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PERFORMANCE ANALYSIS OF UNSIGNALIZED INTERSECTION ON PERJUANGAN AND VETERAN STREET MARTAPURA BANJAR DISTRICT

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ABSTRACT

The intersection of Jl. Perjuangan – Jl. Veteran is located in Martapura City, Banjar Regency, South Kalimantan Province. At this intersection there are only cautionary street lights or yellow lights, then the Intersection condition which is the road to residential areas, schools, shops, and traditional markets to support the occurrence of traffic jams and accidents

Primary data or data taken from the field include geometric conditions, environmental conditions, side barriers, traffic volume at the Intersection of Jalan Perjuangan - Jalan Veteran Martapura City. Secondary data includes the number of residents in Martapura City and data on the growth of the number of vehicles. Furthermore, the data samples were analyzed using the Indonesian Road Capacity Manual (MKJI, 1997) to find out whether Intersection performance is still feasible or not. If the results of the analysis show that the Intersection performance is no longer feasible, it is necessary to solve the problem.

At the intersection, Jl. Perjuangan - Jl. Veteran, Martapura City, Banjar Regency, on a unsignal condition, obtained a degree of saturation (DS) of 0.76 and delay (D) of all intersections of 12.7 seconds / smp with the Service Level Index at B, which indicates that at the intersection still has good conditions. After forecasting analysis, it is found that in the 6th year the degree of saturation (DS) is 1.11 and the whole delay is 26.21 seconds / smp with the Service Level Index in class D where the intersection has reached a bad condition or must be done intersection management analysis. By analyzing the form of intersection management when applied with a signalized intersection, the alternative 2 phase proposal is the best which is seen from the degree of saturation and delay with the value of Degree Saturation (DS) 0.74 and Delay (D) 18,33 seconds / smp with the intersection service level becomes C.

Keywords: Martapura, Non-Signalized Intersection, Delay

1. INTRODUCTION

Background

Martapura City is one of the cities in South Kalimantan Province. Based on data from the Central Bureau of Statistics of Martapura City, the population in Martapura City is approximately 115,828 people. With high population growth, of course, road infrastructure services are needed. But along with that, the level of traffic growth in Martapura City is quite high.

The intersection analyzed in this study is the non-signaled intersection at Jalan Perjuangan and Jalan Veteran, the city of Martapura. At this intersection there are only cautionary street lights or yellow lights and are located in business areas (shops) so that many vehicles stop and make queues of vehicles, even reducing travel time.

Problem Identification

From the description of the background, the three intersections of Jalan Perjuangan and Jalan Veteran in the city of Martapura, are still experiencing delays, which are caused by the chaos of the road users who pass the three intersections. For this reason, it is necessary to do a study and analysis of the level of servants on the road to the flow of traffic moving on the road.

Problem Identification

This study has the following objectives:

1. Evaluate the performance of the Jalan Perjuangan and Jalan Veteran intersection in the city of Martapura in the existing condition using the MKJI 1997 method.
2. Predict and determine in what year the intersection performance does not meet the requirements.
3. Providing alternative solutions needed to overcome the performance of intersections that do not meet the requirements.rements.

Research Benefits

The benefit of this final assignment research located at Jalan Perjuangan and Jalan Veteran Martapura city is to provide information, solutions, and advice to relevant parties and road users who need it, as well as future learning.

Problem Limitation

1. The area under review is a three-branched branch (three-arm intersection).
2. Calculation of intersection performance based on MKJI (Manual Kapasitas Jalan Indonesia) 1997.
3. The calculation time parameters on the location of the road reviewed were carried out for 12 hours.
4. Secondary data on traffic flows obtained from the relevant agencies.

Location of Intersection

The location of the three intersections of the Struggle Road and Jalan Veteran can be seen in the intersection sketch in Figure 1.1

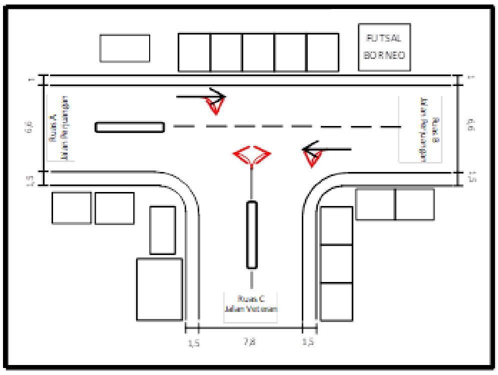

Figure 1.1 Sketch of Intersection

2. THEORETICAL BASIS

General review

Capacity on urban roads is usually determined by the ability of vehicles that are passed/released by intersections. The road network consists of roads and crossroads, which each of these components has a physical character that affects the maximum traffic flow that can be passed by the road. The capacity of a road in a highway system is the maximum number of vehicles that have enough possibilities to pass through these roads (in one or two directions) in a certain period and a general road and traffic condition (Clarkson H. Oglesby & R. Gary Hicks,1988).

Identification of problems shows the location of congestion located at intersections or certain points located along the road. Between the two intersections, the road is burdened with very large traffic so that almost no space usually results in traffic that is not smooth and frequent accidents.

Intersection Theory

Intersections can be defined as general areas where two or more roads join or intersect, including roads and roadside facilities for the movement of traffic in them (Khisty, 2005).

Basic Principles of Intersection

Intersections are the most important part of the highway because most of the efficiency, traffic capacity, speed, operating costs, travel time, security and comfort will depend on the planning of the intersection.

Road Intersection Point

The existence of a crossing on a road network is intended so that motorized vehicles, pedestrians, and non-motorized vehicles can move in different directions and at the same time. Thus at the intersection, there will be a situation that is a unique characteristic of the intersection, namely the emergence of repeated conflicts as a result of the movement (maneuver).

