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Performance Analysis of Unsignalized Intersections on the Taman Asri Tambak Rejo Road in Sidoarjo Regency using The PKJI 2014 Method

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KEYWORDS

Traffic Volume, Intersection Capacity, Degree of Saturation, Delay, PKJI 2014, Unsigned Intersection, Taman Asri Main Road, Sidoarjo.

ABSTRACT

Road intersections are conflict-prone points, particularly during peak traffic hours, where vehicle interactions often lead to congestion and delays. One intersection that serves as the focus of this study is a non-signalized three-way intersection located on Taman Asri Main Road, Sidoarjo Regency, connecting Taman Asri Main Road, Wadung Asri Road, and Rungkut Mananggal Road. This intersection has a 324M configuration, consisting of one approach with two lanes and two approaches with four lanes equipped with a median. The study aims to analyze traffic volume, road capacity, and overall intersection performance using the Indonesian Road Capacity Guidelines (Pedoman Kapasitas Jalan Indonesia – PKJI) method, which evaluates capacity, degree of saturation, queue probability, and average delay. The data utilized include geometric road characteristics, traffic volume, and capacity parameters collected through direct field surveys conducted at various times and on different days. The analysis results show that the highest traffic volume occurred on Friday afternoon, reaching 4,042 vehicles per hour, while the lowest volume was recorded on Tuesday noon at 2,085 vehicles per hour. The highest calculated capacity was observed on Monday afternoon at 4,391 vehicles per hour, whereas the lowest capacity occurred on Saturday noon at 3,649 vehicles per hour. The performance evaluation indicates that peak congestion occurred on Friday afternoon, with a degree of saturation of 0.95, queue probability ranging from 36–72%, and an average delay of 17.10 seconds. Although the intersection is generally considered to operate adequately, the degree of saturation exceeds the PKJI-recommended limit of 0.85, indicating the need for traffic management improvements to prevent future congestion.

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INTRODUCTION

According to Law of the Republic of Indonesia Number 22 of 2009 on Road Traffic and Transportation, a road is defined as a land transportation infrastructure that includes all parts of a road, including complementary structures and equipment intended for traffic, located on the ground surface, above the ground surface, below the ground surface and/or water, as well as above the water surface, excluding railway tracks, trolley roads, and cable roads (Airlangga & Suryokencono, 2024; Budiman et al., 2023; Feri et al., 2025; Nurachman & Machmudin, 2019). Safe, comfortable, and unobstructed traffic movement is the desired goal for road users. When this condition is not achieved, traffic becomes a problem for the community. One of the main points on roads that significantly contributes to travel delays is road intersections. Therefore, improving intersections can reduce traffic disturbances, increase road capacity, and decrease the occurrence of accidents (Dasgupta et al., 2024; Shahriar et al., 2023; Yaibok et al., 2024).

Road intersections are conflict points that frequently occur in urban traffic flows, especially when vehicle volumes are high during peak hours. One example of an intersection that serves as the focus of this study is an unsignalized three-leg intersection on Jalan Raya Taman Asri, Sidoarjo Regency (Castañeda et al., 2021, 2025b, 2025a; Olayode et al., 2023). This intersection has a three-leg configuration consisting of a one-way, two-lane approach and a two-way, four-lane approach with a median (324M), located at the junction of Jalan Raya Taman Asri, Jalan Wadung Asri, and Jalan Rungkut Menanggal. This intersection functions as an arterial road that connects traffic from local roads to main roads and also serves as an alternative route between shopping centers, higher education institutions, and access to Juanda International Airport.

Traffic congestion at this intersection is caused by several factors, such as the absence of traffic signals (APILL), which result in drivers being unwilling to yield; on-street parking; road user behavior that tends to prioritize overtaking; high vehicle volumes; and a lack of awareness of traffic regulations (Anderson, 2014; Nafila, 2018; Park et al., 2022; Sultana, 2015). These conditions lead to long vehicle queues, particularly in the afternoon around 4:30 PM, especially in the directions toward Jalan Rungkut Menanggal and Jalan Wadung Asri.

This study aims to analyze the performance of the unsignalized three-leg intersection using the PKJI (Pedoman Kapasitas Jalan Indonesia) 2014 method. The author chose the PKJI method because it is an update of the MKJI method and is considered to better reflect actual field conditions.

Conducting an analysis of the performance of this unsignalized intersection is expected to assist both the government and the community in improving traffic safety and efficiency. By increasing the efficiency of the unsignalized intersection, traffic congestion and vehicle travel time at the intersection can be reduced. In connection with the congestion problems occurring at the Jalan Raya Taman Asri intersection—caused by factors such as the absence of traffic signals (APILL), on-street parking, aggressive driving behavior, high traffic volumes, and low awareness of traffic rules—the author raises the research title: "Performance Analysis of an Unsignalized Intersection on Jalan Raya Taman Asri, Sidoarjo Regency Using the PKJI 2014 Method."

