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TRAFFIC PERFORMANCE ANALYSIS DUE TO SHOPPING CENTER ACTIVITIES (Case Study of Ahmad Yani Street, Ketintang Street and Ahmad Yani-Ketintang Street Intersection Surabaya)

Mohamad Rahan Ardiansyah[1], Hanie Teki Tjendani[2]
[1]Civil Engineering, Universitas 17 Agustus 1945 Surabaya, [2]Civil Engineering, Universitas 17 Agustus 1945 Surabaya
[1]rahanardiansyah633@Gmail.com; [2]hanie@untag-sby.ac.id

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ABSTRACT

The growth of commercial areas in urban areas, especially shopping centers, has contributed significantly to the increase in traffic volume. This study aims to analyze the influence of Royal Plaza visitor activities on traffic volume and degree of saturation on the Jalan Ahmad Yani network, Jalan Ketintang, and the Ahmad Yani-Ketintang intersection in Surabaya City. The method used refers to the Indonesian Road Capacity Guidelines (PKJI) 2023, with primary data collection through a traffic volume survey for four days in three time periods (day, evening, night), then analyzed to obtain capacity values, actual volume, and degree of saturation (DS) on each road segment. The results of the analysis show that the highest traffic volume was recorded at 5444.70 SMP/hour on Jalan Ahmad Yani, with a road capacity of 5115.64 SMP/hour, resulting in a degree of saturation (DS) value of 1.06. This value indicates that the level of road service is in category F, which reflects very saturated traffic conditions and congestion. Meanwhile, the Ahmad Yani–Ketintang intersection shows DS ranging from 0.85 to 1.19, depending on peak times. This finding confirms that the presence of Royal Plaza places a significant traffic burden on the surrounding road network, and a traffic management strategy is needed to mitigate the impact and improve road service performance.

Keywords : *Degree of saturation, PKJI 2023, Road performance, Traffic volume.*

1. INTRODUCTION

Shopping centers are a vital element in the development of modern urban areas. Their function is not only as a place for economic transactions, but also as a magnet for social activities that have a major impact on the surrounding transportation system. One of the main challenges in urban spatial planning is how to balance economic growth and the efficiency of an integrated transportation system. (Alfian Haris Aryawan, 2018). In big cities like Surabaya, the growth of commercial centers is not always balanced by an increase in the capacity and efficiency of the road network, which ultimately has an impact on the decline in the level of road service. (Muhamad Lukman Nur Hakim, Herry Widhiarto, 2014).

Surabaya City as the economic center of East Java has experienced significant growth in the commercial sector, including the construction of large-scale shopping centers such as Royal Plaza. Royal Plaza is located on Jalan Ahmad Yani, which is a primary arterial road with high traffic density. (Adie et al., 2021). The existence of the shopping center has great potential in increasing the intensity of vehicle flow, especially on weekends and holidays. (Salfa Hanum Cahyani, 2023).

A similar study at Pesona Depok Mall by (Febira Chaerunisa, 2019) found that more than 22% of vehicles passing through the area were headed to the shopping center, and the increase in volume pushed the DS value from 0.83 to 0.86.

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Research by (Agustinus Rivaldo, John H. Frans, 2023) in the Ruko Lontar area of Surabaya shows that the elimination of right turns and traffic diversion can reduce DS from 0.677 to 0.329. This shows that technical evaluation and intervention are very necessary in areas with high commercial activity.

Furthermore, a study by (Iqbal Kharis Hanafi, 2022) in Gresik stated that the projection of vehicle volume in the next five years without handling will increase DS from 0.76 to 0.87. While (Andreas Ohotan, Meike M. Kumaat, 2023) using VISSIM simulation in Manado and showing that shopping centers can increase the average delay by 40 seconds per vehicle.

Traffic problems arising from shopping center activities need to be analyzed to determine the extent of their influence on the performance of the surrounding road network. Without proper transportation management and planning, increased vehicle volumes due to shopping activities can reduce the level of road service, increase delays, and worsen congestion. (Pongkorung et al., 2024).

This study aims to analyze the influence of shopping center activities on traffic performance on Jalan Ahmad Yani, Jalan Ketintang, and the Ahmad Yani–Ketintang intersection. The study uses an analytical method based on the Indonesian Road Capacity Guidelines (PKJI) 2023 to measure traffic volume, road capacity, and degree of saturation. It is hoped that the results of this study can provide technical and strategic policy recommendations for improving traffic performance in the area around the shopping center. The scope of the study is limited to the analysis of road performance on Ahmad Yani Street, Ketintang Street, and their intersection in the Royal Plaza area, focusing on weekend traffic conditions during peak hours in the afternoon, evening, and nighttime. It includes an assessment of geometric characteristics of the roads and intersection, traffic volumes derived from daily traffic surveys and road inventory, as well as an analysis of the impact of Royal Plaza activities on road capacity, traffic behavior, and level of service, based on PKJI 2023. Additionally, the study offers recommendations for mitigation strategies aimed at improving the efficiency and quality of service of the road network and intersection. However, it does not include detailed discussions on land use, off-peak traffic conditions, delay-related costs, parking conditions, or future transportation projections.