Main Principles of Nn Signals Intersection

1. Geometric Conditions

Sketches of geometric conditions should provide a good picture of the intersection of information about the curb, the width of the path, the shoulder, and the median. The names of the main and minor roads, the name of the city, and the direction arrows for the traffic also need to be illustrated in the sketch as information from the intersection.

2. Traffic conditions

Input data for traffic conditions consists of four parts, as described below:

1) Period and question (alternative).
2) Sketch of traffic flows describing various movements and traffic flows, currents are given in hitch/hour.

3) Traffic composition in percent (0/0).

4) The Flow of non-motorized vehicles.

3. Environmental conditions

The city size class is estimated from the total number of urban areas in million as shown in Table 2.2 below:

Ukuran Kota	**Jumlah Penduduk**
Sangat Kecil	< 0,1
Kecil	0,1-0,5
Sedang	0,5-0,1
Besar	1,0-3,0
Sangat Besar	>3,0

4. Traffic Volume / Flow

Traffic volume/flow is the number of motorized vehicles that pass through a point on the road segment unit of time and at a certain time. The volume model shape is as follows:

$$\textbf{Volume} = \sum MC + \sum LV + \sum HV \quad \textbf{.......(2.1)}$$

Average road width, number of lanes and type of intersection

The average width of the approach for the intersection and the main road can be calculated using the following formula:

$$W_{AC} = (W_A + W_C)/2 \text{ dan } \quad \text{.........(2.2)}$$

$$W_{BD} = (W_B + W_D)/2 \text{..................(2.3)}$$

The average width of the approach for all intersections is:

$$W_1 = (W_A + W_C + W_B + W_D) / \text{Jumlah lengan simpang} \text{....................(2.4)}$$

If = 0, then W1 = (WC + WB + WD) / Number of intersection arms

The number of lanes used for calculation purposes is determined from the average width of the road approach for the intersection and the main road can be seen in Table 2.3 below:

Table 2.3 Approach Width and Number of Lanes

Lebar pendekat jalan rata-rata, W_{AC}, W_{BD} (m)		Jumlah lajur (total) untuk kedua arah
$W_{BD} = (b+d/2)/2$	<5,5	2
	≥5,5	4
$W_{AC} = (a/2+c/2)/2$	<5,5	2
	≥5,5	4

Traffic Control Equipment

Traffic control equipment includes; signs, markers, removable barriers and traffic lights. The function of traffic control equipment is to ensure the safety and efficiency of intersections by separating the flow of intersecting vehicle traffic.

Cross Traffic Conflict

In the intersection area, the trajectory of the vehicle will intersect at one point of conflict. This conflict will hamper movement and is also a potential location for contact/accident. The flow of traffic affected by the conflict in an intersection has complex behavior, each movement turns (left or right) or straight each faces a different conflict and is directly related to the behavior of the movement.

Type of Movement Meeting

Basically there are four types of traffic movement meetings:

1. Crossing movement
2. Diverging movements
3. Merging / Converging Movement
4. Weaving / Weaving Movement

Traffic Performance

The following non-signalized intersection performance measures can be estimated for certain conditions with respect to geometry, environment and traffic are:

-Capacity (C)

-Degree Saturation (DS)

-Delay (D)

- Queue opportunities (QP%)

1. Basic Capacity

Table 2.5 Basic intersection type capacity

Type Intersection IT	Basic Capacity SMP/HOUR
322	2700
342	2900
324 atau 344	3200
422	2900
424 atau 444	3400

(Source MKJI, 1997)

2. Non-Significant Intersection Capacity

$$C = C_o \times F_w \times F_m \times F_{cs} \times F_{rsu} \times F_{lt} \times F_{rt} \times F_m \text{.....(2.5)}$$

Description:

C = Capacity (pcu / hour)

Co = Basic capacity value (pcu / hour)

Fw = Approximate width correction factor

Fm = The median correction factor for the main road

FCS = City size correction factor

FRSU = correction factor for road type environment, side barriers, and non-motorized vehicles

FLT = Current influence factor turns left

FRT = Current influence factor turns right

Fmi = Minor median road correction factor

3. Degree of Saturation

$$DS = Q_{SMP} / C \text{...(2.6)}$$

Description:

DS = Degree of saturation

C = Capacity (pcu / hour)

Asmp = real total current (pcu / hour),

Calculated as follows:

$$Q_{SMP} = Q_{kend} . X\ F_{smp} \text{.................................(2.7)}$$

4. Delay (D)

The delay at the intersection is the total time the average obstacle experienced by the vehicle when it passes through an intersection (Tamin. O.Z, 2000; p. 543).

Average traffic delay for all intersections (DTi)

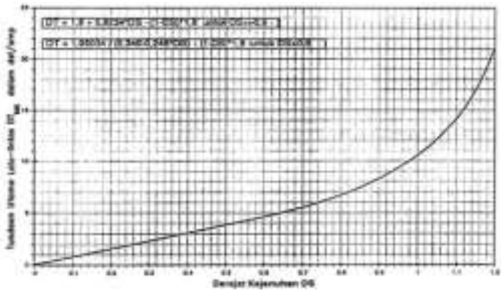

Figure 2.3 Traffic delay intersection vs. degree of saturation

Average traffic delay for major roads (DTMA)

