JICE Journal Innovation of Civil Engineering
Vol. 3, No. 1, pp. 26-34, March 2022
e-ISSN: 2775-5592

STUDY OF UNSIGNING PHASE PERFORMANCE AT THE JUNCTION OF JL. SUMBER ANYAR – JL. LARANGAN TOKOL TLANAKAN REGENCY OF PAMEKASAN DISTRICT

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ABSTRACT

To analyze the capacity and performance level of an unsignalized intersection, one must take data from the field. The data were geometric (width of each foot of the intersection) and the type and number of vehicles crossing the intersection. It was then calculated the capacity and performance level of the intersection, which included the degree of saturation and the delay of the intersection, using the Indonesian Road Capacity Manual method (MKJI 1997). At the intersection of Jl. Sumber Anyar – Jl. Raya Larangan Tokol, Tlanakan District, Pamekasan Regency, a maximum C (capacity) value of 2189.03 smp/hour does not exceed the basic capacity (Co = 2700 smp/hour). Then it is included in the low capacity classification occurring Monday, January 10, 2022 at 15.00 – 18.00 WIB, while the highest DS (Degree of Saturation) value is 0.32 and the highest D (intersection delay) value is 8.63 sec/smp, which occurs on Monday, January 10, 2022 at 06.00 – 10.00 WIB. From the calculation results, it can be seen that at the intersection of Jl. Sumber Anyar – Jl. Raya Larangan Tokol, Tlanakan District, Pamekasan Regency, is still feasible and can accommodate traffic flow as a consideration in controlling and managing future traffic.

Keywords: *Capacity; Intersection Performance Level; Unsignaled Phase.*

1. Introduction

The use of private vehicles, both motorized and non-motorized vehicles, is the most important part as a means of mobility and as a measure of a person's level of success. In general, the types of motorized and non-motorized vehicles that cross national roads often encounter various obstacles at intersections.

Along with the increasing human need for motorized vehicles, the number of trips made by humans using motorized vehicles will increase day by day. In rush hour conditions, it can be seen that in the morning, which is the time to go to work and in the afternoon, which is when you come home from work, it is necessary to do research to reduce congestion [5].

The existence of a transportation network is to support community activities in the service of changing vehicle movements to support economic growth. Along with the increasing number of population growth to settle in an area and the increasing number of actors/users of transportation equipment on several roads, so that the roads to be passed experience delays in the movement of transportation equipment experiencing congestion at several intersection points [13].

The intersection is a part of the road that is the center of the meeting of various traffic flow movements. At the type of unsignalized intersection, traffic flow conflict points are often found which result in traffic congestion, especially during rush hours [10]. Intersections are an integral part of the road network. In urban areas there are usually many intersections, where drivers must decide to go straight or turn and change roads to reach one destination. An intersection can be

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defined as a general area where two or more roads join or intersect, including roads and roadside facilities for traffic movement in them [15].

The performance of an intersection is the main factor in determining the most appropriate treatment to optimize the function of the intersection [1]. Junctions must be shared by everyone who wants to use them, so they must be designed carefully, taking into account efficiency, safety and operating costs. Traffic movements that occur and their sequences can be handled in various ways, depending on the type of intersection required [16].

MKJI states that the number of accidents at unsignalized intersections is estimated at 0.60 accidents/million vehicles, due to the driver's lack of attention to the YIELD signs and STOP signs, resulting in the behavior of drivers crossing the intersection having the behavior of not waiting for gaps and forcing them to place vehicles on the road to be entered, this results in traffic flow conflicts that result in traffic jams and even the potential for accidents.

The unsignalized intersection in this study is the Jl. Sumber Anyar – Jl Raya Larangan Tokol. This intersection is an intersection that triggers an accident because it is a vehicle passing to the center of Pamekasan, campuses and schools, tourism places. Based on this incident, it is necessary to conduct an Unsignalized Phase Performance Study at the Jl. Sumber Anyar – Jl. Raya Larangan Tokol, Tlanakan District, Pamekasan Regency.

