year II), can provide benefits to the smooth traffic as the results of the design of roundabout plus underpass at the intersection, so that congestion at the junction can be overcome with the use of roundabout plus underpass facilities and blend the use of traffic light to accommodate the entire intersection approach which exists.

2. RESEARCH METHOD

This research will be done in stages over three years by reviewing some of the variable orientations and research objectives to be achieved as illustrated in the following fishbone (a detailed description of the research procedure presented in the first year until the third year):

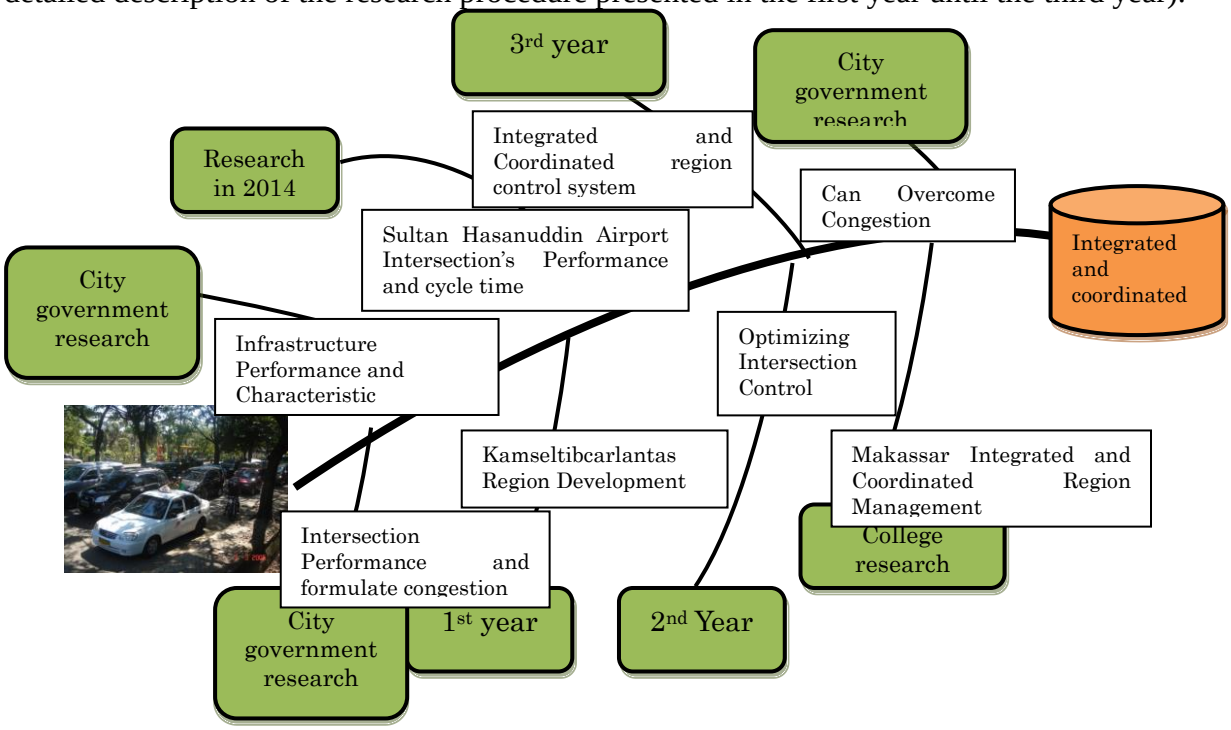

Figure 1. Research fishbone

1st year research focused on developing kamseltibcarlantas region in the city's economy central, and to know the capacity and level of services, decrease the degree of saturation that occurs on roads and intersections, including a reduction in travel time and delay with the possible patterns of a given management.

Zoning Kamseltibcarlantas region in Makassar, covering the area of main road AP Pettarani, Abdullah Dg.Sirua, Boulevard, Pandang Raya, Pengayoman, Hertasning, Bau Mangga, Ance Dg ngoyo, Adyaksa, Adyaksa Baru as well as all the roads and the integrated intersection.

A better picture of the object study Kamseltibcarlantas can be obtained through the relevant information with the intent and purpose of the study. Further information can be obtained by observation and direct observation in the field, simple interviews with relevant parties. In this survey obtained by the volume of vehicles using the area, travel time to a certain distance and optimizing the function of the streets in the area to minimize the side barrier impact. All information related to the traffic volume, queues, saturation flow, distance and time, delay, assessing the performance of existing intersection are the basis in Zoning of Kamseltibcarlantas.

Research including the formulation and identification of problems related to the wisdom of organizing road traffic, a policy that has been done, in conjunction with it to do a study of theories relating. Analysis oriented on road segment and intersection performance to the valuation characteristics were examined for the purpose for this study, which are based on the standard MKJI (Highway Capacity Manual Indonesia)

Feasibility in technical/ engineering traffic of Kamseltibcarlantas region with Management Control Systems in Integrated and Coordinated region as the main element in the analysis of capacity building of roads and intersections, the application of the one way system

and the system of canalization and various openings in the median necessary, the efficiency of the value of time, delay and the difference in travel time in the perspective of the service until 2025.

The stages of implementation in the process of this research activity will be described as follows:

Phase I. Determination of Kamseltibcarlantas Territory

Determination of Kamseltibcarlantas Area in Makassar City, covering the area AP Pettarani Road, Abdullah Dg.Sirua, Boulevard, Pandang Raya, Pengayoman, Mirah Seruni, Hertasning, Bau Mangga, Ance Dg Ngoyo, Adyaksa, Adyaksa Baru and all road segments And integrated intersection.

Phase II. Implementation of Survey

A better description of the Kamseltibcarlantas area under study can be obtained through information relevant to the intent and purpose of the study. Further information can be obtained by conducting field reviews, simple interviews with related parties.

The types of data to be taken in intersection during this research and the following sources can be described as follows;

A. Research to obtain direct data (*primary*) obtained by direct survey in the field to find out how much vehicles volume using the area, travel time at a certain distance and the optimization of the function of road segments within the region in minimizing the influence of side barriers.
B. Secondary data concerning Legislation, Government Regulation and Decree of the Minister of Transportation in Indonesia, and also region regulation related to Kamseltibcarlantas.
C. The data that have been collected is made in the form of tables to facilitate the processing, some of the required variables include: traffic volume, queue length and queue opportunities, saturation current, distance and travel time, delay, assess the performance of the existing intersection as the basis of Determination of Kamseltibcarlantas.