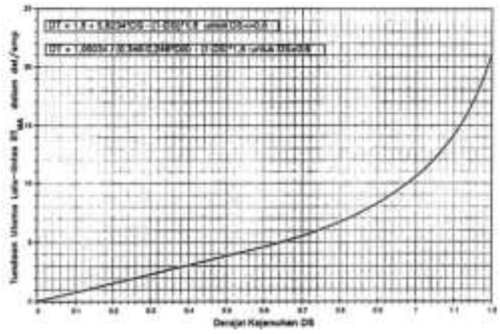

Figure 2.4 Main road traffic delays and degrees of saturation

Minor road average traffic delay (DTMI)

$$\mathbf{DTMI} = \frac{[(Qsmp\ x\ DTi) - (Qma\ x\ DTma)]}{Qmi} .. (2.12)$$

Description:

QSMP = Actual total current (pcu / hour),

QMA = The number of vehicles entering is deviates through major roads (pcu / hour)

QMI = Number of vehicles entering at the intersection by minor road (pcu / hour)

Geometric delay intersection (DG)

For DS <1.0 :

$DG = (1 - DS) \times (PT \times 6 + (1 - PT) \times 3) + DS \times 4$ ..(2.13)

For DS≥1,0 :

D = DG + DTI .... (2.15)

Description:

DS = Degree of Saturation

DG = Geometric delay intersection

PT = The ratio turns to total flow.

6 = Normal Geometric Delay for uninterrupted turning vehicles (sec/pcu)

4 = Normal geometric delay for a vehicle that is interrupted (sec/smp).

Intersection Delay

D = DG + DTI.......................................(2.16)

Description:

DG = Geometric delay intersection

DTI = Delay of intersection traffic

5. Queue opportunities (QP%)

Upper limit :

$Qpa = (47,71 \times DS) - (24,68 \times DS^2) + (56,47 \times DS)$..(2.16)

Lower limit :

$QPb = (9,02 \times DS) + (20,66 \times DS^2) + (10,49 \times DS^2)$..(2.17)

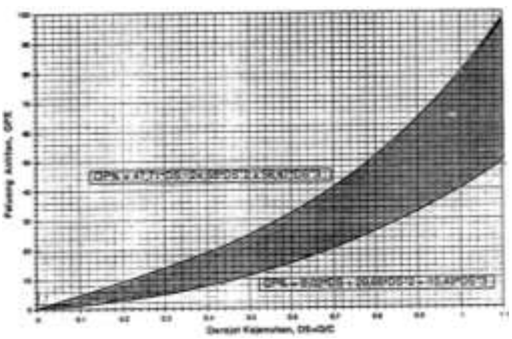

Figure 2.5 Opportunities for queues

6. Adjustment Factor Element

Approach Width Adjustment Factor

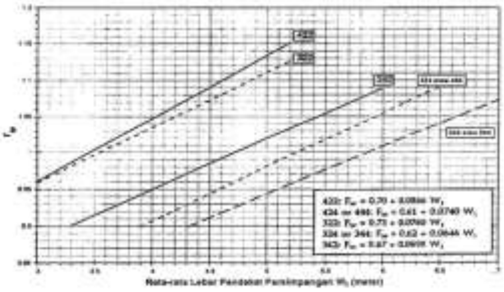

Figure 2.6 Approach width adjustment factor

The median adjustment factor for the main road

Table 2.7 The median adjustment factor for the main road

Uraian	Tipe M	Faktorpenyesuaian median (F_M)
Tidakada median jalan utama	Tidak ada	1,00
Ada median jalan utama,lebar <3m	Sempit	1,05
Ada median jalan utama,lebar3m	Lebar	1,20

City Size Adjustment Factor

Table 2.8 City size adjustment factors

Ukuran kota C	Penduduk Juta	Faktor penyesuaian ukuran kota F_{CS}
Sangatkecil	<0.1	0
Kecil	0,1-0,5	0,8
Sedang	0,5-1,0	0,9
Besar	1,0-3,0	1,0
Sangat besar	>	1,0

Adjustment Factors for Road Type, Side Obstacles and Non-Motorized Vehicles.

Factors for adjusting the type of road environment, side barriers and non-motorized vehicles, FRSU is calculated using Table 2.9 below.

Table 2.9 Table of road type environmental adjustments, side barriers, and FRS non-motorized vehicles FRS

Kelas tipe lingkungan jalan RE	Kelas hambatan samping SF	Rasio kendaraan tak bermotor pUM					
		0,00	0,05	0,10	0,15	0,20	0,25
Komersial	Tinggi	0,93	0,88	0,84	0,79	0,74	0,70
	Sedang	0,94	0,89	0,85	0,80	0,75	0,70
	Rendah	0,95	0,90	0,86	0,81	0,76	0,71
Permukima	Tinggi	0,96	0,91	0,86	0,82	0,77	0,72
	Sedang	0,97	0,92	0,87	0,82	0,77	0,73
	Rendah	0,98	0,93	0 88	0,83	0,78	0,74
Akses terbatas	tinggi/sedang/rendah	1,00	0,95	0,90	0,85	0,80	0,75

The table is based on the assumption that the effect of non-motorized vehicles on capacity is the same as light vehicles, namely emp UM = 1.0. The following equation can be used if the user has evidence that emp UM # 1.0, which may be a condition if the non-motorized vehicle is mainly in the form of a bicycle the following equation can be used:

$$FRSU = FRSU\ (PUM=0) \times (1-PUM \times empUM) \quad (2.18)$$

The slope adjustment factor (FG) is a function of the slope of the road for each approach.

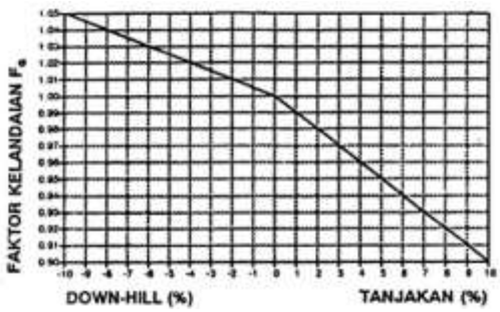

Figure 2.7 Adjustment Factors for FG Slope

Parking adjustment factor (FP) is a function of distance from the stop line until the first parked vehicle.