The problem formulation in this research is :

How much does the traffic volume and degree of saturation due to shopping center visitor activities affect the performance of the Jalan Ahmad Yani, Jalan Ketintang, and Jalan Ahmad Yani – Jalan Ketintang intersection networks ?

2. LITERATURE REVIEW

Transportation System

An effective transportation system is essential for regional development, especially in large cities with rapid population and economic growth. This system includes road networks, transportation facilities, and traffic management to ensure smooth and efficient mobility of people and goods. In Indonesia, the road transportation system is the most widely used because of its accessibility and flexibility. However, urban transportation systems often experience pressure due to an imbalance between road capacity and increasing travel demand, causing congestion and declining service quality. Good transportation planning requires vehicle volume data and road network performance evaluation to improve efficiency and reduce problems.

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Indonesian Road Capacity Manual 1997 (MKJI 1997)

Indonesian Road Capacity Manual MKJI 1997 is a manual book, whict is used to calculate road traffic performance but cannot be used to view or analyze the network. The manual guideline for planning, designing, analyzing road facility operations, traffic situations and conditions in Indonesia. MKJI provides methods and parameters for analyzing road and intersection performance, but has been update with PKJI 2023 which uses more modern methods and is in accordance with current conditions.

Indonesian Road Capacity Guidelines 2023 (PKJI 2023)

Indonesian Road Capacity Guidelines PKJI 2023 is a technical document prepared by the Directorate General of Highways as a reference in analyzing the performance of road sections and intersections. PKJI is used by transportation planners, local governments, and academics in evaluating whether a road is able to serve traffic flow optimally. PKJI 2023 is a revision of the previous version, with adjustments to capacity parameters, free flow models, and passenger car units (PCU) based on the development of road conditions in Indonesia. provides a method for calculating road capacity, both for one-way, two-way, and collector and arterial roads. In addition, PKJI also provides guidance in assessing unsignalized intersections, signalized intersections. In this study, PKJI 2023 is the main reference for calculating traffic volume, road capacity, and degree of saturation in order to determine the level of road service affected by shopping center activities. (PKJI, 2023).

Traffic Volume

Traffic volume is the number of vehicles passing a point on a road during a given time, usually measured in vehicles per hour or passenger car units (PCU/hour). It is affected by the time of day and day, as well as the characteristics of road users. In transportation research, traffic volume is converted to PCU to equalize the effects of different types of vehicles on road capacity, since vehicles vary in size and speed. Thus, this conversion helps in more accurate traffic planning and management.

Tabel 2.1 Passenger Car Unit Factor.

No.	Vehicle Type	Class	CPU	
			Section	Crossroads
1.	Sedan/Jeep, Oplet, Microbus, Pick Up	LV	1,00	1,00
2.	Standard Bus, Trailer Truck, Heavy Truck	HV	1,20	1,30
3.	Motorcycle	MC	0,25	0,40
4.	Rickshaw, Bicycle, Etc.	UM	0,80	1,00

Source: PKJI (2023)

High traffic volumes, especially during peak hours, often put pressure on road infrastructure. Therefore, evaluating vehicle volumes is essential in the study of the impact of shopping centers on traffic.

Road Capacity

Road capacity is defined as the maximum amount of traffic that can pass a point on the road per unit time (per hour) under certain conditions. For two-lane, two-way roads, capacity is calculated for two-way traffic (a combination of both directions), while on multi-lane roads, traffic is separated by direction and capacity is calculated per lane. Urban road capacity is usually expressed in passenger car

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units per hour (pcu/hour). To analyze road capacity, the calculation formula that is in accordance with PKJI can be used as follows :

C = Co x FCw x FCsp x FCsf x FCcs……...(2.1)

Description :

C = Capacity
Co = Basic Capacity
FCw = Capacity correction factor for road width
FCsp = Capacity correction factor due to direction division
FCsf = Capacity correction factor due to side disturbances
FCcs = Capacity correction factor due to City size

Intersection Capacity

Unsignalized intersections are road intersections that do not use signal lights to regulate traffic, these intersections are usually found on local roads in the city or in housing complexes. The calculation of the capacity of unsignalized intersections is determined by the following equation : (PKJI, 2023)