Method of collecting data

The methods used to obtain the required data are as follows:

1. Library Research, by conducting theory, information and data related research objectives.
2. Field Research, is research directly on the object under study, with
   A. Observation, namely through observation and systematic statement of symptoms or phenomena observed based on direct observation.
   B. Interviews, with related parties in this case One Way Directions System Operations (SSA), canalization patterns, activities along the periphery of the road.
   C. Documentation, using documentation in the form of photographs and research-related notes.

Phase III. Data analysis

The research undertakes the formulation and identification of issues related to the policy of road traffic management, the policy that has been done, together with the study of theory and other related libraries.

Questionnaires, namely data collection techniques by providing a series of questions asked to respondents in this case the road users from various communities proportionally. The intended analysis is related to the performance of segments and intersections related to the assessment of the characteristics studied for the purposes of this study.

The second year of research will be conducted by integrating intersection control by integrating the canalization system with various openings in the median with the acquisition of field data that can be obtained directly, and secondary data through the relevant agencies both

in the order of Makassar and the South Sulawesi provincial level. Field data is done in two forms: manual counting and direct distance survey and travel time.

The tools used in obtaining field data include:

1) Map of intersection situations as well as master plans that describe the situational of the existing facilities.
2) Stopwacth to record the time between arrival and departure of vehicles entering and exiting from a certain point.
3) Tents and umbrellas and desks for observation posts placed in the intersection area.
4) Theodolite and or roll meter to measure the position of physical facilities intersection and road network segment.
5) Camera to record the events that occur, the documentation is still or moving.
6) Stationery, ruler and calculator for recording and counting related to inventory, data collection through manual counting and side interview and other measurements.
7) Computer set and Transit Program and SPSS Program as the main tool in backing up all research activities, starting from the initial design until the end of reporting.
8) Counting to calculate the volume of each particular vehicle type that crosses the road and the intersection of the entire intersection and the direction of the movement.

The third year research will be conducted by integrating the control of the Kamseltibcarlantas Area junction with an integrated and coordinated control system, field data acquisition that can be obtained directly and secondary data through the relevant agencies. It will then be integrated through a coordinated light system especially at the nearest intersection which is estimated to have a long queue value up to the adjacent approach.

3. RESEARCH RESULT AND ANALYSIS

3.1 Survey Result

3.1.1 Condition of road network system

The condition of the road network system in Pettarani Region which is the location of the survey in this activity is presented in Figure 2 below:

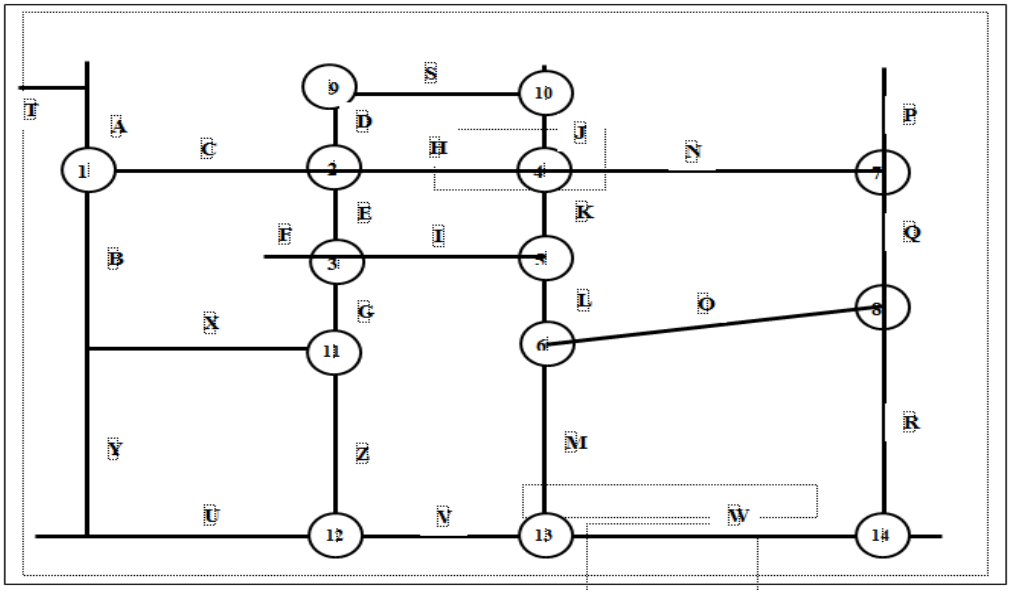

Figure 2.Road network system in Panakukkang area

Table 2 List of road in panakukkang area

Code	Road	Code	Nama Ruas Jalan
A	Abd. Dg. Sirua 1	N	Adyaksa
B	Abd. Dg. Sirua 2	O	Bau Mangga
C	Adyaksa Baru 1	P	Hertasning 1
D	Pandan Raya	Q	Hertasning 2
E	Boelevard 1	R	Hertasning 3
F	Per. Belakang PMCC	S	Mirah Seruni
G	Boelevard 2	T	Prof.Dr.Abdurrahman A.Basalamah
H	Adyaksa Baru 2	U	A.P.Pettarani 1
I	Boegenville	V	A.P.Pettarani 2
J	Pengayoman 1	W	A.P.Pettarani 3
K	Pengayoman 2	X	Ance Dg.Ngoyo
L	Pengayoman 3	Y	Abdullah Dg.Sirua 3
M	Pengayoman 4	-	-

Table 3 List of intersection in panakukkang area

No.	Road	No.	Road
1	Simpang Abd. Dg. Sirua 1 - Adyaksa	8	Simpang Hertasning – Bau Mangga
2	Simpang Adyaksa Baru – Boelevard – Meranti	9	Simpang Pandang Raya – Mirah Seruni
3	Simpang Boelevard – Boegenville	10	Simpang Pengayoman – Mirah Seruni
4	Simpang Adyaksa Baru – Pengayoman	11	Simpang Boulevard - Bau Mangga
5	Simpang Boegenville – Pengayoman	12	Simpang A.P.Pettarani – . Boelevard
6	Simpang Bau Mangga – Pengayoman	13	Simpang A.P.Pettarani - . Pengayoman
7	Simpang Adyaksa Baru – Hertasning	14	Simpang .A.P.Pettarani – Hertasning