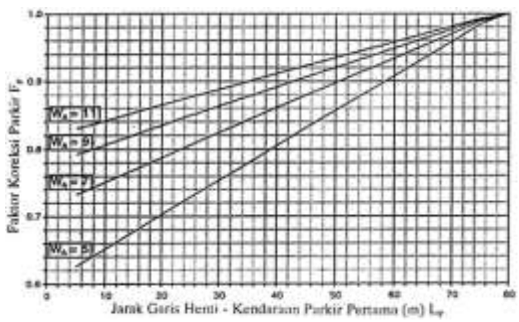

Figure 2.8 Adjustment Factors for Parking

The right turn adjustment factor (PRT) is a function of the ratio of vehicles

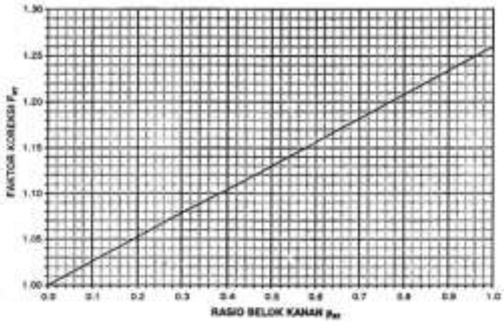

Figure 2.9 Adjustment Factors to Turn Right

The adjustment factor for the left turn is a function of the ratio of the vehicle turning left PLT

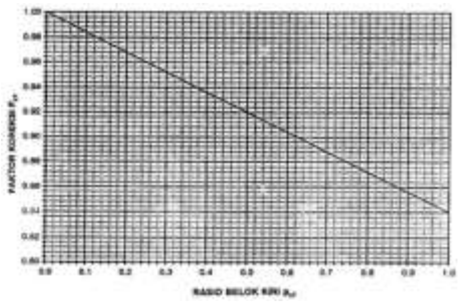

Figure 2.10 Adjustment Factors for Turning Left

7. The behavior of the driver of the vehicle at the intersection

A driver's behavior is influenced by external factors in the form of his surroundings, weather conditions, areas of view, information and also influenced by his own emotions such as impatience.

8. Service Level

Table 2.10 Traffic Service Level Index

Tingkat Pelayanan	Tundaan per Kendaraan
A	≤5,0
B	5,1 – 15,0
C	15,1 – 25,0
D	25,1 – 40,0
E	40,1 – 60,0
F	>60

3. RESEARCH METHODS

Subject Determination Method

The purpose of determining this subject is a variable that can be targeted in the study. Some of these variables are intersection geometric conditions, environmental conditions, traffic settings, traffic volume, number of approaches, signal phase, cycle time, vehicle clarification and observation period.

Library Study Method

A literature study is needed as a reference for research after the subject is determined. Library studies are also the theoretical foundation for research that refers to books, opinions, and theories related to research.

Preliminary Survey and Site Selection

Observe several existing intersections visually (geometric conditions, vehicle composition, and road facilities), and finally select the three intersections of the Jalan Perjuangan, and Jalan Veteran Martapura city because problems often occur in traffic intersections.

Data collection

Primary data or data taken from the field include geometric conditions, environmental conditions, side barriers, traffic volume. Secondary data includes the number of residents in Martapura City, data on growth in the number of vehicles.

Research Tools

In data collection several tools are used to support the implementation of the research as follows;

a. Stopwatch

   Used as a timekeeper for traffic delays on the main road.

b. Hand counter or enumerator

   Used to calculate the number of vehicles that pass through the intersection based on the type of vehicle on each arm per period.

c. Meter roll

   Used as a tool to measure the width of the road on each arm in a cross.

d. Forms - research forms and stationery

As a recording device the results of primary data that existed at the time of the observation took place.

Data Analysis for Unsignaled Intersection with MKJI 1997

Data analysis for Non-Signalized Intersection using the Manual Kapasitas Jalan Indonesia (MKJI, 1997) aims to determine whether performance is still feasible or not. If the results of the analysis show that the intersection performance is no longer feasible, it is necessary to solve the problem.

Determining Intersection Management and Signal Phase

Management is made based on the results of traffic light planning and the effect of signals on capacity, degree of saturation, traffic behavior (queue length, stop number, ratio of stop and delay vehicles).

Research Flow Chart

Research flow chat is used as the basis for conducting research and to make it easier in the study. The flow chart can be seen in Figure 3.1 below.

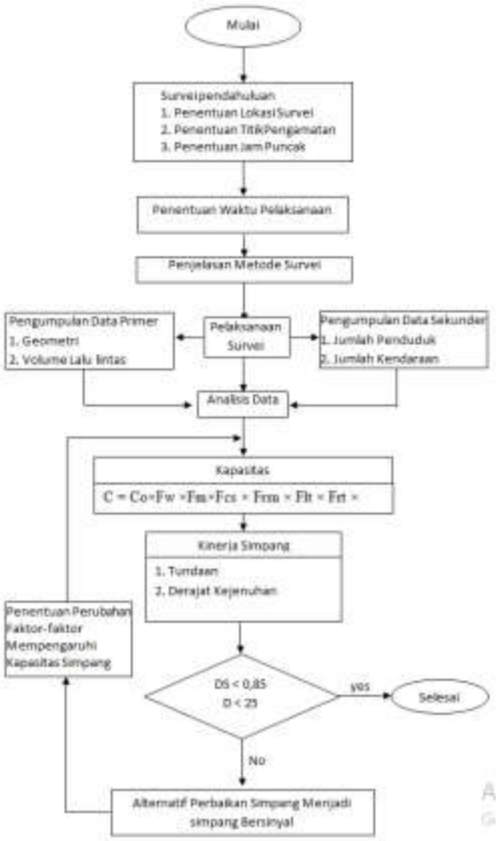

Figure 3.1 Research Flow Chart

4. RESULTS AND DISCUSSION

Data

The data used in this study are based on the results of a survey that has been conducted in the field on December 6, 2018. Traffic data is obtained from the results of field volume and measurement surveys, then grouped in geometric data and traffic data by dividing in the composition of flows/vehicle equivalent type, data has been entered into the form table that has been exemplified by MKJI 1997.