C = Co x Fw x Fcs x Frsu x Flt x Fmi (smp/jam)……..(2.2)

Description :

C = Capacity (Pcu/Hour)
Co = Basic Capacity (Pcu/Hour)
Fw = Capacity Correction Factor For Intersection Road Width
Fcs = Capacity Coreection Factor due to City size (Population)
Frsu = Capacity Correction Factor due to Environmental type, side disthurbances and non-motorized vihicles
Flt = Capacity Correction Factor due to Left turning movement
Frt = Capacity Correction Factor due to Right turning movement
Fmi = Capacity Correction Factor due to traffic flow on minor roads

Degree of Saturation

The degree of saturation is one of the most crucial indicators in analyzing road performance. This value indicates the level of utilization of road capacity by actual vehicle volume. The higher the DS value, the greater the possibility of congestion because the road capacity is almost fully utilized. The DS value is calculated using the formula:

DS : $\frac{V}{C}$……..…(2.3)

Description :

V = Traffic Volume (Cpu/Hour)
C = Maximum Road Capacity (Cpu/Hour)

If the DS value approaches or exceeds 1, then the traffic flow becomes very unstable, delays often occur, and the potential for congestion increases. Roads with DS > 1 are declared saturated and require technical intervention such as traffic engineering or road widening.

Level Of Service

Level of Service is a classification of road performance based on the degree of saturation. PKJI divides LOS into six levels, from A to F, with A indicating free flow conditions and F indicating total congestion.

Tabel 2.2 Level of Service Category

Degrees of Saturation (DS)	Level of Service (LOS)	Characteristics Service
0,00 - 0,20	A	Aris is free, there is nothing obstacle.

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0,21 – 0,44	B	Steady current,speed tall.
Degrees of Saturation (DS)	**Level of Service (LOS)**	**Characteristics Service**
0,45 – 0,74	C	Steady current, speed starting to be affected
0,75 – 0,84	D	The Current is approaching saturation the delay is starting to be felt
0,85 – 1,00	E	The current is unstabe delay often occur
> 100	F	The current is very saturated, traffic jams occur continuously

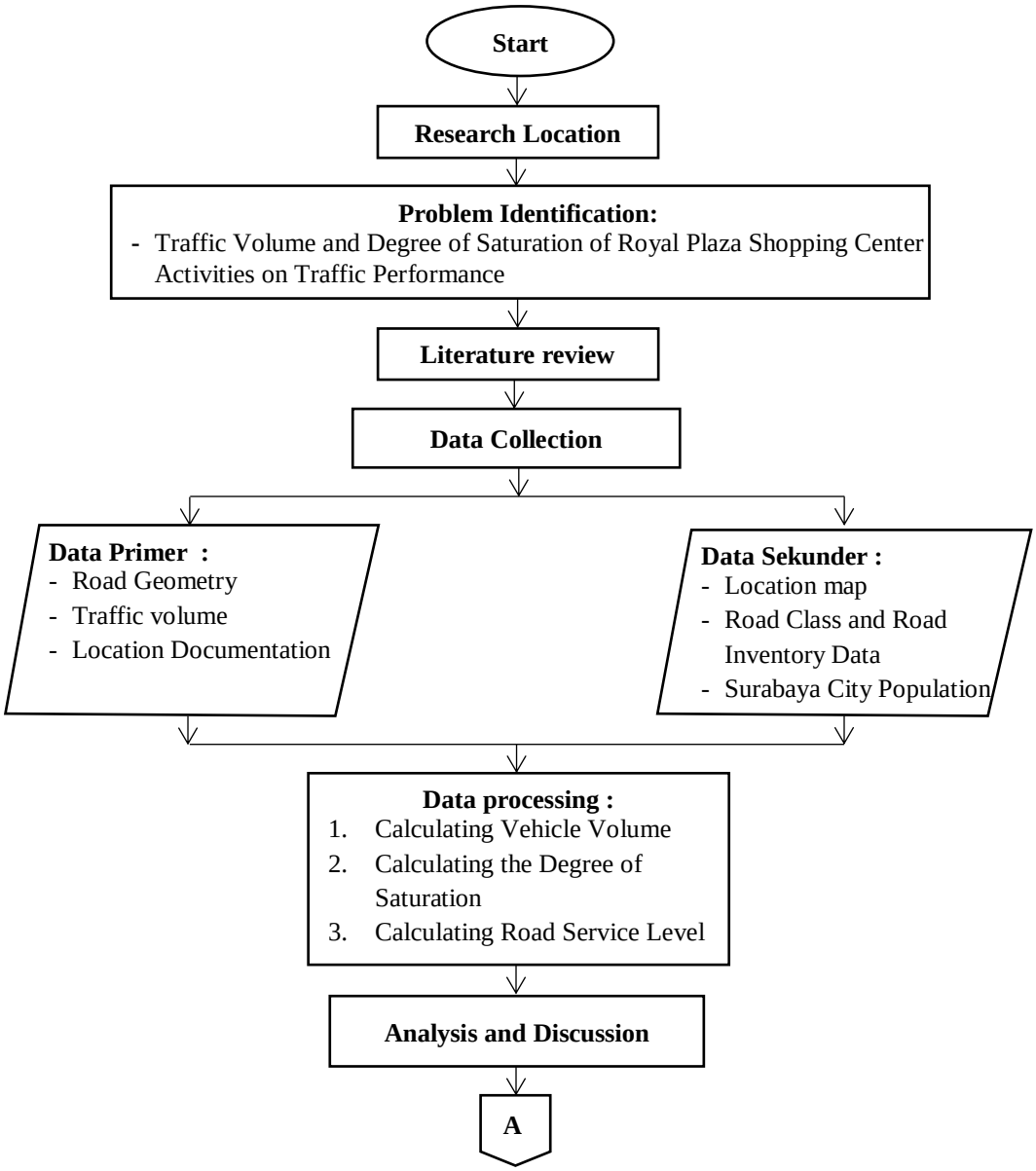
Source: PKJI (2023)