3.1.2 Road network length

The length of each road network in the Study Area is presented in Table 4 as shown below:

Table 4 Length of road network in Panakukang area

No	**Code**	**Road**	**Length (m)**
1	C	Jl. Adyaksa Baru1	595
2	E	Jl. Boelevard	275
3	H	Jl. Adyaksa Baru2	240
4	I	Jl. Boegenville	235
5	K	Jl. Pengayoman1	271
6	L	Jl. Pengayoman2	47
7	N	Jl. Adiyaksa	431
8	O	Jl. Bau Mangga	435
9	Q	Jl. Hertasning 1	19
10	R	Jl. Hertasning 2	47
11	U	Jl. A.P.Pettarani 1	505
12	V	Jl. A.P.Pettarani 2	245
13	W	Jl. A.P.Pettarani 3	441

3.1.3 Condition of movement direction at intersection

Direction of traffic movement at each intersection in the Panakukang area which is the location of the study is presented in Figure 3. The following:

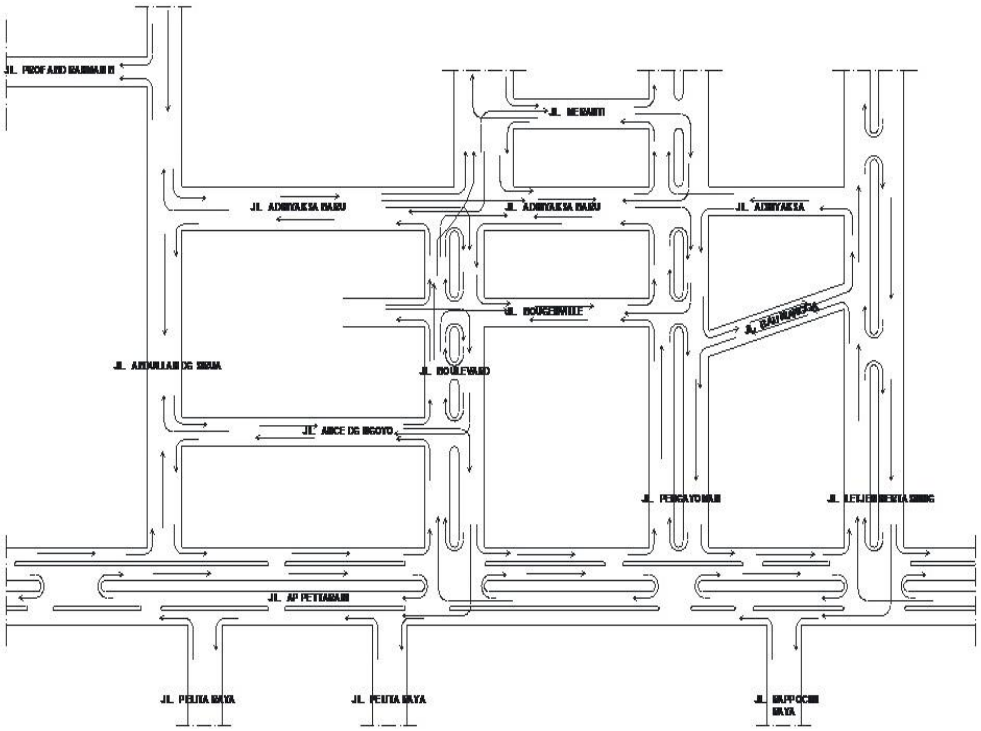

Figure 3. Direction of traffic movement at Panakukang area intersection

3.1.4 Daily volume and traffic composition at intersection

The recapitulation of the overall intersections reviewed in the Panakukang Area is presented in the following tables and figures:

Table 5 Recapitulation of traffic volume at intersection in Panakukang Area

Time	Traffic Volume (smp/hour)										
	1	2	3	4	5	6	7	8	Mean	MAX	MIN
07.00-08.00	3,521.20	751.70	1,937.40	2,111.90	1,796.10	1,435.90	3,207.00	885.30	1,955.81	3,521.20	751.70
08.00-09.00	3,480.50	665.80	2,411.15	2,235.20	2,179.87	1,646.00	3,966.30	2,325.20	2,363.75	3,966.30	665.80
09.00-10.00	2,378.20	1,053.70	2,751.15	2,095.20	1,904.98	1,330.10	2,786.30	1,009.68	1,913.66	2,786.30	1,009.68
10.00-11.00	1,882.70	1,092.90	2,496.50	2,211.30	1,796.75	1,322.10	2,195.60	866.95	1,733.10	2,496.50	866.95
11.00-12.00	2,391.40	1,228.80	2,865.50	2,128.80	1,918.30	1,304.50	2,724.50	1,149.93	1,963.97	2,865.50	1,149.93
12.00-13.00	2,151.70	1,814.30	3,569.90	2,569.00	2,458.64	1,748.75	3,461.50	1,375.38	2,393.65	3,569.90	1,375.38
13.00-14.00	2,331.00	1,714.10	3,795.25	3,036.80	2,451.36	1,783.75	3,380.90	1,493.65	2,498.35	3,795.25	1,493.65
14.00-15.00	1,955.70	1,606.70	2,641.80	2,531.60	2,019.24	1,525.80	2,353.60	1,055.23	1,961.21	2,641.80	1,055.23
15.00-16.00	2,113.70	1,543.00	2,648.00	2,648.00	2,093.93	1,584.90	2,414.90	1,135.73	2,022.77	2,648.00	1,135.73
16.00-17.00	2,584.20	1,682.30	3,317.50	3,317.50	2,436.82	1,824.55	2,802.60	1,197.63	2,395.39	3,317.50	1,197.63
17.00-18.00	2,726.70	2,155.10	3,929.70	3,929.70	3,034.94	2,305.25	3,579.70	1,676.88	2,917.25	3,929.70	1,676.88
18.00-19.00	2,968.70	1,892.20	3,783.65	3,783.65	2,182.50	1,977.30	3,600.40	1,786.28	2,746.84	3,783.65	1,786.28
19.00-20.00	2,999.10	1,600.20	3,917.95	3,917.95	2,562.16	1,941.65	3,753.30	1,709.85	2,800.27	3,917.95	1,600.20
Mean	**2,575.75**	**1,446.22**	**3,081.96**	**2,808.97**	**2,218.12**	**1,671.58**	**3,094.35**	**1,359.05**	**2,282.00**	**3,326.12**	**1,212.70**
MAX	**3,521.20**	**2,155.10**	**3,929.70**	**3,929.70**	**3,034.94**	**2,305.25**	**3,966.30**	**2,325.20**	**2,917.25**	**3,966.30**	**1,786.28**
MIN	**1,882.70**	**665.80**	**1,937.40**	**2,095.20**	**1,796.10**	**1,304.50**	**2,195.60**	**866.95**	**1,733.10**	**2,496.50**	**665.80**