The problem formulation of this study focuses on traffic conditions at the unsignalized intersection on Jalan Raya Taman Asri, Sidoarjo Regency. The issues examined include the volume of vehicles passing through the intersection, the available traffic flow capacity, and the performance of the unsignalized intersection in serving traffic flows. These three aspects form the basis of the analysis to determine the level of service and traffic problems occurring at the study location.

The objectives of this study are to calculate the volume of vehicles passing through the unsignalized intersection on Jalan Raya Taman Asri, Sidoarjo; to analyze the existing traffic capacity; and to evaluate the performance of the unsignalized intersection. The study is limited to the unsignalized intersection on Jalan Raya Taman Asri, Sidoarjo Regency, using the PKJI 2014 guidelines. Surveys were conducted during peak hours, namely 06:00–08:00 WIB, 12:00–14:00 WIB, and 16:00–18:00 WIB, with analysis parameters including traffic volume, capacity, delay, and degree of saturation.

The results of this study are expected to provide benefits to various parties. For the University of 17 August 1945 Surabaya and its students, this research can serve as an academic reference and a supporting resource for learning activities. For the government, the findings are expected to be useful as a consideration in addressing and improving traffic problems in the area. Meanwhile, for the researcher, this study contributes to increasing knowledge and experience in the field of transportation and serves as one of the requirements for academic graduation.

METHOD

1. Explanation of the Research Flowchart

This section provides an explanation of the stages involved in the research to be conducted, based on the research flowchart.

2. Literature Review

A literature review is a method used to collect data or sources related to the topic addressed in a study. The literature review used in the preparation of this Final Project was obtained from various sources covering intersection types, traffic volume calculations, traffic performance analysis, relevant regulations, and other supporting references accessible through the internet and libraries.

3. Site Survey

At this stage, an inspection of the research location was conducted to identify field conditions and determine the requirements needed to carry out the study. To obtain primary data, geometric surveys and traffic volume surveys were conducted. The geometric survey involved measuring the length and width of the roads at the unsignalized intersection. Based on the results of the initial survey conducted over three days—during the morning, afternoon, and evening—at the Jalan Raya Taman Asri intersection in Sidoarjo Regency, traffic activity was found to be busiest in the morning when people commute to work and school. In the afternoon, traffic conditions were observed to be less dense compared to the morning and evening periods. Finally, in the evening, traffic congestion occurred at the unsignalized intersection on Jalan Raya Taman Asri, Sidoarjo Regency.

RESULTS AND DISCUSSIONS

After collecting the required data, the next step was the calculation process to obtain results based on the formulated research problems. The process of data calculation and discussion at this intersection consisted of the following: the traffic volume calculation tables were obtained from field surveys, after which calculations were carried out for each intersection approach on Monday during the morning, afternoon, and evening periods.

After the traffic volumes were entered into the calculation tables, the data were converted into passenger car units (pcu) by multiplying the values by passenger car equivalents (PCE/emp) according to each vehicle type. The passenger car equivalents (emp) for unsignalized intersections were obtained from the Pedoman Kapasitas Jalan Indonesia (PKJI) 2014. The traffic volume calculation table (pcu/hour) was derived from the USIG-I form by converting the traffic volumes on each approach using the following multiplication factors:

1. Medium Vehicles (MP) × 1.0
2. Heavy Vehicles (KS) × 1.8
3. Motorcycles (SM) × 0.2

Example of Calculation for Monday

qJP = LHRT × K
qJP = 8,451 × 0.12 = 1,014 pcu/hour

Based on the calculation example above, the traffic volume obtained was 1,014 pcu/hour on Monday. This traffic volume is still acceptable, as the intersection's volume capacity is 3,200 pcu/hour. The traffic volume calculation tables were derived from field surveys and then calculated for each intersection approach on Tuesday during the morning, afternoon, and evening periods.

After the traffic volumes were entered into the calculation tables, the data were converted into passenger car units (pcu) by multiplying them by passenger car equivalents (emp) according to each vehicle type. The passenger car equivalents (emp) for unsignalized intersections were obtained from the Pedoman Kapasitas Jalan Indonesia (PKJI). The traffic volume calculation table (pcu/hour) was derived from the USIG-I form by converting the traffic volumes on each approach using the following multiplication factors:

a. Medium Vehicles (MP) × 1.0
b. Heavy Vehicles (KS) × 1.8
c. Motorcycles (SM) × 0.2

Example of Calculation for Tuesday
qJP = LHRT × K
qJP = 2,492 × 0.12 = 299 pcu/hour

Based on the calculation example above, the traffic volume obtained was 299 pcu/hour on Tuesday. This traffic volume is still acceptable, as the intersection's volume capacity is 3,200 pcu/hour. The traffic volume calculation tables were derived from field surveys and then calculated for each intersection approach on Wednesday during the morning, afternoon, and evening periods.