1. Geometric Data

The research location at the three intersections of Jl.Perjuangan - Jl.Veteran for the condition of each road segment approach has a different geometric for the segment of the major and minor legs. The type of environment of the road at this intersection is visually commercial (commercial) because it is an environment consisting of shops, restaurants, and access to the Darul Hijrah Islamic Boarding School, etc.

2. Residents of Martapura City

According to data obtained at the Central Bureau of Statistics, Kab. Banjar, the temporary number of residents of Martapura City in 2017 was 115,828 people, the average population growth rate for 7 years (2010-2017) was obtained = 1.82%. So, the number of residents in the current existing condition of 2018 is

Population. = 115.828 x (1,82/100)
= 117.936

3. Traffic Conditions

Observations made at the intersection of Jalan Perjuangan - Jalan Veteran in the city of Martapura obtained the busiest traffic at 07.05-08.05 Wita.

Data analysis

1. Traffic Flow Analysis (Q) in Existing Conditions

The Flow of Jalan Perjuangan and Jalan Veteran at three intersections in the morning at 07.05-0.05 in the existing conditions as follows:

Table 4.6 Calculation of comparison of main and minor lines in existing conditions.

Q_{MI}	= 428,6 +197,5	=	626,1 smp/jam
Q_{MA}	= 210,5 + 546 +102,5 +280,8	=	1139,8 smp/jam
Q_{TOT}	= 626,1 + 1139,8	=	1765,9 smp/jam
Q_{TOT}	= 1011 + 505 + 793 + 391 + 195 + 365	=	3260 knd/jam
Q_{UM}	= 4 + 1 + 4 + 2 + 2 + 1	=	14 knd/jam
Q_{LT}	= 197,5 + 546	=	743,5 smp/jam
Q_{RT}	= 2 8 0 , 8 + 428,6	=	709,4 smp/jam
P_{MI}	= Q_{MI} / Q_{TOT} =626,1 / 1765,9	=	0.3545
ρ_{LT}	= Q_{LT} / Q_{TOT} = 743,5 / 1765,9	=	0.4210
ρ_{RT}	= Q_{RT} / Q_{TOT} = 709,4 / 1765,9	=	0.4017
ρ_{UM}	= Q_{UM} / Q_{TOT} = 1 4 / 1765,9	=	0.0079

Basic Capacity (Co)

Based on Table 2.5 Basic intersection type capacity, base capacity value (Co) according to intersection type = 2700

Adaptive Width Adjustment Factor (Fw)

The approximate average width of the intersection type 322 is obtained:

Fw = 0,73+ (0,0760 x W1)

Fw = 0,73+ (0.0760 x 3,5)

Fw = 0,996

Main Street Median Adjustment Factor (FM)

Based on Table 2.7 Main Street Median Adjustment Factor obtained FM value = 1.05

City Size Adjustment Factor (FCS)

The number of population of Martapura City obtained from the source is Banjar Regency Central Statistics of 2017 amounting to 118.075 people. Therefore, based on Table 2.8 Factor Adjustment City Size Obtained FCS value = 0.88

Road Type Type Adjustment Factors, Side and Non-Motorized Obstructions (FRSU)

ρUM = 0,007993605 by means of interpolation, obtained:

FRSU=((0,93 - 0,88) x (0,050,007993605) / (0,05-0,00)) + 0,90

FRSU = 0,92600

Left Turn Adjustment Factor (FLT)

See figure 2.10 Left Turn Adjustment Factor (FLT) With a ratio of ρLT = 0.418236839

Obtained FLT = 1.51786

Turn Right Adjustment Factor (FRT)

$FRT = 1,09-0,922.P_{RT}$

$= 1,09-0,922\ (0,401050588)$

$= 0,71961$

Adjustment Factor for Intersection Flow Ratio (FMI)

$FMI = 1,19 \times P_{MI}^2 - 1,19 \times P_{MI} + 1,19$

$= 1,19 \times (0,3545)^2 - 1,19 \times 0, 3545 + 1,19$

$= 0,91768$

Then based on equation 2.5 obtained:

C = 2306,3541 smp/jam

Degree of Saturation in Existing Conditions

Known: QTOT = 1765.9 pcu/hour.