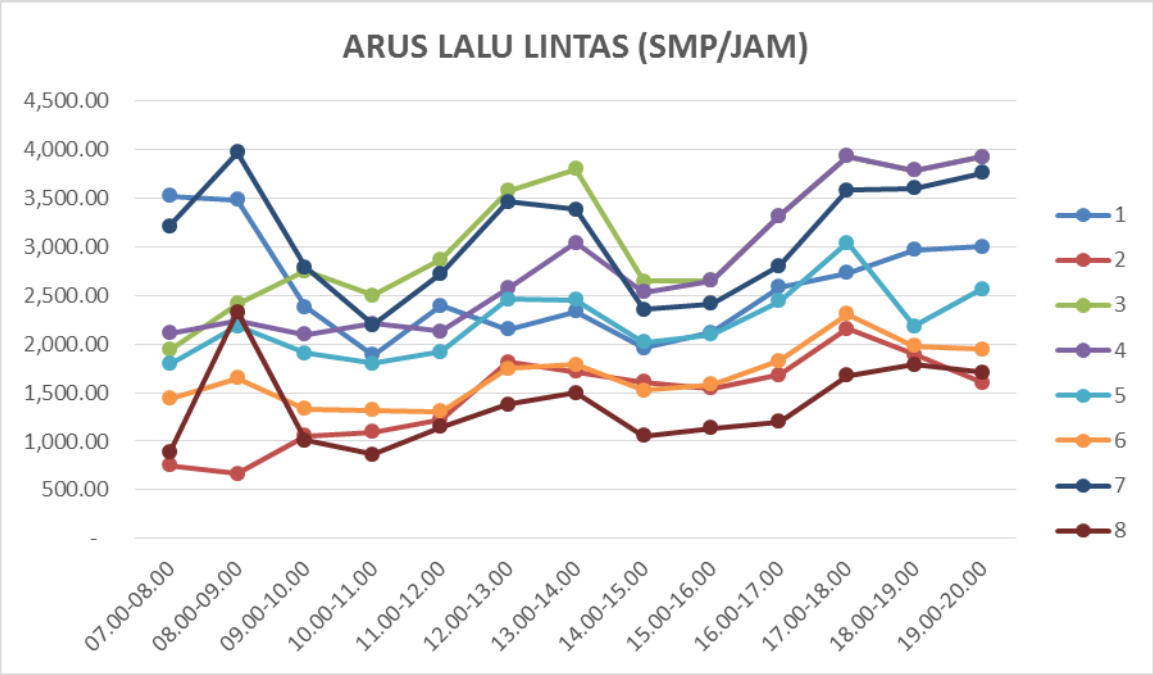

Figure 4. Traffic volume graph at Intersection in Panakukang Area

Traffic volume of intersecion in the central area between 2200-4000 smp/ hour, while in the suburban area around the junction between 800-2000 smp / hour. The vehicle composition is dominated by motor bike by 42% - 72%, followed by passenger cars/ jeep and Van Mini Bus (private vehicles) with a composition of 20% - 24%

3.2 Analysis of Intersection Performance

3.2.1 Intersection Capacity

The capacity of intersections in Panakukang area is presented as Table 6 and Figure 5 as follows :

Table 6 Recapitulation of intersection capacity in Panakukang Area

Time	Intersection Capacity (smp/ hour)										
	1	2	3	4	5	6	7	8	Mean	MAX	MIN
07.00-08.00	6,344.43	5,967.11	4,791.89	5,401.85	3,980.22	3,053.00	4,266.61	3,668.47	4,684.20	6,344.43	3,053.00
08.00-09.00	4,805.15	6,411.13	4,687.88	5,401.85	4,173.30	3,023.19	3,980.46	4,315.54	4,599.81	6,411.13	3,023.19
09.00-10.00	4,659.90	7,464.32	4,750.57	5,401.85	4,488.72	3,077.42	4,034.07	3,802.30	4,709.89	7,464.32	3,077.42
10.00-11.00	5,318.56	6,463.70	4,625.19	5,401.85	4,175.21	3,069.60	4,222.29	3,130.23	4,550.83	6,463.70	3,069.60
11.00-12.00	5,341.83	7,461.00	4,722.72	5,401.85	4,332.54	3,032.09	4,168.85	3,786.30	4,780.90	7,461.00	3,032.09
12.00-13.00	6,053.45	6,713.37	4,661.38	5,401.85	4,250.15	3,009.85	4,031.62	4,115.51	4,779.65	6,713.37	3,009.85
13.00-14.00	6,067.35	6,900.10	4,779.37	5,401.85	4,177.10	3,105.13	4,010.94	3,725.89	4,770.97	6,900.10	3,105.13
14.00-15.00	5,541.11	6,964.38	4,441.33	5,401.85	4,040.29	3,074.87	4,202.43	3,363.42	4,628.71	6,964.38	3,074.87
15.00-16.00	5,661.40	6,970.52	4,585.29	5,401.85	4,121.54	3,082.81	4,093.60	3,456.01	4,671.63	6,970.52	3,082.81
16.00-17.00	5,538.75	6,727.08	4,545.00	5,401.85	4,132.11	3,109.91	4,251.01	3,523.40	4,653.64	6,727.08	3,109.91
17.00-18.00	5,522.68	6,914.98	4,595.99	5,401.85	4,159.66	3,062.50	4,102.21	3,999.06	4,719.87	6,914.98	3,062.50
18.00-19.00	5,525.74	7,589.19	4,516.48	5,401.85	4,325.05	2,990.16	3,697.17	3,888.79	4,741.80	7,589.19	2,990.16
19.00-20.00	6,254.17	6,457.05	4,478.90	5,401.85	3,957.87	3,039.36	3,684.50	3,623.34	4,612.13	6,457.05	3,039.36
Mean	**5,587.27**	**6,846.46**	**4,629.38**	**5,401.85**	**4,177.98**	**3,056.15**	**4,057.37**	**3,722.94**	**4,684.92**	**6,875.48**	**3,056.15**
MAX	**6,344.43**	**7,589.19**	**4,791.89**	**5,401.85**	**4,488.72**	**3,109.91**	**4,266.61**	**4,315.54**	**4,780.90**	**7,589.19**	**3,109.91**
MIN	**4,659.90**	**5,967.11**	**4,441.33**	**5,401.85**	**3,957.87**	**2,990.16**	**3,684.50**	**3,130.23**	**4,550.83**	**6,344.43**	**2,990.16**