Understanding Level of Service is essential in formulating transportation policies and making technical decisions to improve traffic performance.

3. RESEARCH METHODOLOGY

Flowchart

In general, the research stages in this study are designed to simplify the implementation process. These stages illustrate the sequence of steps taken by the author in completing the research, as explained below:



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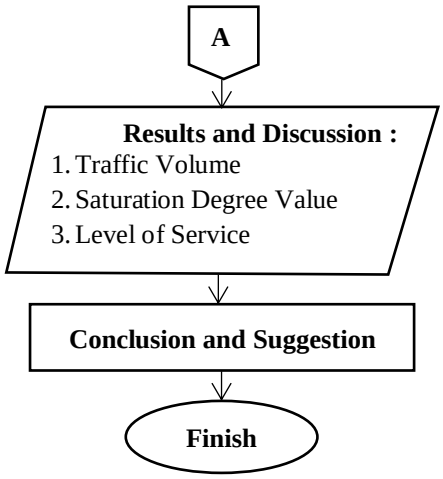

Figure 3.1 Flowchart

Survey Time and Location

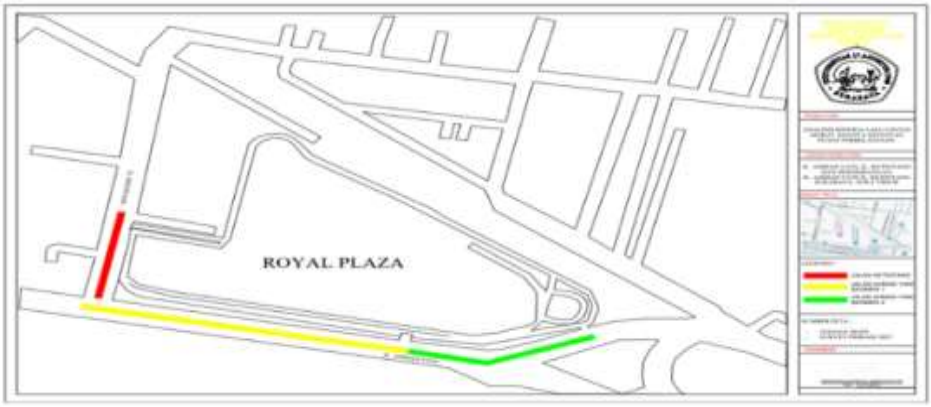

Figure 3.2 Research Location

This study uses a quantitative approach with survey data obtained directly from the research location, then analyzed based on the Indonesian Road Capacity Guidelines. (PKJI 2023)

Data collection using the Traffic Counting method was carried out for 4 days, namely on Monday, Tuesday, Saturday and Sunday. The time for implementing Traffic Counting per day is divided into 3 time ranges, namely the afternoon peak (12.00 - 13.00), Evening Peak (15.00 - 16.00) and Night Peak (18.00 - 19.00). The method used in calculating traffic volume is manual and LHR collection is carried out at 3 locations (Ketintang Street, Ahmad Yani Street segment I, Ahmad Yani Street segment II and the Ahmad Yani-Ketintang Street intersection) which have been determined in **Figure 3.2** with 10 surveyors.

Data Collection

The data collection during the survey were : Data on the number of Vechicles, Type of vechicles (LV, HV, MC, UM) and Road Geometry data.