After the traffic volumes were entered into the calculation tables, the data were converted into passenger car units (pcu) by multiplying them by passenger car equivalents (emp) according to each vehicle type. The passenger car equivalents (emp) for unsignalized intersections were obtained from the Manual Kapasitas Jalan Indonesia (MKJI) 1997. The traffic volume calculation table (pcu/hour) was derived from the USIG-I form by converting the traffic volumes on each approach using the following multiplication factors:

a. Light Vehicles (LV) × 1.0
b. Heavy Vehicles (HV) × 1.8
c. Motorcycles (MC) × 0.2

Example of Calculation for Wednesday
qJP = LHRT × K
qJP = 2,385 × 0.12 = 286 pcu/hour

Based on the calculation example above, the traffic volume obtained on Wednesday was 286 pcu/hour. This traffic volume is still acceptable, as the intersection volume capacity is 3,200 pcu/hour. The traffic volume calculation tables were obtained from field surveys and then calculated for each intersection approach on Thursday during the morning, afternoon, and evening periods.

After the traffic volumes were entered into the calculation tables, the data were converted into passenger car units (pcu) by multiplying them by passenger car equivalents (emp) according to each vehicle type. The passenger car equivalents (emp) for unsignalized intersections were obtained from the Indonesian Highway Capacity Manual (MKJI 1997). The traffic volume calculation table (pcu/hour) was obtained from the USIG-I form by converting the traffic volumes on each approach using the following multiplication factors:

a. Light Vehicles (LV) × 1.0
b. Heavy Vehicles (HV) × 1.8
c. Motorcycles (MC) × 0.2

Example of Calculation for Thursday
qJP = LHRT × K
qJP = 2,735 × 0.12 = 328 pcu/hour

Based on the calculation example above, the traffic volume obtained on Thursday was 328 pcu/hour. This traffic volume is still acceptable, as the intersection's volume capacity is 3,200 pcu/hour. The traffic volume calculation tables were derived from field surveys and then calculated for each intersection approach on Friday during the morning, afternoon, and evening periods.

After the traffic volumes were entered into the calculation tables, the data were converted into passenger car units (pcu) by multiplying them by passenger car equivalents (emp) according to each vehicle type. The passenger car equivalents (emp) for unsignalized intersections were obtained from the Manual Kapasitas Jalan Indonesia (MKJI) 1997. The traffic volume calculation table (pcu/hour) was derived from the USIG-I form by converting the traffic volumes on each approach using the following multiplication factors:

a. Light Vehicles (LV) × 1.0
b. Heavy Vehicles (HV) × 1.8
c. Motorcycles (MC) × 0.2

Example of Calculation for Friday
qJP = LHRT × K
qJP = 3,224 × 0.12 = 387 pcu/hour

Based on the calculation example above, the traffic volume obtained on Friday was 387 pcu/hour. This traffic volume is still acceptable, as the intersection's volume capacity is 3,200 pcu/hour. The traffic volume calculation tables were derived from field surveys and then calculated for each intersection approach on Saturday during the morning, afternoon, and evening periods.

Passenger car equivalents (emp) for unsignalized intersections were obtained from the Manual Kapasitas Jalan Indonesia (MKJI) 1997. The traffic volume calculation table (pcu/hour) was derived from the USIG-I form by converting the traffic volumes on each approach using the following multiplication factors:

a. Light Vehicles (LV) × 1.0
b. Heavy Vehicles (HV) × 1.8
c. Motorcycles (MC) × 0.2

Example of Calculation for Saturday
qJP = LHRT × K
qJP = 2,928 × 0.12 = 351 pcu/hour

Based on the calculation example above, the traffic volume obtained on Saturday was 351 pcu/hour. This traffic volume is still acceptable, as the intersection volume capacity is 3,200 pcu/hour. The traffic volume calculation tables were obtained from field surveys and then calculated for each intersection approach on Sunday during the morning, afternoon, and evening periods.

Passenger car equivalents (emp) for unsignalized intersections were obtained from the Indonesian Highway Capacity Manual (MKJI 1997). The traffic volume calculation table

(pcu/hour) was obtained from the USIG-I form by converting the traffic volumes on each approach using the following multiplication factors:

a. Light Vehicles (LV) × 1.0
b. Heavy Vehicles (HV) × 1.8
c. Motorcycles (MC) × 0.2

Example of Calculation for Sunday
qJP = LHRT × K
qJP = 3,066 × 0.12 = 368 pcu/hour

Based on the calculation example above, the traffic volume obtained on Sunday was 368 pcu/hour. This traffic volume is still acceptable, as the intersection volume capacity is 3,200 pcu/hour.

Capacity

To determine the capacity of an intersection, it is first necessary to identify the adjustment factors, which consist of approach width, road median, city size, side friction, left-turn ratio, right-turn ratio, and the basic capacity of the intersection.