2. Material and Methods

A level crossing is a difficult and complex part of a highway system. This is where most vehicle and pedestrian encounters occur, which invariably causes delays, accidents and traffic jams. Level crossings (meaning that they are located in the same plane, and not interchanges) can be controlled by traffic lights, such intersections are known as traffic lighted intersections. However, intersections without traffic lights make up the largest proportion of level crossings in the road system. Stop signs and speed control signs are used to give right of way, but drivers must use judgment in choosing gaps in the main roadway to make cutting and turning movements at two-way intersections and control speed control signs.

Roads are land transportation facilities that have an important role in facilitating economic relations activities and social relations activities, and play a major role in the progress and development of an area [2]. Roads are a traffic infrastructure that is very important for community mobility. One part of the road infrastructure is the intersection, which is the meeting node of each road segment so that the performance of an intersection will affect the performance of the road section as a whole. Optimizing the function of the intersection needs to be done if you want to improve the performance of the intersection and the road network as a whole [8].

Transportation is an inseparable part of the existence of an area, both urban and rural areas [9]. The reduction in the effective width of the road and conflicts that occur at intersections that result in congestion at the intersection arm require an analysis of the performance of the intersection based on measures [11]. An unsignalized intersection is a combination of two or more roads that are not equipped with a traffic signaling device, namely a traffic light [3].

Many problems at intersections occur because of movements that conflict with each other, especially vehicles turning right (left vehicles are usually given free movement). The solution is to increase the capacity of the intersection, with certain parameters or reduce the traffic volume. The value of traffic volume (Q) reflects the composition of traffic, by expressing the flow in Passenger Car Units (SMP). All traffic volume values (per direction and total) are converted into Passenger Car Units (SMP) using the Passenger Car Equivalent (EMP) which is derived empirically [6].

From the above theory, in the study of the performance of the unsignaled phase at the intersection of Jl. Sumber Anyar – Jl. Raya Larangan Tokol is more focused on the theory of Juniardi, 2016. All the problems that occur at this intersection are due to the vehicle factor that will make a right turn movement. At the intersection of Jl. Sumber Anyar – Jl. Raya Larangan Tokol, usually vehicles from the east that will make a right turn to the north, there are often conflicting meeting movements that are chaotic. This is due to road users or drivers who are not careful if they

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e-ISSN: 2775-5592

are going to make a right turn without paying attention to the condition of vehicles coming from the west.

2.1. Determining the Research Location

Determine the location of the research site that can generate a fairly large volume of traffic flow in Pamekasan Regency and its surroundings, in this case at the intersection of Jl. Sumber Anyar – Jl. Raya Larangan Tokol, with a population of 75,399 people who are still alive Report of Population in TLanakan District for January 2022.

2.2. Data Collection Techniques

a. Primary Data Collection

Primary data includes all motorized and non-motorized vehicles crossing the Jl. Sumber Anyar – Jl. Raya Larangan Tokol, Tlanakan District, Pamekasan Regency.

b. Secondary Data Collection

Which includes secondary data is the location plan. The map of the location studied is the intersection of Jl. Sumber Anyar – Jl. Raya Larangan Tokol, Tlanakan District, Pamekasan Regency.

The data needed to analyze the capacity and delay at the intersection of Jl. Sumber Anyar – Jl. Raya Larangan Tokol, Tlanakan District, Pamekasan Regency, namely:

1. Traffic volume data for each arm of the intersection during rush hour.
2. Road geometric data (width and number of lanes).
3. Data on environmental conditions and land use in the intersection area.

