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ANALYSIS OF T JUNCTION ON PRAMUKA STREET – DHARMA BUDI STREET, BANJARMASIN CITY

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ABSTRACT

The growth of land transportation is increasing from year to year, especially in the city of Banjarmasin. The T junction of Jalan Pramuka – Jalan Dharma Budi is an unsignalized intersection in Banjarmasin. The flow of deviated traffic is high, and there is the potential for congestion and conflict between road users. Therefore, it is necessary to analyze to improve the level of service at the intersection and make it optimal. The analysis calculation refers to the 1997 Indonesian Road Capacity Manual and is assisted by applying of the Indonesian Road Capacity Analysis (KAJI) application. The data needed for this analysis are primary data obtained from a field survey conducted for 15 hours from 06.00 – 21.00 WITA, and secondary data in the form of population growth data in Banjarmasin. Based on the analysis and calculation of the intersection in existing conditions, the degree of saturation (DS) is 1.205, the queue probability is 90%, the intersection delay (D) is 41.77 sec/pcu, the service level index (ITP) is included in the "E" level. The performance of the Jalan Pramuka – Jalan Dharma Budi intersection can be improved by widening the geometric, increasing the median, and at the 3-phase signalized intersection. The value of the degree of saturation (DS) has improved to 0.802; the delay value is 17.02 sec/pcu with a cycle time of 48 seconds so that the service level index (ITP) value of "C" is obtained.

Keywords: Signalized Intersection, Unsignalized Intersection, Service Level

I INTRODUCTION

Land transport infrastructure, especially roads, has the impact on socio-economic development that improves people's living standards. Problems in land transportation such as traffic jams, air pollution, accidents, queues, and delays are often encountered

with small and large volumes. This problem is common in several cities in Indonesia, including Banjarmasin.

The city of Banjarmasin is the capital city in southern Kalimantan, which is the link between provinces. Thus indirectly increasing the traffic flow in Banjarmasin

and proper traffic management is needed to regulate traffic flow, especially in the T-junction area.

The junction of Jalan Dharma Budi-Jalan Pramuka can cause accidents, queues, and traffic jams, due to the very large traffic volume, especially during rush hour with various types of vehicles. The traffic that goes through the intersection is traffic to Jalan Ahmad Yani and Jalan Veteran. Kind of road surroundings around the T junction Jalan Dharma Budi-Jalan Pramuka is a public area that can be seen from the presence of campuses, workshops, places to eat and shops. Based on the above problems, it is necessary to analyze the characteristics and performance of the intersection.

II LITERATURE REVIEW

Transportation is the use of vehicles or other means of people or goods to and from geographically separated places. Generally speaking, it can be concluded that transportation is the activity of moving something (person or cargo) from one place to another, with or without facilities. (Steenbrink, 1974).

At the unsignalized intersection, data is needed to determine its performance to analyze it.

$$= \frac{Jl.Lv.SmpLv + Jl.HV.SmpHv + Jl.Mc.SmpMc}{jam} = Smp/jam$$

Lv (MP)= Light Vehicle

HV= Heavy Vehicle

Mc= Motorcycle

SMP= Passenger Car Unit

The capacity is the total capacity of the intersection for a pre-determined condition (condition), the capacity (pcs/hour) is determined by the type intersection as in table 4. (Helwiyah et al. 2016).

Table 4. Basic Capacity (Co)

Junction type	Co base capacity (pcs/hour)
322	2700
342	3900
324 or 344	3200
422	2900
424 or 444	3400

Source: MKJI (1997)

$$LOS = \frac{V}{C}$$

According, to MKJI 1997, capacity refers to the maximum business flux that can be maintained (fixed) on a part of the road in terms of vehicles/hour or smp/hour under certain conditions. (Intari, 2019)

C = C0 x FW x FM x FCS x FRSU x FLT x FRT x FMI

Where:

C= Capacity

Co= Basic capacity (pcu/hour)

FCw= Road width adjustment factor

FCSP = Directional division adaption factor only for concentratedroads

FCSF = Side and shoulder resistance adjustment factor

FC_{CS} = City size adjustment factor

DS = Qtot / C

Where :

DS= Degree of Saturation

Q_{tot} = Actual Total Current (pcu/hour).