Table 1. Intersection Capacity Data on Monday, 08 September 2025

Pilihan	Kapasitas Dasar	Faktor Penyesuaian							Kapasitas
		Flp	Fm	Fuk	Fhs	Fbki	Fbka	Frmi	
pagi	3200	1,68	1,05	1,05	0,88	1,27	0,74	0,84	4130
siang	3200	1,68	1,05	1,05	0,88	1,29	0,69	0,85	3910
sore	3200	1,68	1,05	1,05	0,88	1,32	0,75	0,85	4391

(Source: Processed by the Researcher, 2025)

The intersection capacity on Monday morning shows a basic capacity (C_0) of 3,200 pcu/hour, with adjustment factors consisting of Flp (average approach width) of 1.68, Fm (major road median) of 1.05, Fuk (city size) of 1.05, Fhs (side friction) of 0.88, Fbki (left-turn ratio) of 1.27, Fbka (right-turn ratio) of 0.74, and Frmi (minor road to total flow ratio) of 0.84. After applying all adjustment factors, the resulting intersection capacity is 4,130 pcu/hour. For Monday midday, the basic capacity (C_0) remains 3,200 pcu/hour, with Flp of 1.68, Fm of 1.05, Fuk of 1.05, Fhs of 0.88, Fbki of 1.29, Fbka of 0.69, and Frmi of 0.85, resulting in an intersection capacity of 3,910 pcu/hour. Meanwhile, for Monday afternoon, using the same basic capacity (C_0) of 3,200 pcu/hour and adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.32, Fbka 0.75, and Frmi 0.85, the calculated intersection capacity is 4,391 pcu/hour.

To determine the intersection capacity on Tuesday morning, the basic capacity (C_0) is 3,200 pcu/hour, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.23, Fbka 0.69, and Frmi 0.87, resulting in an intersection capacity of 3,871 pcu/hour. On Tuesday midday, with the same basic capacity (C_0) of 3,200 pcu/hour and adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.22, Fbka 0.69, and Frmi 0.87, the resulting capacity is 3,837 pcu/hour. For Tuesday afternoon, applying adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.26, Fbka 0.73, and Frmi 0.87 yields an intersection capacity of 4,165 pcu/hour.

The intersection capacity on Wednesday morning is calculated using a basic capacity (C_0) of 3,200 pcu/hour, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.26, Fbka 0.67, and Frmi 0.86, resulting in a capacity of 3,813 pcu/hour. For Wednesday midday, the same basic capacity (C_0) of 3,200 pcu/hour with adjustment factors of Flp 1.68, Fm 1.05,

Fuk 1.05, Fhs 0.88, Fbki 1.25, Fbka 0.69, and Frmi 0.84 produces an intersection capacity of 3,766 pcu/hour. On Wednesday afternoon, applying Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.30, Fbka 0.72, and Frmi 0.87 results in an intersection capacity of 4,217 pcu/hour.

For Thursday morning, the intersection capacity is obtained from a basic capacity (C_0) of 3,200 pcu/hour, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.27, Fbka 0.66, and Frmi 0.88, resulting in a capacity of 3,827 pcu/hour. On Thursday midday, using the same basic capacity (C_0) and adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.22, Fbka 0.69, and Frmi 0.86, the intersection capacity is 3,762 pcu/hour. For Thursday afternoon, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.25, Fbka 0.75, and Frmi 0.87, the calculated capacity is 4,243 pcu/hour.

On Friday morning, the intersection capacity is calculated using a basic capacity (C_0) of 3,200 pcu/hour, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.20, Fbka 0.72, and Frmi 0.88, resulting in a capacity of 3,979 pcu/hour. For Friday midday, applying the same basic capacity (C_0) and adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.20, Fbka 0.71, and Frmi 0.86 yields an intersection capacity of 3,871 pcu/hour. Meanwhile, on Friday afternoon, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.25, Fbka 0.74, and Frmi 0.88, the resulting intersection capacity is 4,254 pcu/hour.

To determine the intersection capacity on Friday morning, the basic capacity (C_0) is 3,200 pcu/hour, with adjustment factors consisting of Flp (average approach width) of 1.68, Fm (major road median) of 1.05, Fuk (city size) of 1.05, Fhs (side friction) of 0.88, Fbki (left-turn ratio) of 1.20, Fbka (right-turn ratio) of 0.72, and Frmi (minor road to total flow ratio) of 0.88. After applying all adjustment factors, the resulting intersection capacity is 3,979 pcu/hour. To calculate the intersection capacity on Friday midday, the basic capacity (C_0) remains 3,200 pcu/hour, with Flp of 1.68, Fm of 1.05, Fuk of 1.05, Fhs of 0.88, Fbki of 1.20, Fbka of 0.71, and Frmi of 0.86, resulting in an intersection capacity of 3,871 pcu/hour. Meanwhile, for Friday afternoon, using the same basic capacity (C_0) of 3,200 pcu/hour and adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.25, Fbka 0.74, and Frmi 0.88, the calculated intersection capacity is 4,254 pcu/hour.