Data Processing

Vehicle data is converted to Passenger Car Units (SMP) using the equivalence factor according to PKJI 2023. Road capacity is calculated based on geometric characteristics and road classification. Furthermore, the degree of saturation (DS) is calculated using **Formula 2.3.**

Analysis using the PJKI 2023 method

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The analytical method in this study is used to process data obtained from primary and secondary surveys. One of the main analyses conducted is the calculation of the level of service (LOS), which is a qualitative measure that describes the operational condition of traffic flow as well as drivers' and passengers' perceptions of these conditions. The assessment of LOS is based on two key factors: travel speed and the volume-to-capacity (V/C) ratio, which reflects traffic congestion levels. Each road facility is classified into six levels of service, ranging from Level A, indicating excellent operating conditions, to Level F, representing very poor conditions. The characteristics of the LOS based on the ratio are determined using established formulas and reference tables (**Formula 2.3 and Table 2.2**). The results of this calculation provide an overview of how the road's level of service can influence the trip generation and attraction associated with the shopping center, in accordance with the existing LOS categories.

4. ANALYSIS AND DISCUSSION

In analyzing road performance, it is essential to understand both the road capacity and the traffic volume on the roads being studied. Road capacity can be determined by identifying the geometric characteristics of the road, such as lane width, number of lanes, and intersection design. Meanwhile, traffic volume is measured by counting the number of vehicles passing through a given point over a specific time period. These two parameters are crucial in assessing the efficiency and level of service of the road. In the context of this study, the presence and activities of Royal Plaza significantly influence traffic patterns in the surrounding area, particularly during peak hours on weekends. Increased vehicle flow to and from the plaza may lead to congestion, reduced travel speed, and lower service levels, making it necessary to analyze how this commercial activity affects the overall performance of the adjacent road network and intersection.

Road Geometry

Tabel 4.1 Road Geometry

Road Characteristics	Ketintang Street	Ahmad Yani Street	
		Segmen I	Segmen II
Road Type	2/2 UD	6/2 D	6/2 D
Pavement Widht	6,5 meters	12,75 meters	12,6 meters
Number of Lanes	2	3	3
Direction System	2	2	2
Median	-	1,85 meters	0,3 meters
Sidewalk	-	2,3 meters	1,1 meters
Roadside	3 meters	-	-
City Class Size	High (3.020.000 people)		

Source : Researcher's Process Results, 2025

Road Capacity

The following is an example of calculating road capacity based on the variables in the road capacity equation formula.

Ketintang Street

- **Basic capacity adjustment factor**
  The Type of Ketintang road is two (2) lanes, Two (2) directions, Therefore, the basic capacity value. (Co) is 2900 x 1 = 2900
  Co = 2900
- **Capacity correction factor for road width**
  The type of Ketintang road is two (2) lanes, two (2) directions with an effective

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width per lane of 9 meters. Therefore, the value of the capacity correction factor due to road width. (FCw) = 1,25

FCw = 1,25

- **Capacity correction factor due to direction division**
  The type of Ketintang road is two (2) lanes, two (2) directions in connection with the research which only focuses on 1 direction, then the division of the SP direction is 55% - 45%. Therefore, the value of the Capacity Correction Factor due to the division of directions.(FCsp) = 0,97
  FCsp = 0,97
- **Capacity correction factor due to side disturbances**
  Based on the classification of side obstacles, Ketintang Street is included in the high category because it is a commercial area with relatively high roadside activities. With a high class of side obstacles with a shoulder width of 1.5. So, the value of the capacity correction factor due to side disturbances. (FCsf) = 0,82
  FCsf = 0,82
- **Capacity correction factor due to city size**
  Based on data from the Surabaya City document in figures for 2025, it is recorded that the population of Surabaya City in 2024 is recorded at 3.02 million people. Therefore, the value of the capacity correction factor due to city size. (FCcs) = 1,04
  FCcs = 1,04

Based on the calculations of each variable that have been carried out above, the road capacity can be determined as follows :

Tabel 4.2 Road Capacity

Road Capacity	Ketintang Street	Ahmad Yani Street	
		Segmen I	Segmen II
Co	2900	4950	4950
FCsp	0,97	1,00	1,00
FCw	1,25	1,08	1,08
FCsf	0,82	0,98	0,92
FCcs	1,04	1,04	1,04
Capacity (C)	2998,66	5448,64	5115,05