C = Capacity (pcu/hour).

a. Intersection Traffic Delay (DTI)

   DS 0,6:

   DT = 2+ (8.2078 x DS)

Meanwhile, DS 0.6:

DT =(1.0504 / 0.2742−(0.2042 x DS))x [(1 DS) x 2]

b. Main Road Traffic Delay (DTMA)

For DS <= 0.6

DT = 1.8 + 5.8234 x DS – (1 – DS) x 1.8

For DS > 0.6

DT = 1.0504 / (0.346 – (0.246 x DS) – (1 – DS) x 1.8

Where:

DT = Intersection Traffic Delay

DS = Degree of Saturation

c. Minor Road Traffic Delay (DTMT)

DTMI = (Qtot x DT1 – QMA x DTMA) QMI

Where:

Q_{TOT} = total flow of motorized vehicles (pcu/hour).

DTOT = Total average delay (sec/hour).

QMA = Main road traffic flow (pcu/hour).

D_{MA} = Average delay of main roads (sec/pcu).

QM1 = Minor road traffic flow (pcu/hour).

d. Intersection Geometric Delay (DG)

The geometric detention of the crossroad is the average geometric detention of all motorized vehicles entering the crossroad.

For DS < 1.0

DG = (1 – DS) x (PT x 6 + (1 – PT) x 3) + DS x 4 (sec/pcu)

For DS 1.0: DG = 4

Where:

DG= Intersection Geometric Delay

DS= Degree of Saturation

PT = Total Turn Ratio

Opportunity upper limit:

QP% = (47.71 x DS) – (24.68 x DS2) + (56.47 x DS2)

Opportunity lower limit:

QP% = (9.02 x DS) + (20.66 x DS2) + (10.49 x DS2)

Description;

QP = Queue Chance

DS = Degree of Saturation

According to the 1997 MKJI description, the general reasons for using traffic lights are as follows:

a. I am Avoiding business at corners caused by business conflicts, and icing that certain capacity indeed during maximum business or peak hours.
b. Provide opportunities for vehicles and pedestrians from (small) junctions to bypass the main road.
c. They are reducing the number of accidents due to collisions.

$$\frac{Jl.Lv.SmpLv + Jl.HV.SmpHv + Jl.Mc.SmpMc}{jam} = Smp/jam$$

Lv = Light Vehicle

HV= Heavy Vehicle

Mc= Motorcycle

SMP= Passenger Car Unit

Based on the guidelines of the 1997 Indonesian Road Capacity Manual, for operational or planning analysis, it is recommended to calculate the inter-green time (IG) and lost time (LTI) in detail. (Bawangun, 2015) Values between greens can be seen in the table 5.

Table 5. A Normal Values Between Greens

Junction size	Average road width	Normal value between green
Small	6 – 9 meters	4 seconds/phase
Currently	10 – 14 meters	5 seconds/phase
big	>15 meters	>6 seconds/phase

Source: MKJI (1997)

The critical conflict in each phase (i) is the point that produces the red time, which can be seen in Figure 1.