2.3. Data Processing Method

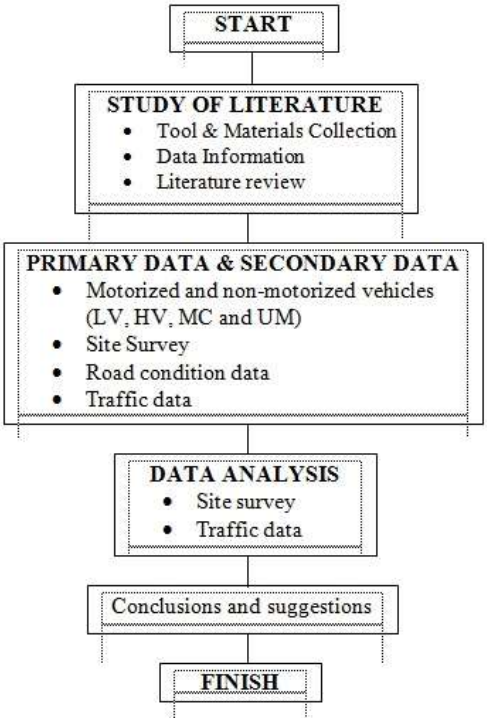

Figure 1. Research Flowchart

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3. Result and Discussion

3.1. Unsignalized Intersection Capacity

Intersection capacity is the maximum traffic flow that can pass through an intersection at the initial traffic conditions and road conditions and traffic signs. The maximum traffic flow is calculated for a time period of 15 minutes, and is expressed in vehicles per hour [17].

The total capacity for all intersection arms is the product of the basic capacity (Co), namely the capacity under certain conditions (ideal) and adjustment factors (F), taking into account the effect of field conditions on capacity.

$$C = Co \times FW \times FCS \times FRSU \times FLT \times FRT \times FMI \quad (1)$$

The capacity calculation will be carried out in several steps. The order that has been set must be followed systematically, this is in order to facilitate calculations by analyzing data. Step by step will be explained as follows [17]:

1. Approach width and intersection type

To explain the beginning of this capacity calculation, it will be divided into three steps, namely:

a. The average width of the WC and WAB minor and major approaches and the average width of the W1 approach.

The approach width is measured at a distance of 10 m from the imaginary line connecting the pavement edges of the intersecting road, which is considered to represent the effective approach width for each approach. For frequent approaches to parking at a distance of less than 20 m from the imaginary line connecting the pavement edges of intersecting roads, the approach width should be reduced by 2 m [17].

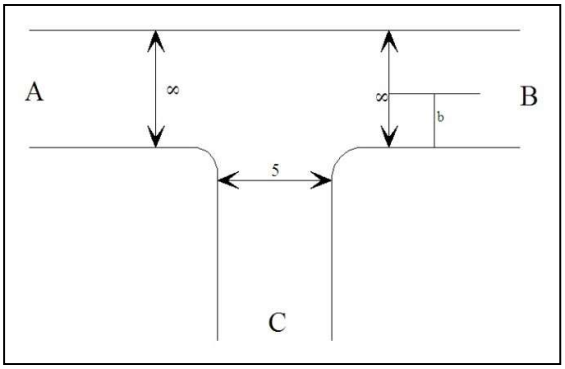

Figure 2. Approx Average Width

$$W1 = (WA + WB + WC) / \text{number of intersection arms} \quad (2)$$

b. Junction type

The type of intersection determines the number of intersection arms and the number of lanes on the main road and minor road at the intersection with a three-digit code. The number of arms is the number of arms with incoming or outgoing traffic or both [17].

Table 1. Junction Type Code

IT Code	Number of Arms Intersection	Number of Minor Lanes	Number of Minor Lanes
322	3	2	2
324	3	2	4
342	3	4	2
422	4	2	2
424	4	2	4

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2. Base capacity (Co)

The basic capacity values have been determined according to the junction type previously discussed. For details, it will be shown in the following table [17]:

Table 2. Intersection Capacity by Junction Type

IT Junction Type	Basic Capacity (SMP/hour)
322	2700
342	2900
324 atau 344	3200
422	2900
424 atau 444	3400

3. Approach width adjustment factor (Fw)

The input variable is the average width of all W1 approaches and the type of IT intersection. The limit values given in the figure are the empirical and manual baseline ranges [17].

Traffic engineering considerations are needed to determine the median factor. The median is called if standard light vehicles can take cover in an area without disturbing the flow of departing on the main road. This may occur if the median width is 3 m or more, in some circumstances eg the main road approach is wide [17].