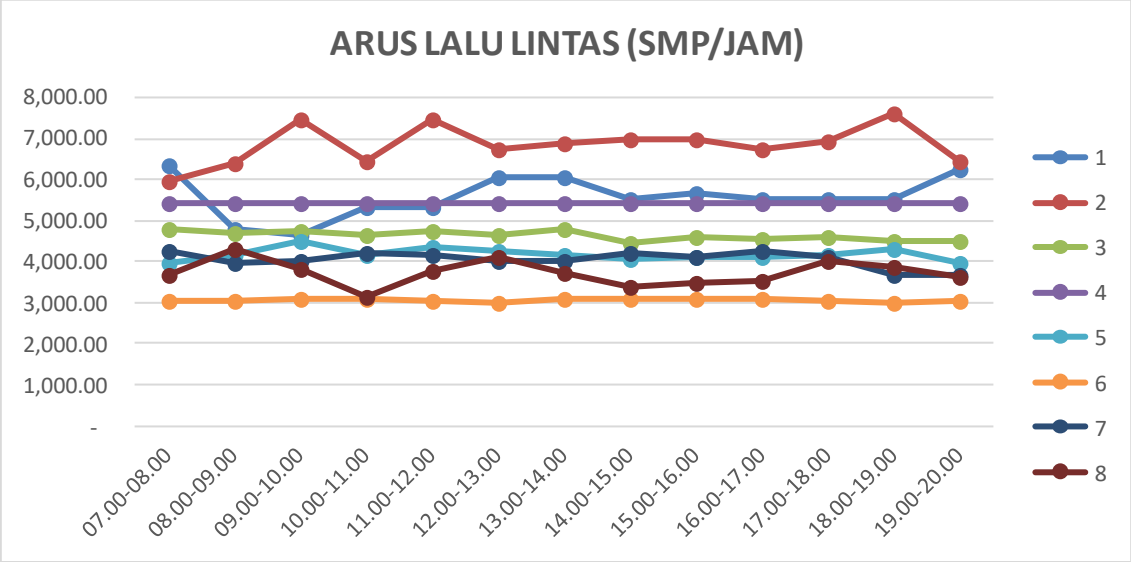

Figure 5. Intersection capacity in Panakukkang Area

The capacity of the intersection in Panakukang Region shows between 3000-7600 smp / hour.

3.2.2 Degree of Saturation

The degree of traffic saturation at intersections in Panakukang is presented as Table 7 and Figure 6 as follows:

Table 7 Recapitulation of degree of saturation in Panakukang Area

Time	Degree of Saturation (DS)										
	1	2	3	4	5	6	7	8	MEAN	MAX	MIN
07.00-08.00	0.555	0.126	0.514	0.457	0.451	0.470	0.752	0.241	0.446	0.752	0.126
08.00-09.00	0.724	0.104	0.579	0.486	0.522	0.544	1.001	0.539	0.562	1.001	0.104
09.00-10.00	0.510	0.141	0.540	0.453	0.424	0.432	0.691	0.266	0.432	0.691	0.141
10.00-11.00	0.354	0.169	0.607	0.488	0.430	0.431	0.520	0.277	0.410	0.607	0.169
11.00-12.00	0.448	0.165	0.766	0.501	0.443	0.430	0.654	0.304	0.464	0.766	0.165
12.00-13.00	0.355	0.270	0.794	0.589	0.578	0.581	0.859	0.334	0.545	0.859	0.270
13.00-14.00	0.384	0.248	0.595	0.654	0.587	0.574	0.843	0.401	0.536	0.843	0.248
14.00-15.00	0.353	0.231	0.577	0.568	0.500	0.496	0.560	0.314	0.450	0.577	0.231
15.00-16.00	0.373	0.221	0.730	0.568	0.508	0.514	0.560	0.329	0.475	0.730	0.221
16.00-17.00	0.467	0.250	0.855	0.533	0.590	0.587	0.659	0.340	0.535	0.855	0.250
17.00-18.00	0.494	0.312	0.838	0.586	0.730	0.753	0.873	0.419	0.626	0.873	0.312
18.00-19.00	0.537	0.249	0.875	0.545	0.505	0.661	0.974	0.459	0.601	0.974	0.249
19.00-20.00	0.480	0.248	0.667	0.617	0.647	0.639	1.019	0.472	0.599	1.019	0.248
MEAN	**0.464**	**0.210**	**0.687**	**0.542**	**0.532**	**0.547**	**0.767**	**0.361**	**0.514**	**0.811**	**0.210**
MAX	**0.724**	**0.312**	**0.875**	**0.654**	**0.730**	**0.753**	**1.019**	**0.539**	**0.626**	**1.019**	**0.312**
MIN	**0.353**	**0.104**	**0.514**	**0.453**	**0.424**	**0.430**	**0.520**	**0.241**	**0.410**	**0.577**	**0.104**

The degree of saturation of traffic in average between 0.51 and 1.02 for peak conditions that occur at the intersection of Hertasning Road – Adyaksa Road. The next highest degree of saturation conditions occur at the intersection of Boulevard Road – Bougenville Road.