All red i = $\left[\frac{LEV+IEV}{VEV} - \frac{LAV}{VAV}\right]_{max}$

Where:

LEV, LAV = distance from the stop line to the point of conflict for each departing and arriving vehicle (m)

IEV = length of the departing vehicle (m)

VEV, VAV = respective speed for departing and arriving vehicles (m/s)

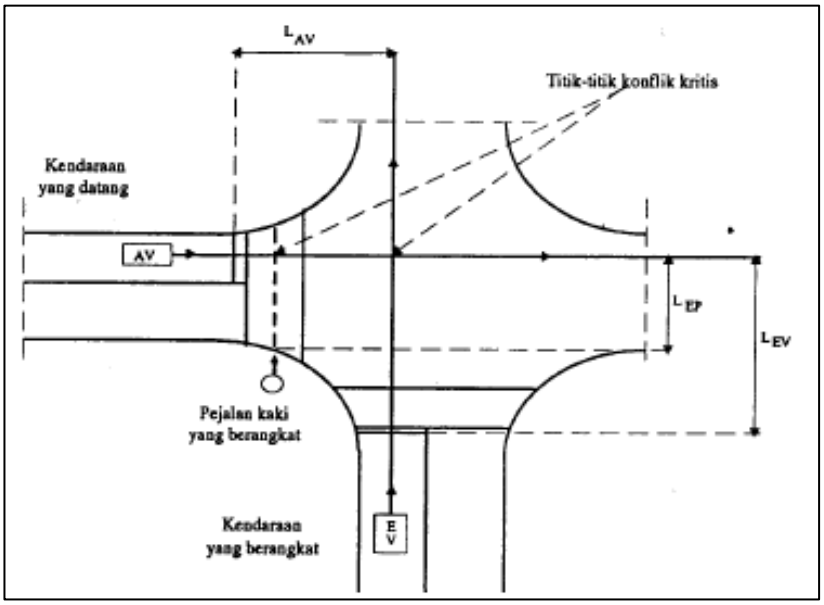


Figure 1. Conflict Point and Departure Distance

I.1 Signal Timing

a. Selection of Approach Type

Determination of the type of approach with a protected (P) or counter (O) type based on the theory in Figure 2.

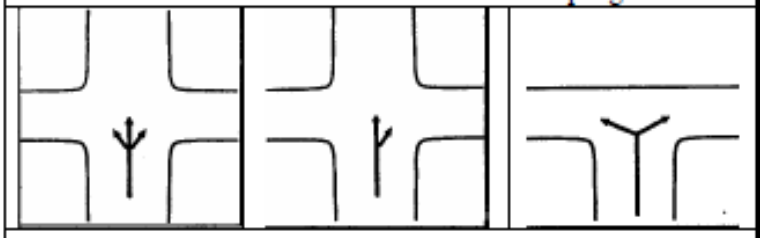
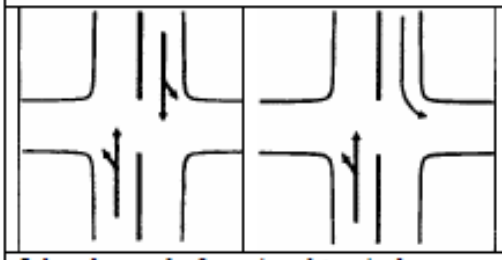
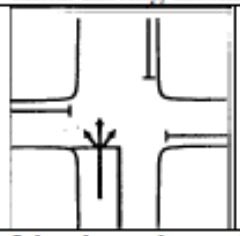
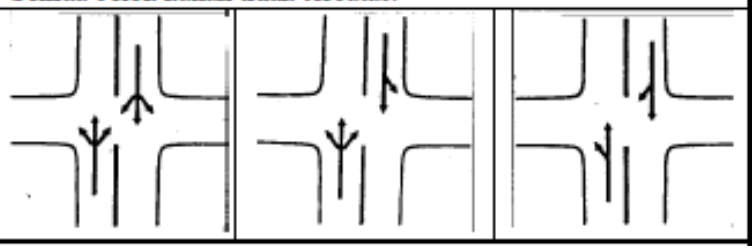
Tipe pendekat	Keterangan	Cotoh pola-pola pendekatan
Terlindung P	Arus berangkat tanpa konflik dengan lalu lintas dari arah berlawanan	Jalan satu arah; Jalan satu arah; Simpang T 
		Jalan dua arah, gerakan belok kanan terbatas 
		Jalan dua arah, fase sinyal terpisah untuk masing-masing arah. 
Terlawan O	Arus berangkat dengan konflik dengan lalu lintas dari arah berlawanan	Jalan dua arah, arus berangkat dari arah-arah berlawanan dalam fase yang sama. Semua belok kanan tidak terbatas. 