Source: Researcher's Process Results, 2025

Traffic Volume

Tabel 4.3 Traffic Volume on Ketintang Road

Ketintang Road						
Day	Peak	UM	MC	LV	HV	Total
Saturday	Afternoon	41	2096	302	-	2439
	Evening	33	1718	278	-	2029
	Night	40	2103	330	-	2473
Sunday	Afternoon	38	1994	346	-	2378
	Evening	30	1630	302	-	1962
	Night	35	2008	350	-	2393
Monday	Afternoon	66	2478	252	-	2796
	Evening	41	1895	354	-	2290
	Night	32	2305	301	-	2638
Tuesday	Afternoon	65	2392	297	-	2754
	Evening	39	1842	372	-	2253
	Night	30	2181	325	-	2536

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Source: Researcher's Process Results, 2025

Tabel 4.4 Traffic Volume on Ahmad Yani Road segmen I

Ahmad Yani Road segmen I						
Day	**Peak**	**UM**	**MC**	**LV**	**HV**	**Total**
Saturday	Afternoon	22	9321	2766	17	12126
	Evening	21	7236	3031	40	10328
	Night	19	6435	3292	19	9765
Sunday	Afternoon	24	6508	2596	16	9144
	Evening	18	8762	3002	36	11818
	Night	31	6582	3585	20	10218
Monday	Afternoon	23	8577	3218	97	11915
	Evening	18	8079	3481	64	11642
	Night	15	8216	2972	19	11222
Tuesday	Afternoon	28	8287	3157	68	11540
	Evening	25	7808	2846	49	10728
	Night	15	8026	3259	16	11316

Source: Researcher's Process Results, 2025

Tabel 4.5 Traffic Volume on Ahmad Yani Road segmen II

Ahmad Yani Road segmen II						
Day	**Peak**	**UM**	**MC**	**LV**	**HV**	**Total**
Saturday	Afternoon	24	9402	2465	23	11914
	Evening	26	7256	2734	48	10064
	Night	16	6593	2832	18	9459
Sunday	Afternoon	22	8956	2368	22	11368
	Evening	25	7369	2557	57	10008
	Night	14	8793	2706	16	11529
Monday	Afternoon	23	8521	2879	98	11521
	Evening	21	8178	3303	67	11569
	Night	18	8494	2805	19	11336
Tuesday	Afternoon	28	8489	2832	86	11435
	Evening	22	8246	3104	58	11430
	Night	16	8503	2945	23	11487

Source: Researcher's Process Results, 2025

Level Of Service

By using the collected road capacity and traffic volume data, the Vehicle data is converted to Passenger Car Units (SMP) using the equivalence factor according to PKJI 2023. Service level analysis can be done using the formula in **Formula 2.3** and **Table 2.2**. to determine the classification of road service level assessment.

The following is an example of the calculation of the road service level applied during Saturday Afternoon Peak on Jalan Ahmad Yani Segment I:

I = V/C = 5134,25 / 5448,64 = **0,94** (Including Service Level Classification F)

Tabel 4.6 Level of Service on Ketintang Road

Ketintang Road									
Day	**Peak**	**UM**	**MC**	**LV**	**HV**	**Total**	**Road Capacity**	**DS**	**LOS**
Saturday	Afternoon	32,80	524,00	302,00	0,00	858,80	2998,66	0,29	B
	Evening	26,40	429,50	278,00	0,00	733,90	2998,66	0,24	B
	Night	32,00	525,75	330,00	0,00	887,75	2998,66	0,30	B
Sunday	Afternoon	30,40	498,50	346,00	0,00	874,90	2998,66	0,29	B
	Evening	24,00	407,50	302,00	0,00	733,50	2998,66	0,24	B
	Night	28,00	502,00	350,00	0,00	880,00	2998,66	0,29	B

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	Afternoon	52,80	619,50	252,00	0,00	924,30	2998,66	0,31	B
Day	**Peak**	**UM**	**MC**	**LV**	**HV**	**Total**	**Road Capacity**	**DS**	**LOS**
Monday	Evening	32,80	473,75	354,00	0,00	860,55	2998,66	0,29	B
	Night	25,60	576,25	301,00	0,00	902,85	2998,66	0,30	B
Tuesday	Afternoon	52,00	598,00	297,00	0,00	947,00	2998,66	0,32	B
	Evening	31,20	460,50	372,00	0,00	863,70	2998,66	0,29	B
	Night	24,00	545,25	325,00	0,00	894,25	2998,66	0,30	B

Source: Researcher's Process Results, 2025

Based on the table above, the lowest road service performance on Jalan Ketintang on Tuesday occurred at the afternoon peak with the highest DJ of 0,32. As a result, the level of road service decreased to category B.