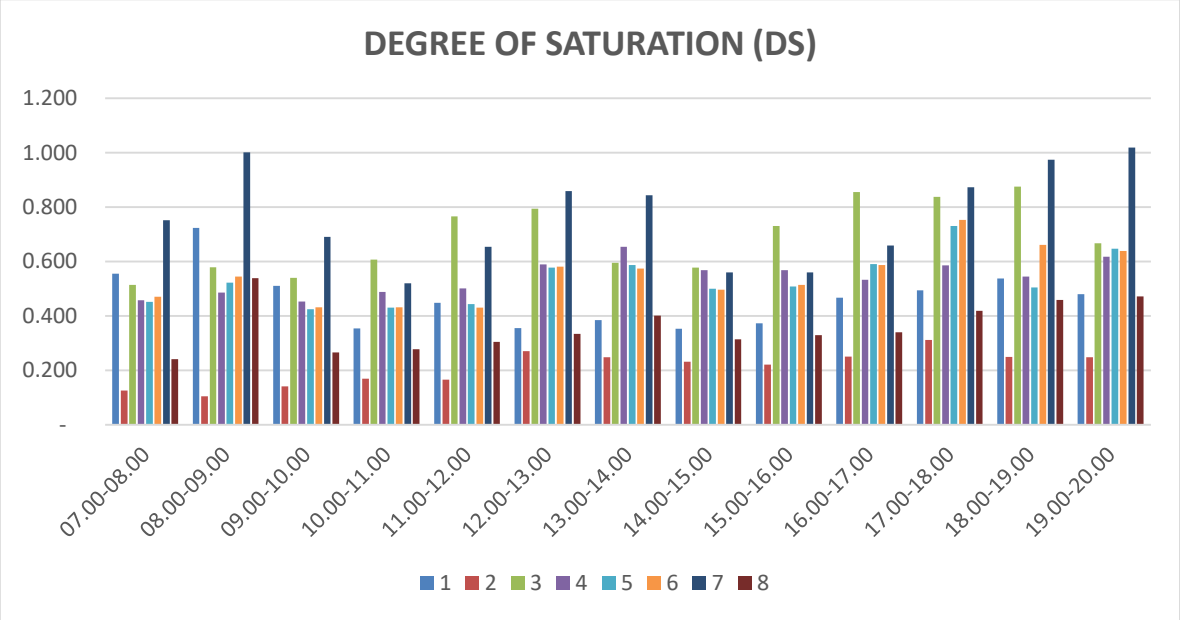

Figure 6. Degree of saturation in Panakukkang Area

3.2.3 Traffic Delays and Queues at Intersection

The traffic delay at the intersection in Panakukang is presented in Table 8 and Figure 6 as follows:

Table 8 Traffic delay at intersection in Panakukang Area

Time											
	1	2	3	4	5	6	7	8	MEAN	MAX	MIN
07.00-08.00	10.251	6.019	8.062	21.823	8.697	8.626	12.287	6.293	10.257	21.823	6.019
08.00-09.00	12.126	5.702	9.183	22.031	9.442	9.434	19.073	9.567	12.070	22.031	5.702
09.00-10.00	9.964	6.106	9.822	21.909	8.555	8.181	11.313	6.612	10.308	21.909	6.106
10.00-11.00	8.558	6.255	9.397	22.238	8.550	8.195	9.403	6.401	9.875	22.238	6.255
11.00-12.00	9.376	6.368	10.111	36.432	8.715	8.216	10.843	6.923	12.123	36.432	6.368
12.00-13.00	8.520	7.387	12.379	38.182	10.032	9.783	14.361	7.334	13.497	38.182	7.334
13.00-14.00	8.756	7.116	12.927	37.697	10.117	9.672	14.003	7.924	13.527	37.697	7.116
14.00-15.00	8.469	6.957	9.952	36.761	9.221	8.849	9.828	6.834	12.109	36.761	6.834
15.00-16.00	8.693	6.869	9.811	37.064	9.336	9.065	10.102	7.034	12.247	37.064	6.869
16.00-17.00	9.504	7.097	11.790	36.544	10.150	9.836	10.931	7.167	12.877	36.544	7.097
17.00-18.00	9.711	7.786	14.215	36.534	11.939	12.123	14.711	8.161	14.398	36.534	7.786
18.00-19.00	10.198	7.117	13.825	36.422	9.320	10.737	17.892	8.593	14.263	36.422	7.117
19.00-20.00	9.714	7.192	14.709	36.459	10.759	19.908	19.908	8.621	15.909	36.459	7.192
MEAN	**9.526**	**6.767**	**11.245**	**32.315**	**9.603**	**10.202**	**13.435**	**7.497**	**12.574**	**32.315**	**6.753**
MAX	**12.126**	**7.786**	**14.709**	**38.182**	**11.939**	**19.908**	**19.908**	**9.567**	**15.909**	**38.182**	**7.786**
MIN	**8.469**	**5.702**	**8.062**	**21.823**	**8.550**	**8.181**	**9.403**	**6.293**	**9.875**	**21.823**	**5.702**

Traffic delays at the intersection in Panakukang Region amounted to 32.31 seconds on average and 38.18 seconds for peak conditions that occur at the intersection of Adyaksa Road – Pengayoman Road. The highest queue opportunities that occur at unsignalized intersections in the Panakukang region is 42% - 83% occurring at the intersection of Adyaksa road – Hertasning Road.