Figure 2. Determination of Approach Type

b. Saturated Current (S)

The saturation current is expressed as the saturation current (So) which is the saturated current at standard conditions, which an adjustment factor (F). (Sukirman, 1994).

$S = S_0 \times FCS \times FSF \times FG \times FP \times FRT \times FLT$

Where:

S0 = Basic saturation current

FCS= City size adjustment factor

FSF = Side resistance adjustment factor

FG = slope adjustment factor

FP = Parking adjustment factor

FRT = Right turn adjustment factor

FLT= Left turn adjustment factor

The volume for each arm of the signalized crossroad is arranged by the formula below.

C = S xg / c

Where:

C = Capacity (pcu/hour)

g = green time (seconds)

$Pn= Po.(1 + i)^n$

Description :

Pn: Traffic Flow Plan Year

Po: Traffic Flow this Year

i: Traffic Flow Growth Factor

n: Plan Year

The ranking of road service (LOS) in road planning is represented by letters A to F; each letter represents the ranking of service from the stylish to the worst (Permen hub No. 14 2006). The service level index can be seen in table 8 and table 9.

Table 8. Service Level Index by Degree of Saturation

Service Level	Delay Per vehicle (seconds)	Degree of Saturation
A	5.0	0.35
B	5.1 – 15.0	0.54
C	15.1 – 25.0	0.77
D	25.1 – 40.0	0.93
E	40.1 – 60.0	1.0
F	> 60.0	> 1.0

Source: Permenhub. No. 14 of 2006

Table 9. "STOP" Priority Intersection

Service Level	Average stop delay (driving seconds)
A	<5
B	5-10
C	11-20
D	21-30
E	31-45
F	>45

Source: Permenhub. No. 14 of 2006

III METHODS

The research location is located at the intersection of three Jalan Pramuka – Jalan Dharma Budi, East Banjarmasin District, Banjarmasin City, South Kalimantan can be seen in Figure 3.

Figure 3. Research Locations

The data needed for analysis are primary data and secondary data. Data analysis for unsignalized corners using reference to the Indonesian Road Capacity Manual (MKJI, 1997) with the KAJI operation (Indonesian Road Capacity).

IV RESULTS AND DISCUSSION

Based on observations and measurements in the field, the main road Jalan Pramuka has a width of 9.5 meters, and the auxiliary road, Dharma Budi Street has a width of 5.2 meters, as shown in Figure 4.