To determine the intersection capacity on Saturday morning, the basic capacity (C_0) is 3,200 pcu/hour, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.25, Fbka 0.71, and Frmi 0.87, resulting in an intersection capacity of 4,030 pcu/hour. For Saturday midday, using the same basic capacity (C_0) and adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.24, Fbka 0.66, and Frmi 0.86, the calculated intersection capacity is 3,649 pcu/hour. Meanwhile, on Saturday afternoon, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.24, Fbka 0.73, and Frmi 0.86, the resulting intersection capacity is 4,105 pcu/hour.

To determine the intersection capacity on Sunday morning, the basic capacity (C_0) is 3,200 pcu/hour, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.28, Fbka 0.69, and Frmi 0.86, resulting in an intersection capacity of 3,928 pcu/hour. For Sunday midday, applying the same basic capacity (C_0) and adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.26, Fbka 0.72, and Frmi 0.87 yields an intersection capacity of 4,131 pcu/hour. Meanwhile, on Sunday afternoon, with adjustment factors of Flp 1.68, Fm 1.05, Fuk 1.05, Fhs 0.88, Fbki 1.29, Fbka 0.73, and Frmi 0.86, the calculated intersection capacity is 4,203 pcu/hour.

The following is an example calculation for the Friday afternoon peak hour:

$$\text{Capacity} = C_0 \times Flp \times Fm \times Fuk \times Fhs \times Fbki \times Fbka \times Frmi$$
$$= 3{,}200 \times 1.68 \times 1.05 \times 1.05 \times 0.88 \times 1.25 \times 0.74 \times 0.88$$
$$= 4{,}254 \text{ pcu/hour}$$

Table 2. Average Peak Afternoon Capacity from Monday to Sunday

Hari	Senin	Selasa	Rabu	Kamis	Jumat	Sabtu	Minggu
Kapasitas (smp/jam)	4391	4165	4217	4243	4254	4105	4203

The capacity graph shows that the highest capacity at the unsignalized intersection on Jalan Raya Taman Asri–Tambak Rejo occurs on Monday afternoon with a capacity of 4,391 pcu/hour, while the lowest capacity is recorded on Saturday midday at 3,649 pcu/hour.

The traffic behavior analysis focuses on determining the Degree of Saturation (DS) and delays. The Degree of Saturation (DS) is used as a parameter to determine the level of service of the intersection. If the resulting DS reaches 0.85, the intersection is considered congested and produces long queues. Furthermore, traffic delay (DTi) is calculated as the waiting time caused by conflicting traffic movements, followed by the determination of average geometric delay (DG), which is caused by vehicle deceleration and acceleration when turning at the intersection, and finally the total intersection delay (D).

Table 3. Degree of Saturation and Delay Data for Monday, 8 September 2025

Pilihan	Arus lalu lintas	Kinerja lalu lintas						
		Dj	Tll	Tllma	Tllmi	Tg	T	Pa
Pagi	3899	0,94	9,75	7,29	13,39	4,05	13,80	7.83-19.2
Siang	2305	0,59	6,67	5,03	9,2	4,47	11,14	10.6-24.0
Sore	3784	0,86	10,67	7,81	15,4	4,14	14,81	20.4-41.4

(Source: Processed by the Researcher, 2025)

To determine the delay on Monday morning, the traffic delay (Tll) is 9.75 seconds. The traffic delay on the major road (Tllma) is 7.29 seconds, while the traffic delay on the minor road (Tllmi) is 13.39 seconds. The geometric delay at the intersection (Tg) is 4.05 seconds, resulting in a total intersection delay (T) of 13.80 seconds. The degree of saturation for the morning period is 0.94. For Monday midday, the traffic delay (Tll) is 6.67 seconds, with a major road delay (Tllma) of 5.03 seconds and a minor road delay (Tllmi) of 9.20 seconds. The geometric delay (Tg) is 4.47 seconds, resulting in a total delay (T) of 11.14 seconds, and the degree of saturation is 0.59. For Monday afternoon, the traffic delay (Tll) is 10.67 seconds, the major road delay (Tllma) is 7.81 seconds, the minor road delay (Tllmi) is 15.40 seconds, the geometric delay (Tg) is 4.14 seconds, and the total intersection delay (T) is 14.81 seconds, with a degree of saturation of 0.86.

Table 4. Degree of Saturation and Delay Data for Tuesday, 9 September 2025

Pilihan	Arus lalu lintas	Kinerja lalu lintas						
		Dj	Tll	Tllma	Tllmi	Tg	T	Pa
Pagi	2605	0,67	7,42	5,58	10,63	4,34	11,75	7.83-19.2
Siang	2085	0,54	6,25	4,72	9,6	4,45	10,71	10.6-24.0
Sore	2787	0,67	7,53	5,65	11,7	4,32	11,85	20.4-41.4

(Source: Processed by the Researcher, 2025)

To determine the delay on Tuesday morning, the traffic delay (Tll) was found to be 7.42 seconds. The traffic delay on the major road (Tllma) was 5.58 seconds, while the traffic delay on the minor road (Tllmi) was 10.63 seconds. The geometric delay at the intersection (Tg) was 4.34 seconds, resulting in a total intersection delay (T) of 11.75 seconds. The degree of saturation in the morning period was 0.67. To determine the delay on Tuesday midday, the

traffic delay (Tll) was 6.25 seconds, the major road delay (Tllma) was 4.72 seconds, and the minor road delay (Tllmi) was 9.60 seconds. The geometric delay (Tg) was 4.45 seconds, producing a total intersection delay (T) of 10.71 seconds, with a degree of saturation of 0.54.