Based on equation 2.6 obtained values:

DS = QTOT / C

DS = 1765,9 / 2306, 3541

DS = 0,7657

Intersection Traffic Delay (Dti)

$Dti = 1,0504/(0,2742-0,204 \times DS) - (1- DS)^2$

$=1,0504/(0,2742-0,204 \times 0,7657)-(1-0,7657)^2$

= 8,4443 pcu/hour

Major Traffic Delays (DTma)

$DTma=1,05034/(0,346-0,246 \times DS)-(1-DS)^{1,8}$

$=1,05034/(0,346-0,246 \times 0,7657)-(1-0,7657)^{1,8}$

= 6,2408 pcu/hour

Minor Road Traffic Delays (DTmi)

DT_{MI}=(Q_{TOT} xDti-Q_{MA}xDT_{MA})/Q_{MI}

=(1765,9 x 8,4443–1139,8 x 6,2408) / 626,1

= 12,4556 pcu/hour

Intersection Geometric Delay (DG)

DG = (1 – DS) x (pT x 6 + (1 - pT) x 3) + DS x 4

= (1 – 0,7657) x (0,8227 x 6 + (1 - 0,8227) x 3) + 0,7657 x 4

= 4,2609 pcu/hour

Intersection Delay (D)

D = DG + DT_i

= 44,2609 + 8,4443

= 12,7052 pcu/hour

Queue Opportunity (QP%)

QP% = 47,71 x DS – 24,68 x DS^2 + 56,47 x DS^3

= 47,71x0,7657 – 24,68 x 0, 7657^2 +56,47 x 0, 7657^3

= 47,4091 %

Service Level

The level of service taken is based on Peraturan Mentri Perhubungan No 96 Tahun 2015.

The results of the calculation of the comparison of the main vs minor lines in existing conditions can be seen in Table 4.8 as follows:

Table 4.8 The results of the calculation of the comparison of the main vs minor lines in the Existing condition

WAKTU	07.05-08.05	07.30-08.10	11.15-12.15	11.30-12.30	16.00-17.00	16.05-17.05
QMI	626.1	628.1	655.2	656.9	675	673
QMA	1139.8	1129.8	744.7	747.3	816.5	822.5
QTOT (SMP/JAM)	1765.9	1757.9	1399.9	1404.2	1491.5	1495.5
QTOT (KEND/JAM)	3260	3239	2488	2519	2601	2709
QUM	14	15	5	5	5	5
QLT	743.5	747	595.8	588	591.5	597
QRT	788.4	698.4	592.5	586.4	645.5	642.5
PMI	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PLT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PRT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.4296222
PUM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The results of the calculation of the Capacity and Coefficient of the Supporting Factors for Intersection can be seen in Table 4.9 as follows:

Table 4.9 Calculation of Capacity and Coefficient of Supporting Factors for Intersection

WAKTU	07.05-08.05	07.10-08.10	11.15-12.15	11.30-12.30	16.00-17.00	16.05-17.05
Kapasitas Dasar (Co)	2700	2700	2700	2700	2700	2700
Lebar Pendekat (Fw)	0.996	0.996	0.996	0.996	0.996	0.996
Faktor Median (Fm)	1.05	1.05	1.05	1.05	1.05	1.05
Faktor Kota (Fcs)	0.88	0.88	0.88	0.88	0.88	0.88
Faktor Tipe LJ/RSU/TB (Frsu)	0.92600	0.92600	0.92600	0.92600	0.92600	0.92600
Faktor Belok Kiri (Flt)	1.51784	1.52415	1.52522	1.51438	1.47846	1.48271
Faktor Belok Kanan (Frt)	0.72861	0.72317	[illegible]	[illegible]	[illegible]	[illegible]
Faktor Rasio Simpang (Fmi)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The results of the calculation of Traffic Flow Conditions on Existing Conditions can be seen in Table 4.10 as follows:

Table 4.10 Calculation of Traffic Flow Conditions on Existing Conditions

WAKTU	07.05-08.05	07.10-08.10	11.15-12.15	11.30-12.30	16.00-17.00	16.05-17.05
C	2306.35	2324.97	2194.79	2189.00	2104.24	2119.84
Q	1765.90	1757.90	1399.90	1404.20	1491.50	1495.50
DS	0.77	0.76	0.64	0.64	0.71	0.71
DT1	8.44	8.28	6.57	6.62	7.53	7.48
DTMA	6.24	6.13	4.90	4.94	5.60	5.56
DTMI	12.46	12.15	8.47	8.53	9.87	9.83
DG	4.26	4.27	4.45	4.43	4.33	4.34
D	12.71	12.55	11.02	11.05	11.87	11.82
QP%	47.41	46.37	35.04	35.36	41.53	41.20
ITP	B	B	B	B	B	B
Tundaan Rata-rata (DS)			11.864	Nilai ITP Rata - rata		B

Based on the Traffic Service Index Table, the value of Delay (D) is 12.70, the Degree of Saturation (DS) is 0.76 and the Queue Opportunity (QP) is 47.40, then the value or level of intersection is obtained in Class C (07.05 - 08.05).

Forecasting Condition Analysis

The percentage of traffic growth can be calculated using the formula:

$$\mathbf{Pn = Po\ (1+i)^n} \text{................................}\mathbf{(4.1)}$$

Description :

Pn = Total Vehicle Total Flow in n Year

Po = Total Total Vehicle Flow in the Early Year

n = Number of years that will be a number of predictions

i = Average traffic growth per year

The average value of traffic growth in Banjar Regency is 6.39% per year.

Traffic Flow Plan

07.05 – 08.05

Po = 1765,9 pcu/hour

n = 6 year

i = 6,39 %

Pn = 1765,9 $(1+ 0{,}0639)^6$

= 2560,56 pcu/hour

The ratio increases when the prediction is 6 years = 2560,56 / 1765,9= 1,45

Calculation of predicted traffic flow analysis for the next 6 years can be seen in Table 4.11 below:

Table 4.11 Analysis of 6 Year Predicted Traffic Flow

WAKTU	07.05-08.05	07.10-08.10	11.15-12.15	11.30-12.30	16.00-17.00	16.05-17.05
C	2306.35	2304.97	2194.79	2189.00	2104.24	2119.84
Q	2560.56	2548.96	2029.86	2086.09	2162.68	2168.48
DS	1.11	1.10	0.92	0.93	1.03	1.02
DT1	22.34	21.06	12.16	12.33	16.38	16.13
DTMA	14.61	13.94	8.73	8.84	11.32	11.17
DTMI	36.41	33.83	27.74	28.15	38.80	38.31
DG	3.88	3.89	4.09	4.08	3.97	3.97
D	26.21	24.96	16.25	16.41	20.35	20.10
QP%	99.82	97.06	67.69	68.47	84.27	83.43
ITP	D	C	C	C	C	C
Tundaan Rata-rata (DS)			20.939	Nilai ITP Rata - rata		C

Table 4.12 Results of Analysis of Traffic Prediction Calculation for 6 Years to Come (The Year 2024).