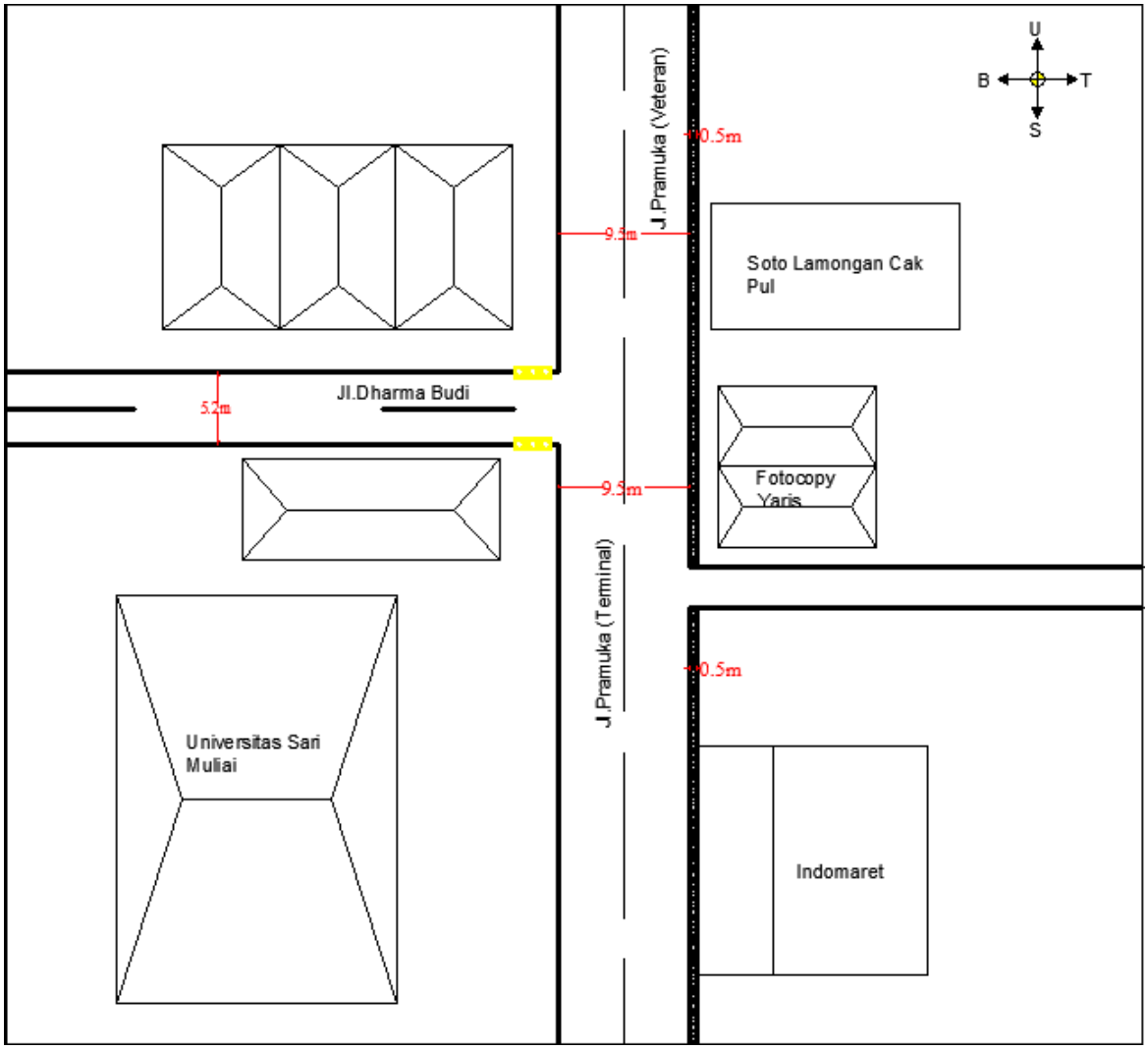


Figure 4 Layout the Pramuka street – Dharma Budi Street

The width of each intersection approach of Jalan Pramuka – Jalan Dharma Budi can be seen in table 10.

Table 10 Approx Width

Approach Code	WA (m)	WEnt (m)	Come out (m)
U (Scouts (Veterans))	2.2	2.2	2.2
S (Scouts (Terminal))	2.2	2.2	1.8
B (Dharma Budi)	1.8	1.8	2.2

The environmental type of Jalan Pramuka – Jalan Dharma Budi is commercial

IV.1 Traffic Volume

The composition of traffic on Jalan Pramuka – Jalan Dharma Budi can be seen in Figure 5 and Figure 6.