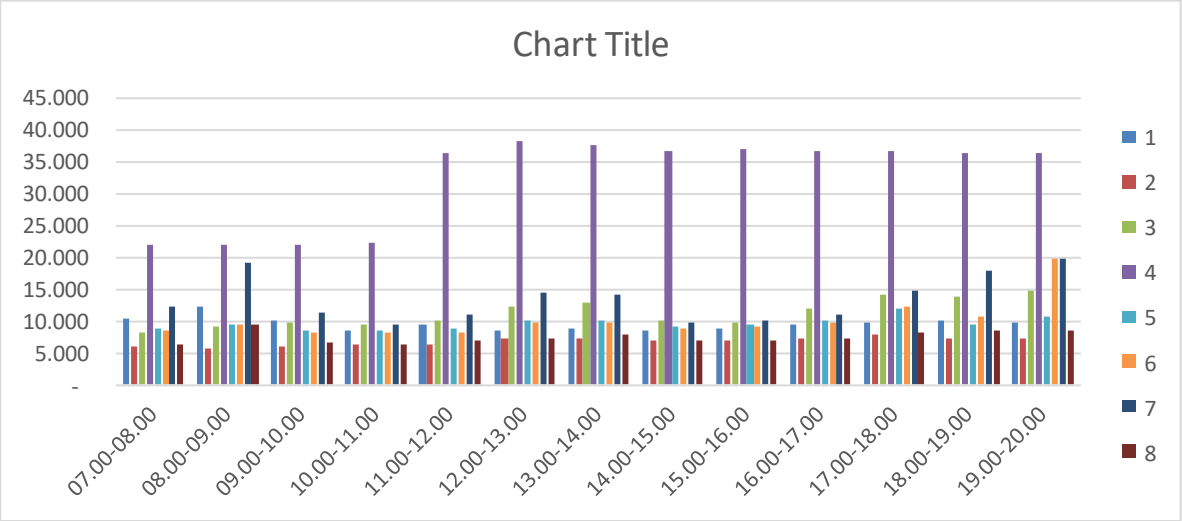

Figure 7 Traffic Delay at Intersection (D)

Traffic queue opportunities at intersections in Panakukang area are presented as Table 9 as follows:

Table 9 Queue opportunity at intersection in Panakukang Area

WAKTU	PELUANG ANTRIAN (QP%)						
	SIMPANG KE -						
	1	2	3	5	6	7	8
07.00 - 08.00	13 - 43	1 - 5	8 - 26	9 - 26	10 - 28	23 - 80	4 - 27
08.00 - 09.00	21 - 25	1 - 6	12 - 30	12 - 20	13 - 21	40 - 40	12 - 12
09.00 - 10.00	11 - 16	2 - 8	14 - 27	8 - 20	9 - 20	20 - 26	4 - 13
10.00 - 11.00	6 - 21	2 - 7	13 - 32	9 - 21	9 - 20	12 - 36	4 - 14
11.00 - 12.00	9 - 16	2 - 12	15 - 47	9 - 30	9 - 30	18 - 59	5 - 15
12.00 - 13.00	6 - 18	4 - 11	24 - 51	14 - 31	14 - 30	30 - 57	6 - 19
13.00 - 14.00	7 - 16	4 - 10	25 - 32	15 - 25	14 - 24	29 - 29	8 - 14
14.00 - 15.00	6 - 17	3 - 10	15 - 30	11 - 25	11 - 26	13 - 31	5 - 15
15.00 - 16.00	7 - 23	3 - 11	14 - 44	11 - 31	12 - 31	15 - 37	6 - 16
16.00 - 17.00	10 - 24	4 - 14	22 - 58	15 - 44	15 - 46	18 - 60	6 - 20
17.00 - 18.00	11 - 27	5 - 11	29 - 56	22 - 25	23 - 37	31 - 75	8 - 22
18.00 - 19.00	12 - 23	4 - 11	28 - 61	11 - 36	18 - 35	38 - 83	10 - 23
19.00 - 20.00	10 - 22	4 - 9	31 - 38	17 - 27	17 - 28	42 - 48	10 - 17
RERATA	**10 - 23**	**3 - 10**	**19 - 41**	**13 - 28**	**13 - 29**	**25 - 51**	**7 - 17**
MAX	**21 - 43**	**5 - 14**	**31 - 61**	**22 - 44**	**23 - 46**	**42 - 83**	**12 - 27**
MIN	**6 - 16**	**1 - 5**	**8 - 26**	**8 - 20**	**9 - 20**	**12 - 26**	**4 - 12**

3.3 Evaluation of Traffic Management Issues

Based on the analysis of the intersection performance in Panakukang Area, then to evaluate traffic management problems that exist as presented in the following table.

Table 10. Traffic Management Issues Evaluation (Intersetion no.1 to 4)

Kind of Issue	Specific issue at the intersection			
	Intersection No. 1	Intersection No. 2	Intersection No. 3	Intersection No. 4
1. Geometric	The road width is to small	Varies in approach lane width	Width of Residental street approach is too small	Varies in approach lane width
2.Movement Direction	Vehicle always do U-Turn maneuver at end of approach lane of Adiyaksa 1	Is limited at the end of Adiyaksa 2 & Pandang Raya approach lane	-	-
3. The Number of Conflict Points	-	5 major conflict points	20 major conflict points	13 major conflict points
4. Side Barrier	- Pedicab Parking - Shopping Complex	- Pedicab Parking - Crossing pedestrian	- On street Parking	- Public transport parking in Pengayoman Road - Taksi queueing in Jl. Adiyaksa Baru2 street
5. Road Sign & Markings	- Impermanent Marking - Less secure marking	-Impermanent Marking - Less secure marking	- Lack of Road Signs - Lack of Road Markings	-
6. Vehicle Composition	-	-	-	-
7.Intersection Performance	-	-	-	-
a. Degree of Saturation	0,49	0,31	0,838	0,586
b. Delay	9,71 seconds	7,79 seconds	14,21 seconds	36,53 seconds
c. Queue opportunities	21% – 25%	4% – 14%	28% – 61%	4% – 14%
8.Road Segment Perfomance (Degree of Saturation)	0,669 - 0,996	0,125 - 0,676	0,233 - 0,612	0,401 - 0,815

Table 11. Traffic Management Issues Evaluation (Intersetion no.5 to 8)

Kind of Issue	Specific issue at the intersection			
	Intersection No. 5	Intersection No. 6	Intersection No. 7	Intersection No. 8
1. Geometric	-	Bridge existence at Bau Mangga street slow down vehicle movement	Corner Turn at the approach of intersection Jl. Adyaksa is not perpendicular	Corner Turn at the approach of intersection Jl. Bau Mangga is not perpendicular and not safe
2.Movement Direction	-	-	-	-
3. The Number of Conflict Points	3 major conflict points	3 major conflict points	3 major conflict points	-
4. Side Barrier	Vehicles are always Parked in front of	Vehicles are always Parked in front of	Vehicle parking in front Store /	Informal Sector Traders at the