No.	Deskripsi Masalah	Peluang Antrian	Derajat Kejenuhan	Tundaan Rata-Rata	ITP
1	Existing	47.4	0.76	12.7	B
2	Forecasting Tahun 1	52.65	0.81	13.52	B
3	Forecasting Tahun 2	59.38	0.87	14.65	B
4	Forecasting Tahun 3	66.8	0.92	16.06	C
5	Forecasting Tahun 4	76.21	0.98	18.16	C
6	Forecasting Tahun 5	86.68	1.04	21.1	C
7	Forecasting Tahun 6	99.8	1.11	26.21	D

Can be seen from the table above the traffic conditions after predicting the next 6 years the number of delays entering ITP class D, which means that the traffic volume is approaching the capacity of the road.

Analysis of calculation of intersections with traffic lights

To analyze the data is done by designing traffic lights at intersections without geometric changes, then by performing a signalized intersection calculation using an alternative 3-phase and 2-phase

Table 4.13 Vehicle Distribution (vehicle/hour)

TIPE KENDARAAN	PENDEKAT	
	Perjuangan B	
	ST	LT
LV	41	109
HV	0	0
MC	487	1256
Total	528	1365

The vehicle distribution data above is converted to units of SMP / hour by using the formula:

$$Q = LV(1) + HV(1,3) + MC(0,2)$$

$$Q = 150(1) + 0(1,3) + 1743(0,2)$$

$$Q = 449 \text{ smp/jam}$$

From the calculations in the Excel program, LHR data can be seen in Table 4.14 below:

Table 4.14 Turning Vehicle Ratio

Arah Pendekat	Pltor	Plt	Prt
S	0	0,317	0,683
T	0	0,723	0
B	0	0	0,704

1. Signal usage

Determination of signal phase. In this calculation try using 3 phases and 2 phases. Interarrival time and time lost. Based on the normal value of the time between green based on the intersection size obtained 4 seconds/phase with an average width of the road between 6-9 m. Calculating red lights can all use Formula 2.20 by knowing the value of LEV, LAV from the example in Figure 2.14.

2. Determination of the signal time

Type of approach

Based on the provisions for determining the type of approach for the 3 phase type P approach for approach codes B and T and O for the approach code S, while the two phases use the approach type O in all the approach codes.

Basic saturated current

For the type of P approach in 2 phases with the approach code T:

S_O = 600× We

= 600 x 3,30

= 1980 smp/hour.

Adjustment Factor

- The factor of city size adjustment (Fcs) is 0.83 with the city population in the range of 0.1-0.5 million.
- Factors for adjusting side barriers

  Based on the adjustment factor for the type of road environment, the value of the protected and resisted phase type is 0.925 with the commercial road environment, medium side resistance and the ratio of motorized vehicles 0.009.
- The adjustment factor for slope

  Based on Figure 2.19 the adjustment factor for slope (FG) results in 1 with increments of 0.
- Parking adjustment factor

  Parking is considered high Fp = 1,00
- Adjustment factor turns right (FRT) on the B approach type for 2 phases:

  F_{RT} = 1,0+ P_{RT} x 0,26

  = 1,0+ 0,00 x 0,26

  = 1
- Left turn adjustment (FLT) factor for T approach type for 2 phases:

  F_{LT} = 1,0 - P_{LT}×0,16

  = 1,0 – 0,723 ×0,16

  = 0,88

Based on the above calculation, the saturated current value is calculated using the formula below:

$S = S_0 \times F_{CS} \times F_{SF} \times F_G \times F_P \times F_{RT} \times F_{LT}$

$= 1980 \times 0,83 \times 0.95 \times 1 \times 1 \times 1 \times 0,88$

= 1381 smp/jam.

Current / saturation current ratio

- Enter the traffic flow of each approach (Q)

  Based on the results of previous calculations, the Q results of each T approach is 535 pcu / hour, S is 445 pcu / hour and B is 280 pcu / hour.
- Calculate the Current Ratio (FR) of each approach

  FR = Q / S

  = 535 / 1381

  = 0,388
- Calculate the intersection ratio (IFR) in all types of approach for phase 2:

  IFR = $\sum (FR_{crit})$

  = 0,216 + 0,388 + 0,179

  = 0,603
- Calculate Phase Ratio (PR)

  PR = FR_{crit}/IFR

  = 0,388/0,603

  = 0,643

Cycle time and green time

- Pre-Adjustment Cycle Time (cua.) In the T-type approach for phase 2:

  c_{ua} = (1,5 × LTI + 5) / (1 - IFR)

  = (1,5 × 10 + 5) / (1 -0,603)

  = 50,4

- Green Time (g) in T approach code for 2 phases:

  g_I = $(c_{ua}$- LTI) × PR_i

  = (50,4 - 10) × 0,643

  = 26
- Adjusted cycle time (c) for phase 2:

  c = Total g + LTI

  = 40 + 10

  = 50

3. Capacity

Capacity Calculation

$$C = S \text{ x } g/c$$
$$= 1381 \text{ x } (26/50)$$
$$= 711 \text{ smp/jam}$$

Calculation of Degrees of Saturation

$$DS = Q/C$$
$$= 535 / 711$$
$$= 0{,}752$$

Calculation of Performance Levels

In calculating the level of performance, the most decisive is the traffic flow (Q), Saturation degree (DS) and Signal Time obtained from previous calculations and from the data obtained.