Tabel 4.7 Level of Service on Ahmad Yani Road segmen I

Ahmad Yani Road segmen I									
Day	**Peak**	**UM**	**MC**	**LV**	**HV**	**Total**	**Road Capacity**	**DS**	**LOS**
Saturday	Afternoon	17,6	2330,25	2766,0	20,40	5134,25	5448,64	0,94	E
	Evening	16,8	1809,00	3031,0	48,00	4904,80	5448,64	0,90	E
	Night	15,2	1608,75	3292,0	22,80	4938,75	5448,64	0,91	E
Sunday	Afternoon	19,2	1627,00	2596,0	19,20	4261,40	5448,64	0,78	D
	Evening	14,4	2190,50	3002,0	43,20	5250,10	5448,64	0,96	E
	Night	24,8	1645,50	3585,0	24,00	5279,30	5448,64	0,97	E
Monday	Afternoon	18,4	2144,25	3218,0	116,4	5497,05	5448,64	1,01	F
	Evening	14,4	2019,75	3481,0	76,80	5591,95	5448,64	1,03	F
	Night	12,0	2054,00	2972,0	22,80	5060,80	5448,64	0,93	E
Tuesday	Afternoon	22,4	2071,75	3157,0	81,60	5332,75	5448,64	0,98	E
	Evening	20,0	1952,00	2846,0	58,80	4876,80	5448,64	0,90	E
	Night	12,0	2006,50	3259,0	19,20	5296,70	5448,64	0,97	E

Source: Researcher's Process Results, 2025

Based on the table above, the lowest road service performance on Jalan Ketintang on Monday occurred at the afternoon peak with the highest DJ of 1,03. As a result, the level of road service experienced a significant decline reaching category F.

Tabel 4.8 Level of Service on Ahmad Yani Road segmen II

Ahmad Yani Road segmen II									
Day	**Peak**	**UM**	**MC**	**LV**	**HV**	**Total**	**Road Capacity**	**DS**	**LOS**
Saturday	Afternoon	19,2	2350,50	2465,0	27,60	4862,30	5115,64	0,95	E
	Evening	20,8	1814,00	2734,0	57,60	4626,40	5115,64	0,90	E
	Night	12,8	1648,25	2832,0	21,60	4514,65	5115,64	0,88	E
Sunday	Afternoon	17,6	2239,00	2368,0	26,40	4651,00	5115,64	0,91	E
	Evening	20,0	1842,25	2557,0	68,40	4487,65	5115,64	0,88	E
	Night	11,2	2198,25	2706,0	19,20	4934,65	5115,64	0,96	E
Monday	Afternoon	18,4	2130,25	2879,0	117,6	5145,25	5115,64	1,01	F
	Evening	16,8	2044,50	3303,0	80,40	5444,70	5115,64	1,06	F
	Night	14,4	2123,50	2805,0	22,80	4965,70	5115,64	0,97	E
Tuesday	Afternoon	22,4	2122,25	2832,0	103,2	5079,85	5115,64	0,99	E
	Evening	17,6	2061,50	3104,0	69,60	5252,70	5115,64	1,03	F
	Night	12,8	2125,75	2945,0	27,60	5111,15	5115,64	1,00	F

Source: Researcher's Process Results, 2025

Based on the table above, the lowest road service performance on Jalan Ketintang on Monday occurred at the afternoon peak with the highest DJ of 1,06. As a result, the level of road service experienced a significant decline reaching

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category F.

Intersection Service Level

To find the Level of Service of an Intersection, traffic capacity and volume data are required. Intersection Capacity can be calculated using Formula 2.2. The following is an example of a calculation using the Intersection Capacity formula:

Calculation of the Capacity of the Ketintang-Ahmad Yani Road Intersectio

Calculation of road capacity on Saturday afternoon based on the variables in the Intersection capacity equation formula (C)

- **Basic Capacity**
  This Intersection Type is 324 which is a 3-lane Intersection, 2 lanes on minor roads, 4 lanes on major roads. So, the Basic Capacity value (Co) = 3200
  Co = 3200
- **Average Approach Width**
  This Intersection Type is 324 which is a 3-lane Intersection, 2 lanes on minor roads, 4 lanes on major roads. So, the Average Approach Width value (Fw) = 1,29
  Fw = 1,29
- **Major Road Median**
  This Intersection Type is 324, namely Intersection 3, 2 lanes on minor roads, 4 lanes on major roads. With a main road median width of more than 3m, the value of the Major Road Median (Fm) = 1,20
  Fm = 1,20
- **City Size**
  This Intersection Type is 324, Based on data from the Surabaya City document in 2025 figures, it is recorded that the population of Surabaya City in 2024 is recorded at 3.02 million people. So, the City Size Adjustment Factor value (FCcs) = 1,05
  Fcs = 1,05
- **Side Obstacles**
  This Intersection Type is 324, namely Intersection 3, 2 lanes on minor roads, 4 lanes on major roads. With a high commercial area class, the Side Obstacle value (Frsu) = 0,93
  Frsu = 0,93
- **Turn left**
  This Intersection Type is 324 which is a 3-way Intersection, 2 lanes on minor roads, 4 lanes on major roads. With a left turn proportion of (762,60+425,80)/71255,40 = 0,167
  So, Left Turn value (Flt) = 1,0 – 0,167 x 0,16 = 0,973
  Flt = 0,973
- **Turn right**
  This Intersection Type is 324 which is a 3-way Intersection, 2 lanes on minor roads, 4 lanes on major roads. With a Right Turn Proportion of 0 because if there is no right turn lane at the intersection it can be done by ignoring the FRT. So, the Right Turn value (Frt) = 1,0 – 0 x 0,16 = 1
  Frt = 1
- **Minor Ratio**
  This Intersection Type is 324 which is a 3-lane Intersection, 2 lanes on minor