	Barugae Restaurant	Internet cafes at Bau Mangga road	restaurant at intersection approach Adyaksa Road	intersection of Bau Mangga road
5. Road Sign & Markings	- Lack of Road Signs - Lack of Road Markings	- Lack of Road Signs - Lack of Marking	- Lack of Road Signs - Lack of Road Markings	Lack of Road Signs - Lack of Road Markings
6. Vehicle Composition	-	-	-	-
7.Intersection Performance	-	-	-	-
a. Degree of Saturation	0,73	0,753	0,873	0,419
b. Delay	11,94 seconds	12,12 seconds	14,71 detik	8,16 detik
c. Queue opportunities	11% – 36%	15% – 46%	38% – 83%	4% – 27%
8.Road Segment Perfomance (Degree of Saturation)	0,341 - 0,417	0,199 - 0,403	0,534 - 0,815	0,199 - 0,604

3.4 Assessment of Traffic Management Conditions

Based on the evaluations result have been shown in the tabulation above, the assessment of the condition of traffic management at intersections in Panakukang Region, indicates that the intersection is already in a critical condition. This condition is happened as well as in Abd. Dg. Sirua street - Adyaksa Baru street (Intersection No 1), Intersection of Boulevard Road - Boegenville Street (Intersection No 3), Intersection of Adyaksa Baru Street – Pengayoman Road (Intersection No 4), and Intersection of Adyaksa Baru Street - Hertasning Road (Intersection No 7), where the roads are becoming already critical intersection lane approach is Abd. Dg. Sirua street, Adiyaksa street, Boulevard Road (Mall Panakkukang), Pengayoman Road (Mall Panakkukang back side).

4. CONCLUSION

Based on the results and discussion of research data, it can be concluded as follows:

1) The highest traffic volume in the Panakukkang region occurred in Adyaksa - Hertasning Intersection with average traffic volume on the morning and afternoon of 3,100 smp/hour, with the maximum of 4,200 smp / hour is relatively high, with the largest vehicle composition is dominated by motorcycles between 42-72% , while the four-wheel vehicles between 20-25% is a mix of traffic as the main trigger of chaos.
2) The largest vehicle composition is dominated by motorcycle vehicles with the composition of between 42 - 72%, while the low vehicle with the composition between 20-25%
3) Intersection Capacity in Panakukkang area with the average of 6,875.48 smp / hour with a maximum capacity of 7,589.19 smp/hour and a minimum capacity of 2,990.16 smp/hour with a 0,811 average in degree of saturation with a maximum of 1,019 degrees indicating a very low level of level of service.
4) The degree of saturation at the intersection of Panakukkang Area with a mean of

0.811 with a maximum degree of 1.019 and a minimum saturation degree of 0.104

5) The highest traffic delay at the intersection Panakukkang Region is 32.31 seconds with the average of 38.18 seconds, for conditions that occur at the intersection of Adyaksa street – Pengayoman Road with the highest queues opportunities occurred at unsignalized intersections in Panakukkang region between 42-83 % occurring at the intersection of Adyaksa street – Hertasning Roads.
6) The emergence of various low performance in some road segments and intersections due to geometric factor which is not equipped with turn vehicle and pedestrian facilities, median and movement direction in some road segments, the highness of side barriers by parking activities and street vendors, and traffic mix.

REFERENCES

Abbas, S. (1995) *Transport Management.* PT Raja Grafindo Persada, Jakarta

Anonimus (1997) *Indonesia Highway Capacity Manual (MKJI).* Directorate General of Bina Marga DPU, Jakarta.

Banwait, Sp., Mondal, S.S, & Singhal, R. (2004) *Construction Of Grade Separators At The Intersection Of Ring Road And Aurobindo Marg*, New Delhi –A Success Story

Branch, H. (2013) Signal timing at Newark intersection, The cross of Sanquan Road and Huayuan Road, *The News Journal*, Zhengzhou, China, April.

Cahyono, U. (2012) Management of Public Space Around the Cross Roads, Journal RUAS Volume 10, Number 2, Manado, Desember.

Damon (2011) *Highway 130 and Malama Market Intersection to Become Round-A-Bout*, November

Davidson,K.B (1966) *A Flow Travel Time Relationship for Use in Transpor Planning Proc*, Vol.3, Part I. Australia Research, Australia

Gray, C., Simanjuntak, P., Sabur, L., Maspaitella, P., Varley, R. (1997) *Introdution of Project Evaluation*. PT. Gramedia Pustaka, Jakarta.

Hicks, N. (2012) *Three Warlick intersection designs unveiled*, Lincoln Journal Star, November.

Khisty,J. Lall, K. (2005) *Transportation Engineering*, Third Edition. Prentice Hall, New Jersey.

Lake, R. (2013) Roundabout called safer than other intersections, writes about traffic and transportation. The Road Warrior appears Sunday and Wednesday in Nevada News, January

Lumintang, G. Signalized Intersection Traffic Performance (Case Study: Walanda Maramis Manado Intersection). *Journal of Static Civil Vol 1 Number 1*. Manado, November. (in bahasa)

Munawar, A. (2006) *Urban Traffic Management.* Beta Offset, Yogyakarta.

Muroi, T. Fukuda, A. (2005) *Study On Introduction Of The Exclusive Over/Underpass For Small Vehicles In Japan*. Graduate School of Science and Technology, Nihon University 7-24-1-221A, Narashino-dai,Funabashi City, Chiba, 274-8501, Japan

Oglesby,C., Hicks, G. (1988) *Highway Engineering, Second Edition.* Erlangga, Jakarta.

Pignataro,L.J (1993) *Traffic Engineering Theory and Practice*. Prentice Hall, New York

Said, L. (2015) Studies Capacity Management and Engineering Roundabout Interchange Plus Underpass. Transport Study Center Research Reports. Institute for Research and Resource Development UMI, Makassar.

Said, L. (2006) Sensitivity Study of Mass Public Transport Users of Makassar. Transport Study Center Research Reports. Institute for Research and Resource Development UMI, Makassar.

Soedirdjo, T (2002) *Traffic Engineering*. Bandung Institute of Technology, Bandung

Sukirman, S. (1999) *Basics of Road Geometric Planning.* Nova, Bandung

Tamin, O. (2000) *Transport Planning and Modelling, Second Edition*. Bandung Institute of Technology, Bandung