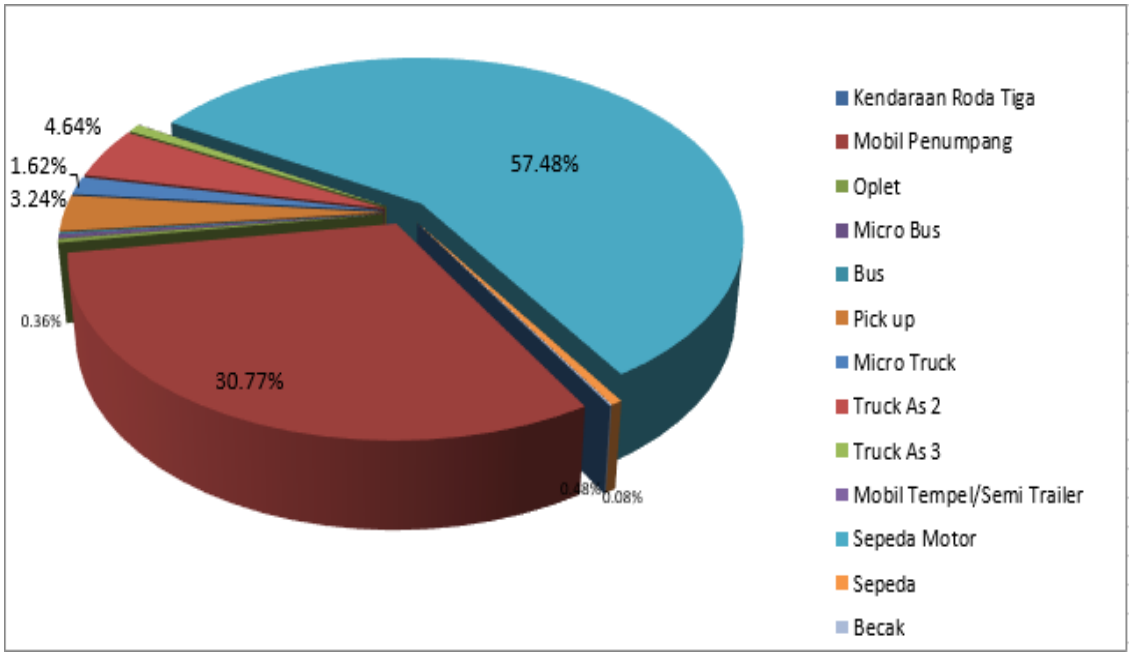


Figure 5 Traffic Composition

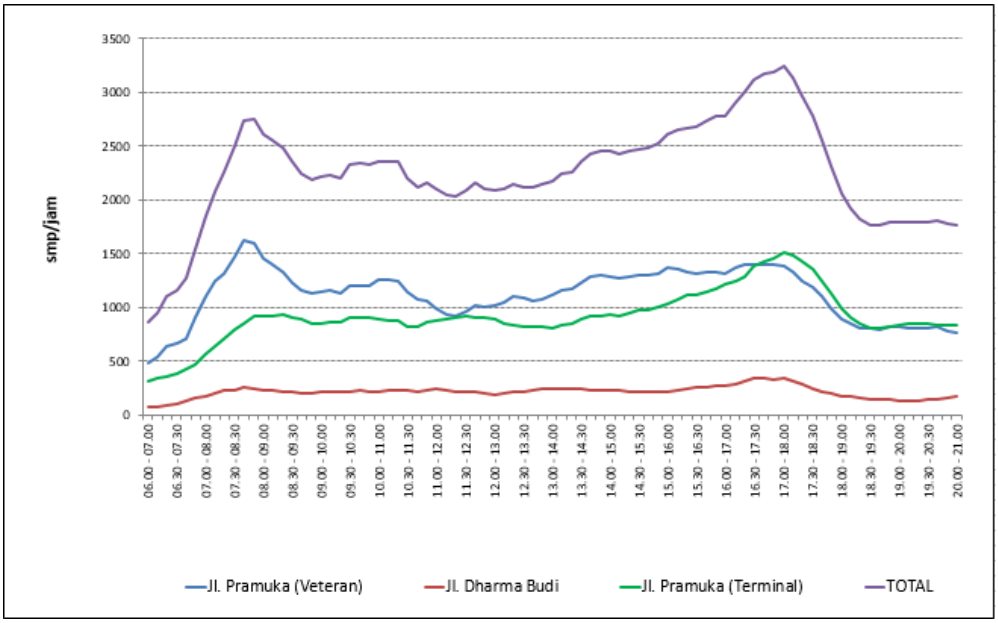


Figure 6 Traffic Flow Graph

From Figures 5 and 6, it can be seen that the peak hours of traffic flow occur at 17.00 – 18.00 WITA, with the composition of traffic being dominated by motorbikes. The road traffic flow data can be seen in Table 12.