4. Traffic Behavior

Queue Length

Use the calculation of the degree of saturation to calculate the number of junior (NQ1) queues left over from the previous green phase in the example below with the T phase 2 for the approach code.

$$NQ_1 = 0{,}25 \times C \times \left[(DS-1) + \sqrt{(DS-1)^2 + \frac{8 \times (DS-0{,}5)}{C}}\right]$$
$$= 0{,}25 \times 711 \times \left[(0{,}75-1) + \sqrt{(0{,}75-1)^2 + \frac{8 \times (0{,}75-0{,}5)}{711}}\right]$$
$$= 1$$

Calculates the number of SMP queues that come during the red phase (NQ2).

$$NQ_2 = c \text{ x } \frac{1-GR}{1-GRxDS} x \frac{Q}{3600}$$
$$= 50 \text{ x } \frac{1-0{,}515}{1-0{,}515x0{,}75} x \frac{535}{3600}$$
$$= 5{,}9$$

Getting the number of vehicles in line (NQ).

$$NQ = NQ1 + NQ2$$
$$= 1 + 5{,}9$$
$$= 6{,}9$$

Calculate the queue length (QL)

$$QL = \frac{NQmax\ x\ 20}{Wenter}$$

$$= \frac{12\ x\ 20}{3{,}3}$$

= 75

Vehicle calculation stopped

Calculate stop numbers (NS)

$$NS = 0{,}9\ x\ \frac{NQ}{Q\ x\ c}\ x\ 3600$$

$$= 0{,}9\ \frac{6{,}9}{535\ x\ 50}\ x\ 3600$$

= 0,834

Calculates the number of stopped vehicles (NSV) for each approach

N_{SV} = Q x NS

= 535 x 0,834

= 447

Time Delay Calculation

Calculate the average traffic delay (DT).

$$DT = c\ x\ A + \frac{NQ1\ x\ 3600}{C}$$

$$= 50\ x\ 0{,}5 + \frac{1{,}1\ x\ 3600}{711}$$

= 14,8 sec/smp

Specifies the average geometry delay.

$DG_j = (1 - P_{SV}) \times P_T \times 6 + (P_{SV} \times 4)$

$= (1 - 0{,}834) \times 0{,}723 \times 6 + (0{,}834 \times 4)$

= 4,1 sec/smp

Calculation of time of average delay (D1)

$$D_1 = \frac{\sum(Q\ x\ D)}{Qtot}$$

$$= \frac{25135}{1260}$$

= 19,94 sec/smp

5. Service level

Table 4.15 Design Comparison of 2 phases and 3 phases of Intersection Jl. Perjuangan - Jl. Veteran

Tipe Fase	Persyaratan	Forecasting (Thn ke 6)	2 Fase	3 Fase
Derajat Kejenuhan (DS)	< 0,85	1,11	0,74	0,84
Tundaan Rata-Rata (D)	D < 25	26,2	18,33	45,52
ITP	< D	D	C	E

The results of phase 2 type analysis show the proportion of delay values and the best degree of saturation of the two analysis results.

6. Traffic diagram

Based on the results of the above calculations, it is obtained a picture of the cycle time of the conditions for red, yellow and green lights according to the specified phase. As can be seen in Figure 4.6 and Figure 4.7 below:

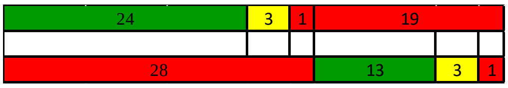

Figure 4.6 2 Phase Condition Cycle Time

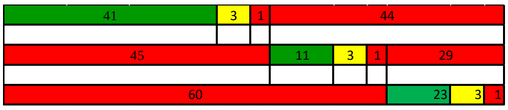

Figure 4.7 3 Phase Condition Cycle Time

5. CLOSING

Conclusion

Based on the results of the analysis it can be concluded the extent of the performance of the current intersection without signaling and the form of intersection management when applied with signal intersections.

1. At the intersection Jl. Perjuangan - Jl. Veteran, Martapura City, Banjar Regency, on a unsignal condition, obtained the degree of saturation (DS) of 0.76 and delay (D) of all intersections of 12.7 seconds / pcu with the Service Level Index at B, which indicated that at the intersection still had good conditions. So from that do forecasting analysis for the coming year.

2. After doing forecasting analysis, in the 6th year, the intersection condition has reached a bad condition with a degree of saturation (DS) of 1.11 and delay (D) in all intersections of 26.21 seconds / pcu with a Service Level Index at D.
3. By analyzing the form rather than intersection management if it is applied with a signalized intersection then an alternative proposal for 2 phases and 3 phases is given which results in the phase 2 type analysis showing the proportion of the delay value and the best degree of saturation from the two analysis results with the Degree of Saturation (DS) 0.74 and Delay (D) 18.33 seconds / pcu with the level of intersection service being C.

Suggestion

1. The need to improve the performance of the original bad intersection to make it better.
2. Complete signs around intersections, such as stop-stop signs and road markings.
3. Reducing and limiting side barriers around intersections, because commercial land use will interfere with the smoothness of traffic.
4. The need to apply the best proposals based on the results of the analysis to improve the performance of the intersection.
5. The existing intersection can adjust to the analysis that I use and make an uncontrolled intersection converted into a Controlled signal.

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