To determine the delay on Tuesday afternoon, the traffic delay (Tll) was 7.53 seconds, the major road delay (Tllma) was 5.65 seconds, and the minor road delay (Tllmi) was 11.70 seconds. The geometric delay (Tg) was 4.32 seconds, resulting in a total intersection delay (T) of 11.85 seconds, with a degree of saturation of 0.67.

Table 5. Degree of Saturation and Delay Data for Wednesday, 10 September 2025

Pilihan	Arus lalu lintas	Kinerja lalu lintas						
		Dj	Tll	Tllma	Tllmi	Tg	T	Pa
Pagi	2375	0,62	6,97	5,25	10,62	4,42	11,40	7.83-19.2
Siang	2105	0,56	6,39	4,83	8,7	4,47	10,87	10.6-24.0
Sore	2575	0,61	6,87	5,18	10,5	4,42	11,29	20.4-41.4

(Source: Processed by the Researcher, 2025)

To determine the delay on Wednesday morning, the traffic delay (Tll) was 6.97 seconds, the major road delay (Tllma) was 5.25 seconds, and the minor road delay (Tllmi) was 10.62 seconds. The geometric delay (Tg) was 4.42 seconds, resulting in a total intersection delay (T) of 11.40 seconds, with a degree of saturation of 0.62. For Wednesday midday, the traffic delay (Tll) was 6.39 seconds, the major road delay (Tllma) was 4.83 seconds, and the minor road delay (Tllmi) was 8.70 seconds. The geometric delay (Tg) was 4.47 seconds, producing a total intersection delay (T) of 10.87 seconds, with a degree of saturation of 0.56. For Wednesday afternoon, the traffic delay (Tll) was 6.87 seconds, the major road delay (Tllma) was 5.18 seconds, and the minor road delay (Tllmi) was 10.50 seconds. The geometric delay (Tg) was 4.42 seconds, resulting in a total intersection delay (T) of 11.29 seconds, with a degree of saturation of 0.61.

Table 6. Degree of Saturation and Delay Data for Thursday, 11 September 2025

Pilihan	Arus lalu lintas	Kinerja lalu lintas						
		Dj	Tll	Tllma	Dj	Tg	T	Dj
Pagi	2269	0,69	7,54	5,68	8,43	4,38	11,91	7.83-19.2
Siang	2587	0,62	6,97	5,25	12,4	4,39	11,36	10.6-24.0
Sore	3490	0,76	8,80	6,55	16,1	4,21	13,01	20.4-41.4

(Source: Processed by the Researcher, 2025)

To determine the delay on Thursday morning, the traffic delay (Tll) was 7.54 seconds, the major road delay (Tllma) was 5.68 seconds, and the minor road delay (Tllmi) was 8.43 seconds. The geometric delay (Tg) was 4.38 seconds, resulting in a total intersection delay (T) of 11.91 seconds, with a degree of saturation of 0.69. For Thursday midday, the traffic delay (Tll) was 6.97 seconds, the major road delay (Tllma) was 5.25 seconds, and the minor road delay (Tllmi) was 12.40 seconds. The geometric delay (Tg) was 4.39 seconds, producing a total intersection delay (T) of 11.36 seconds, with a degree of saturation of 0.62. For Thursday afternoon, the traffic delay (Tll) was 8.80 seconds, the major road delay (Tllma) was 6.55 seconds, and the minor road delay (Tllmi) was 16.10 seconds. The geometric delay (Tg) was 4.21 seconds, resulting in a total intersection delay (T) of 13.01 seconds, with a degree of saturation of 0.76.

Table 7. Degree of Saturation and Delay Data for Friday, 12 September 2025

Pilihan	Arus lalu lintas	Kinerja lalu lintas						
		Dj	Tll	Tllma	Dj	Tg	T	Dj
Pagi	2269	0,76	8,19	6,16	6,08	4,21	12,41	7.83-19.2
Siang	2587	0,67	7,41	5,58	11,0	4,30	11,70	10.6-24.0
Sore	3490	0,95	13,10	9,35	16,8	4,04	17,15	20.4-41.4

(Source: Processed by the Researcher, 2025)

To determine the delay on Friday morning, the traffic delay (Tll) was 8.19 seconds, the major road delay (Tllma) was 6.16 seconds, and the minor road delay (Tllmi) was 6.08 seconds. The geometric delay (Tg) was 4.21 seconds, resulting in a total intersection delay (T) of 12.41 seconds, with a degree of saturation of 0.76. For Friday midday, the traffic delay (Tll) was 7.41 seconds, the major road delay (Tllma) was 5.58 seconds, and the minor road delay (Tllmi) was 11.00 seconds. The geometric delay (Tg) was 4.30 seconds, producing a total intersection delay (T) of 11.70 seconds, with a degree of saturation of 0.67. For Friday afternoon, the traffic delay (Tll) was 13.10 seconds, the major road delay (Tllma) was 9.35 seconds, and the minor road delay (Tllmi) was 16.80 seconds. The geometric delay (Tg) was 4.04 seconds, resulting in a total intersection delay (T) of 17.15 seconds, with a degree of saturation of 0.95.