Table 3. Main Street Median Adjustment Factor

Description	Type M	Median Adjustment Factor (Fm)
There is no main road median	There is no	1,00
There is a main road media, width < 3 m	Narrow	1,05
There is a median of the main road 3 m	Wide	1.20

4. City size adjustment factor (Fcs)

What is meant as an input variable in this step is the size of the city. The size of the city can be determined by the number of inhabitants, for more details will be shown in the table below [17].

Table 4. City Size Adjustment Factor

CS City Size	Population (Million)	City Size Adjustment Factor (Fcs)
Very small	< 0,1	0,82
Small	0,1 – 0,5	0,88
Currently	0,5 – 1,0	0,94
Big	1,0 – 3,0	1,00
Very large	> 3,0	1,05

5. Adjustment factor for road environment type, side barriers and non-motorised vehicles (FRSU)

The input variables are the type of road environment, the class of side barriers and the ratio of non-motorized vehicles [17].

Table 5. Environmental Type Adjustment Factors, Side Barriers and Non-Motorized Vehicles

RE., Road Environment Type Class	Side Barrier Class	PUM's Non-Motorized Vehicle Ratio					
		0,00	0,05	0,10	0,15	0,20	0,25
Commercial	High	0,93	0,88	0,84	0,79	0,74	0,70
	Medium	0,94	0,89	0,85	0,80	0,75	0,70
	Low	0,95	0,90	0,86	0,81	0,76	0,71
Settlement	High	0,96	0,91	0,86	0,82	0,77	0,72
	Medium	0,97	0,92	0,87	0,82	0,77	0,73
	Low	0,98	0,93	0,88	0,83	0,78	0,74
Access	High/Medium/Low	1,00	0,95	0,90	0,85	0,80	0,75

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$$DS = \frac{QTotal}{C} \quad (3)$$

DS < 0,6

$$DTI = 2 + 8{,}2087 \times DS\ (1 - DS) \times 2 \quad (4)$$

DS > 0,6

$$DTI = 1{,}0504 / (0{,}2742 - 0{,}2042 \times DS) \times 2 \quad (5)$$

DS < 0,6

$$DTMA = 1{,}8 + 5{,}8234 \times DS\ (1 - DS) \times 1{,}8 \quad (6)$$

DS > 0,6

$$DTMA = 1{,}05034 / (0{,}346 - 0{,}246 \times DS) - (1 - DS) \times 1{,}8 \quad (7)$$

3.2. Intersection Setting Purpose

The main purpose of traffic regulation in general is to maintain the safety of traffic flow by giving clear and directed instructions, not causing doubt. Traffic regulation at intersections can be achieved by using traffic lights, markings, and signs that regulate, direct, and warn traffic [17].

From the selection of intersection settings can be found the objectives to be achieved as follows:

1. Reduce or avoid the possibility of accidents originating from various conflict point conditions.
2. Maintaining the capacity of the intersection so that in its operation the utilization of the intersection can be achieved in accordance with the plan.
3. In the operation of the intersection arrangement must provide clear and definite instructions, simple, directing traffic in an appropriate and safe place.

3.3. Intersection Arrangement Without Traffic Lights

The design of the intersection without traffic is the first choice for low road classes and if the intersection does not serve high traffic, the experience of accidents is very low or the road speed is low. In detail, the arrangement of level intersections can be distinguished by priority rules, signs and markings, and roundabouts.

3.4. Geometric Characteristics

In this case the geometric characteristics include things that are closely related to the geometric intersection. These include the type of intersection, the determination of the main and minor roads, the determination of the alphabet A, B, C, the median type, the width of the approach, the average width of all approaches, as well as the number of lanes and the direction of the road. An explanation of the things above will be presented below [17]:

1. Junction Type
   Is a code for the number of arms of the intersection and the number of lanes on the minor road or the main road of the intersection. Usually the junction has 3 arms or 4 arms [17].
2. Main Street and Minor Street
   The main road is the most important road at a crossroads, for example in terms of road classification. The main road is usually more traversed or in other words the density of vehicles passing through this road is greater than other roads at this intersection. Meanwhile, minor roads are roads with less volume of vehicles passing through them. At an intersection, a continuous road is always determined as the main road [17].
3. Arm Assignment
   This determination is useful in terms of specifying arm markings at intersections with the main road approach rules called A and B, minor roads called C [17].