Table 12 Peak Hour Traffic Flow

APPROACH		DIRECTION	LV	HV	MC	UM
NORTH	Jl. Scouts (Veterans)	RT	32	0	166	2
		ST	373	21	1749	9
SOUTH	Jl. Pramuka (Terminal)	ST	322	26	2183	20
		RT	21	0	78	2
WEST	Jl. Dharma Budi	LT	52	0	250	1
		RT	42	0	252	2

IV.2 Analysis of Unsignalized Triangular Existing Condition

To determine the level of performance of the intersection in the existing conditions, it is necessary to analyze the work of the intersection. The analysis was carried out in the KAJI program by entering the geometric intersection data.

The following is an illustration of computing the performance of the T junction on Pramuka Street – Dharma Budi Street:

1. Basic Capacity

Because the type intersection is 322, the basic capacity is 2700 pcu/hour

2. Average Width – Approx Average

   W1= (WA + WB + WD)/ Number of intersection arms

   = (2.6 + 4.75 + 4.75)/ 3

   = 4.03

3. Approach Width Adjustment Factor

   Few= 0.73 + 0.0760 W1

   = 0.73 + 0.0760 x 4.03

   = 1.037

4. At the crossroad of Pramuka Street - Dharma Budi Street, there is no middle for the main road, because the middle adaptation factor for the main road attained is FM = 1.00

5. City Size Factor

   The average population in Banjarmasin City is ± 700,430.8 people. Then Fcs = 0.94.

6. For side resistance class $\frac{UM}{MV}$ = 0.012 obtained FRAU 0.924.

7. Since FRAU value = 0.924, Left Turn Adjustment factor

   Known: LT=$\frac{QLT}{Q}$ = $\frac{237}{3242}$ =0.073

   So, FLT= 0.84 + 1.61 PLT

   = 0.84 + 1.61 x 0.073

   = 0.958 m

8. Right Turn Adjustment Factor

   RT =$\frac{QRT}{Q}$ = $\frac{283}{3242}$ = 0.09

   Then, FRT = 1.09 – 0.922 P_{RT}

   = 1.09 – 0.922 x 0.09

   = 1.010

9. Minor Road Flow Ratio Adjustment Factor

   FM I = 1.19 x PMI2 – 1.19 x PMI + 1.19

   = 1.19 x 0.1062 – 1.19 x 0.106 + 1.19

   = 1.077

10. Capacity

    C= Co x FW x FM x FCS x FRSU x FLT x FRT x FMI (pcu/hour)

= 2700 x 0.887 x 1 x 0.94 x 0.924 x 0.978 x 1.002 x 1.096

= 2514 (pcu/hour)

From the analysis of existing conditions, it can be seen that because the DS value is > 0.80, the average traffic delay is > 10 seconds/pcu, the queue probability is > 35%, the intersection delay value is 41.77 seconds/pcu, and the service level index is E. For this reason, it is necessary to make alternative improvements to this intersection.

IV.3 Alternative Treatment

As a result, the performance of the intersection in the existing condition has poor results, namely DS> 1.0. So it is necessary to repair and handle the intersection of Pramuka Street - Dharma Budi Street with geometric widening. In the first phase of the widening plan, Pramuka Street, as the major road is widened to 10 meters. The calculation of the capacity and performance of geometric widening alternatives can be seen in table 15 and table 16.