Table 8. Degree of Saturation and Delay Data for Saturday, 13 September 2025

Pilihan	Arus lalu lintas	Kinerja lalu lintas						
		Dj	Tll	Tllma	Dj	Tg	T	Dj
Pagi	2793	0,69	7,59	5,72	11,74	4,31	11,90	7.83-19.2
Siang	2495	0,68	7,51	5,66	11,1	4,36	11,87	10.6-24.0
Sore	3495	0,85	10,45	7,66	16,0	4,13	14,58	20.4-41.4

(Source: Processed by the Researcher, 2025)

To determine the delay on Saturday morning, the traffic delay (Tll) was 7.59 seconds, the major road delay (Tllma) was 5.72 seconds, and the minor road delay (Tllmi) was 11.74 seconds. The geometric delay (Tg) was 4.31 seconds, resulting in a total intersection delay (T) of 11.90 seconds, with a degree of saturation of 0.69. For Saturday midday, the traffic delay (Tll) was 7.51 seconds, the major road delay (Tllma) was 5.66 seconds, and the minor road delay (Tllmi) was 11.10 seconds. The geometric delay (Tg) was 4.36 seconds, producing a total intersection delay (T) of 11.87 seconds, with a degree of saturation of 0.68. For Saturday afternoon, the traffic delay (Tll) was 10.45 seconds, the major road delay (Tllma) was 7.66 seconds, and the minor road delay (Tllmi) was 16.00 seconds. The geometric delay (Tg) was 4.13 seconds, resulting in a total intersection delay (T) of 14.58 seconds, with a degree of saturation of 0.85.

Table 10. Degree of Saturation and Delay Data for Sunday, 14 September 2025

Pilihan	Arus lalu lintas	Kinerja lalu lintas						
		Dj	Tll	Tllma	Dj	Tg	T	Dj
Pagi	2626	0,67	7,38	5,56	10,72	4,38	11,76	7.83-19.2
Siang	2858	0,69	7,58	5,71	11,8	4,30	11,88	10.6-24.0
Sore	3714	0,88	11,19	8,15	17,1	4,12	15,31	20.4-41.4

(Source: Processed by the Researcher, 2025)

To determine the delay on Sunday morning, the traffic delay (Tll) was 7.38 seconds, the major road delay (Tllma) was 5.56 seconds, and the minor road delay (Tllmi) was 10.72 seconds. The geometric delay (Tg) was 4.38 seconds, resulting in a total intersection delay (T) of 11.76 seconds, with a degree of saturation of 0.67. For Sunday midday, the traffic delay (Tll) was 7.58 seconds, the major road delay (Tllma) was 5.71 seconds, and the minor road delay (Tllmi) was 11.80 seconds. The geometric delay (Tg) was 4.30 seconds, producing a total intersection delay (T) of 11.88 seconds, with a degree of saturation of 0.69. For Sunday afternoon, the traffic delay (Tll) was 11.19 seconds, the major road delay (Tllma) was 8.15 seconds, and the minor road delay (Tllmi) was 17.10 seconds. The geometric delay (Tg) was 4.12 seconds, resulting in a total intersection delay (T) of 15.31 seconds, with a degree of saturation of 0.88.

Example Calculation for Friday Afternoon

Degree of Saturation:

$$D_J = \frac{q}{C}$$

$$= \frac{4042}{4254}$$

$$= 0{,}95$$

Tundaan Lalu Lintas Simpang :

$$T_{LL} = \frac{1{,}0504}{(0{,}2742 - 0{,}2042 D_J)} - (1 - D_J)^2$$

$$T_{LL} = \frac{1{,}0504}{(0{,}2742 - 0{,}2042 \times 0{,}95)} - (1 - 0{,}95)^2$$

= 13,10 det/smp

Tundaan Lalu Lintas Jalan Utama :

$$T_{LLma} = \frac{1{,}0503}{(0{,}3460 - 0{,}2460\ D_J)} - (1 - D_J)^{1{,}8}$$

$$T_{LLma} = \frac{1{,}0503}{(0{,}3460 - 0{,}2460 \times 0{,}95)} - (1 - 0{,}95)^{1{,}8}$$