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4. Main Street Median Type
   The classification of the median type of the main road depends on the possibility of using the median to cross the main road [17].
5. Approach width X (Wx)
   The width of the paved approach, measured in the narrow section, used by moving traffic. X is the name of the approach. If this approach is used for parking, the width will be reduced by 2 m [17].
6. Average Width of All Approaches (Wi)
   The average effective width for all approaches at the crossroads [17].
7. Number of Lanes and Directions
   The number of lanes is the number of divisions of segments in a road and usually have the same direction. The number of lanes is determined from the average width of the minor/major approach [17].

3.5. Environmental Characteristics

Matters related to environmental characteristics in the form of land use, namely land development at the intersection. Other things are the size of the city, limited road access, settlements and side barriers. Side barriers are impacts on traffic behavior due to roadside activities such as pedestrians, stopping other vehicles, vehicles entering and leaving the side of the road and slow vehicles [17].

3.6. Capacity and Performance Level Recapitulation

Table 6. Result of Capacity Recapitulation and Performance Level of Intersection at Jl. Sumber Anyar – Jl. Raya Larangan Tokol

DAY / DATE	Time Interval (WIB)	C (smp/hour)	DS	DTI	DTMA	DTMI	DG (sec/smp)	D (sec/smp)
Monday / January 10, 2022	06.00-10.00	2015,71	0,32	3,27	2,44	34,59	5,36	8,63
	10.00-15.00	2116,87	0,27	2,76	2,06	19,2	5,46	8,22
	15.00-18.00	2189,03	0,26	2,65	1,98	17,02	5,48	8,13
	18.00-21.00	2155,88	0,23	2,35	1,75	14,36	5,54	7,89
Tuesday / January 11, 2022	06.00-10.00	1981,79	0,31	3,16	2,36	15,53	4,99	8,15
	10.00-15.00	2108,07	0,28	2,86	1,64	24,89	5,42	8,28
	15.00-18.00	2188,1	0,22	2,25	1,68	16,55	5,56	7,81
	18.00-21.00	2115,82	0,24	2,45	1,83	12,96	5,52	7,97
Wednesday / 12 January 2022	06.00-10.00	1931,49	0,31	3,16	2,36	16,63	3,33	6,49
	10.00-15.00	2162,12	0,29	2,96	2,21	18,94	5,42	8,38
	15.00-18.00	2096,37	0,24	2,45	1,83	13,54	5,52	7,97
	18.00-21.00	2096,37	0,23	2,35	1,75	13,59	5,56	7,91

4. Conclusions

At the intersection of Jl. Sumber Anyar – Jl. Raya Larangan Tokol with a maximum value of C (capacity) of 2189.03 smp/hour does not exceed the basic capacity (Co = 2700 smp/hour) so it is included in the low capacity classification occurring on Monday, January 10, 2022 at 15.00 – 18.00 WIB, while the value The highest DS (Degree of Saturation) is 0.32 and the highest D (Intersection Delay) is 8.63 sec/smp which occurs on Monday, January 10, 2022 at 06.00 – 10.00 WIB. From the calculation results it can be seen that at the intersection of Jl. Sumber Anyar – Jl. Raya Larangan

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Tokol, Tlanakan District, Pamekasan Regency, is still feasible and able to accommodate traffic flow as a consideration in controlling and managing future traffic. At the intersection of Jl. Sumber Anyar – Jl. Raya Larangan Tokol, the volume of vehicles and traffic flow is stable.

Acknowledgements

This research cannot be carried out without the consent of several parties. The author expresses many thanks to:

1. Mr. Taurina Jemmy Irwanto, ST., MT. as Dean of the Faculty of Engineering, Madura University.
2. Mr. Deddy Asmaroni, ST., MT. as the Head of the Civil Engineering Study Program, Madura University.
3. Friends of the survey team and documentation team who also supported the implementation of this research.

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