Table 15 Recap of Traffic Capacity and Performance

Capacity Adjustment Factor	Value/Result
C0	2700
FW	1.049
FCS	1.00
FRSU	0.924
FLT	0.958
FRT	1.010
FMI	1.076
C	2724
Traffic Performance	
DS	1,191
DTI	34.16
DG	4.00
D	38.16
QP%	58 – 117
ITP	E

From the results of the analysis obtained results that still do not meet the requirements because DS > 0.80, average traffic delay > 10 sec/pcu, queue probability > 35%. Therefore, it is necessary to do alternative repairs with median and signalized intersections.

Making the median at the intersection of Jalan Pramuka – Jalan Dharma Budi is an alternative treatment to improve the performance of the intersection, wherein making the median, there is a change in traffic flow that is moved to another stream, such as on Jalan Dharma Budi cannot turn right. Therefore the flow is moved. Turn left towards Scouts (Veterans), and it is advisable to turn back if you want to enter the Scout road (Terminal). The results of this volition can be seen in Table 16.

Table 16 Recap Traffic Capacity and Performance

Capacity Adjustment Factor	Value/Result
C0	2700
FW	1.049
FCS	1.00
FRSU	0.919
FLT	1,266
FRT	1.090
FMI	1.015
C	3648
Traffic Performance	
DS	0.538
DTI	5.49
DG	3.91
D	9.40
QP%	12 – 27
ITP	B

From the results of the analysis on the median alternative, it is found that the performance of the intersection meets the requirements because DS < 0.80, average traffic delay < 10 sec/pcu, queuing opportunity < 35%, and ITP B is obtained. However, in addition to the median alternative, other alternatives are also carried out, namely with a 3-phase 2-stage signalized intersection, as an alternative comparison.

a. 3-Phase Signalized Intersection

The handling of the three-way intersection of Pramuka Street – Dharma Budi Street, Banjarmasin City to become a signalized intersection is carried out under geometric widening conditions. Handling with signalized intersections is carried out in 3 phases and 2 stages. The results of the analysis of the alternative 3-phase and 2-phase signalized intersections can be seen in table 19.

Table 19 Performance of Signalized Intersections

Stage		DS	Delay		*Cycle time*	ITP
			Traffic	intersection		
1	U	0.505	10.41	17.02	48 sec	C
	S	0.802	21.75			
	B	0.610	24.58			
2	U	0.863	39.53	46.89	99 sec	E
	S	0.873	39.96			
	B	0.36	69.81			

From the results of the alternative analysis of 3-phase signalized intersections in stage 1, the cycle time value is 48 seconds, and the overall delay value of the intersection is 17.02 seconds/pcu, and the ITP C value. In stage 2, the cycle time is 99 seconds; the intersection delay is 46.89 seconds/pcu and ITP E.

V. CLOSING

V.1 Conclusion

1. From the affair of the analysis of the intersection of T junction on Pramuka Street - Dharma Budi Street, Banjarmasin City, the being condition redounded in an crossroad detention of 41.77 seconds/pcu, a line probability value of 90%, and a saturation degree value of 1.205 with an index of service level E. Grounded on the affair over, it can be seen that it is said that the performance of the crossroad in the being condition doesn’t meet the conditions because the DS index value is> 0.8.

2. Grounded on the results of the analysis, several indispensable treatments were carried out to ameliorate the level of service at the crossroad. The first treatment was carried out by widening the main road to 10 meters, the service level index value obtained was E. But the first treatment made the main road unable to provide sidewalk facilities. Followed by the addition of the median, the index value of service level B was obtained. However, apart from adding the median, other alternative handlers were also carried out, namely the handling of the intersection into a 3-phase 2-stage signalized intersection. In the first stage, the service level index obtained is C, then proceed to stage 2, the service level is E.

V.2 Suggestion

1. For planning traffic lights for the next few years, traffic growth data should be considered.
2. Road users are expected to increase awareness of traffic orders to achieve safety and security when driving.

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