= 9,35 det/smp

Tundaan Lalu Lintas Jalan Minor :

$$T_{LLmi} = \frac{q_{KB} \times T_{LL} - q_{ma} \times T_{LLma}}{q_{mi}}$$

$$T_{LLmi} = \frac{3490 \times 13{,}30 - 2842 \times 9{,}35}{1138{,}8}$$

= 16,8 det/smp

Tundaan Geometri Simpang :

Untuk DS $\geq$ 1,0 maka DG = 4

Tundaan Simpang :

D = DG + DT1

= 4 + 13,10

= 17,10 det/smp

Table 10. Average Degree of Saturation from Monday to Sunday

Jam Puncak	Senin	Selasa	Rabu	Kamis	Jumat	Sabtu	Minggu
Pagi	0,94	0,67	0,62	0,69	0,76	0,69	0,67
Siang	0,59	0,54	0,56	0,62	0,67	0,68	0,69
Sore	0,86	0,67	0,61	0,76	0,95	0,85	0,88

(Source: Processed by the Researcher, 2023)

Notes:

DS > 0.85 indicates poor intersection performance.
DS < 0.85 indicates good intersection performance.

Based on Table 4.32, the unsignalized intersection on Jalan Raya Taman Asri–Tambak Rejo shows average degrees of saturation exceeding 0.85 on Monday morning and afternoon, Friday afternoon, Saturday afternoon, and Sunday afternoon. According to PKJI 2014 (see Table 2.5), degrees of saturation below 0.85—observed on Monday midday; Tuesday; Wednesday; Thursday; Friday morning and midday; Saturday morning and midday; and Sunday morning and midday—indicate a good level of service due to the absence of significant delays. Conversely, periods with DS values above 0.85 indicate poor service levels due to the occurrence of delays (17.10 seconds). Therefore, the unsignalized intersection on Jalan Raya Taman Asri–Tambak Rejo experiences busy conditions during Monday morning and afternoon, Friday afternoon, Saturday afternoon, and Sunday afternoon.

Queue Probability

Queue probability (Pa%) represents the likelihood of queues involving more than two vehicles occurring at any approach of an unsignalized intersection. The threshold values of queue probability can be estimated from the relationship between the queue probability curve and the degree of saturation, as shown in Figure 2.5.

Table 11. Lower Bound Queue Probability (%)

	Peluang Antrian						
Hari/Waktu	Senin	Selasa	Rabu	Kamis	Jumat	Sabtu	Minggu
Pagi	36	19	16	19	23	20	18
Siang	15	13	13	16	19	19	20
Sore	30	18	16	24	36	29	31

(Source: Processed by the Researcher, 2025)

Example calculation for Friday afternoon:

$$Pa = 9{,}02 \times Dj + 20{,}66 \times Dj^2 + 10{,}49 \times Dj^3$$
$$= 9{,}02 \times 0{,}95 + 20{,}66 \times 0{,}95^2 + 10{,}49 \times 0{,}95^3$$
$$= 36$$

Table 12. Upper Bound Queue Probability (%)

	Peluang Antrian						
Hari/Waktu	Senin	Selasa	Rabu	Kamis	Jumat	Sabtu	Minggu
Pagi	71	38	34	39	47	40	38
Siang	31	28	29	34	38	39	40
Sore	59	38	33	47	72	58	62

(Source: Processed by the Researcher, 2025)

Example calculation for Friday afternoon:

$$Pa = 47{,}71 \times Dj + 24{,}68 \times Dj^2 + 56{,}47 \times Dj^3$$
$$= 47{,}71 \times 0{,}95 + 24{,}68 \times 0{,}95^2 + 56{,}47 \times 0{,}95^3$$
$$= 72$$

Based on the analysis above, the peak conditions at the unsignalized intersection on Jalan Raya Taman Asri–Tambak Rejo occur on Monday and Friday afternoons, where the queue probability ranges from 36% to 72% (<100%). This indicates that the intersection performance remains acceptable and has not reached full saturation, in accordance with the interpretation of PKJI 2014.

CONCLUSION

Based on the analysis of the research results at the unsignalized intersection on Jalan Raya Taman Asri–Tambak Rejo, it can be concluded that the highest traffic volume occurred on Friday afternoon at 4,042 pcu/hour, while the lowest volume occurred on Tuesday afternoon at 2,085 pcu/hour. The highest intersection capacity was recorded on Monday afternoon at 4,391 pcu/hour with a traffic volume of 3,784 pcu/hour, whereas the lowest capacity occurred on Saturday afternoon at 3,649 pcu/hour with a traffic volume of 2,495 pcu/hour. Furthermore, the performance analysis of the 324-type unsignalized intersection shows that peak congestion occurred on Friday afternoon, indicated by a degree of saturation of 0.95, a queue probability ranging from 36–72%, and an average delay of 17.10 seconds. Although the intersection is generally classified as being in good condition, the degree of saturation exceeds the recommended maximum value of 0.85, indicating the need for traffic engineering improvements to reduce congestion and enhance overall intersection performance.

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