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roads, 4 lanes on major roads. If Qmi (Minor road traffic flow) is 425.80 and Q total is 71255,40 Then, Rmi 425,80/71255,40 = 0,1. So, the Minor Ratio value (Fmi) = 16,6 x $0,1^4$ – 3,33 x $0,1^3$ + 25,3 x $0,1^2$ – 8,6 x 0,1 + 1,95 = 1,34

Fmi = 1,34

Based on the variable calculations that have been carried out, the following intersection capacity was obtained :

Tabel 4.9 Intersection Capacity

Capacity Adjustment Factor										
Day	**Peak**	**Basic Capacity**	**Appoarc Width**	**Road Median**	**City Size**	**Side Obstacle**	**Turn Left**	**Turn Right**	**Minor Ratio**	**Capacity**
		Co	**Fw**	**Fm**	**Fcs**	**Frsu**	**Flt**	**Fr t**	**Fmi**	**C**
Saturday	Afternoon	3200	1,29	1,20	1,00	0,93	0,97	1,00	1,34	5987,98
	Evening	3200	1,29	1,20	1,00	0,93	0,98	1,00	1,34	6049,71
	Night	3200	1,29	1,20	1,00	0,93	0,97	1,00	1,34	5987,98
Sunday	Afternoon	3200	1,29	1,20	1,00	0,93	0,97	1,00	1,34	5987,98
	Evening	3200	1,29	1,20	1,00	0,93	0,98	1,00	1,34	6049,71
	Night	3200	1,29	1,20	1,00	0,93	0,97	1,00	1,34	5987,98
Monday	Afternoon	3200	1,29	1,20	1,00	0,93	0,97	1,00	1,34	5987,98
	Evening	3200	1,29	1,20	1,00	0,93	0,98	1,00	1,34	6049,71
	Night	3200	1,29	1,20	1,00	0,93	0,97	1,00	1,34	5987,98
Tuesday	Afternoon	3200	1,29	1,20	1,00	0,93	0,97	1,00	1,34	5987,98
	Evening	3200	1,29	1,20	1,00	0,93	0,98	1,00	1,34	6049,71
	Night	3200	1,29	1,20	1,00	0,93	0,97	1,00	1,34	5987,98

Source: Researcher's Process Results, 2025

After the Intersection Capacity is obtained, the service level analysis can be done using Formula 2.3. The following is an example of a calculation using the road service level calculation formula during Saturday Afternoon Peak.

Ds = V/C

= 7125,40/5987,98 = 1,19 (Including Service Level Classification F)

Tabel 4.10 Intersection Service Level

Intersection Service Level					
Day	**Peak**	**Volume**	**Basic Capacity**	**Degree of Saturation**	**LOS**
		(Smp/Jam)	(Smp/Jam)	(DS)	
Saturday	Afternoon	7125,40	5987,98	1,19	F
	Evening	5943,80	6049,71	0,98	E
	Night	5469,25	5987,98	0,91	E
Sunday	Afternoon	6081,55	5987,98	1,02	F
	Evening	5930,80	6049,71	0,98	E
	Night	5492,05	5987,98	0,92	E
Monday	Afternoon	5677,35	5987,98	0,95	E
	Evening	5156,80	6049,71	0,85	E
	Night	5452,65	5987,98	0,91	E
Tuesday	Afternoon	5763,25	5987,98	0,96	E
	Evening	5192,15	6049,71	0,86	E
	Night	5316,00	5987,98	0,89	E

Source: Researcher's Process Results, 2025

Based on the table above, the lowest Intersection service performance on Saturday occurred at the afternoon peak with the highest DJ of 1,19. This has an impact on the decline in the level of road service to category F.

5. CONCLUSION AND SUGGESTIONS

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Conclusion

This study analyzed the impact of shopping centers on traffic performance in Surabaya. The following key findings summarize the results:

1. Traffic Volume
   The highest traffic volume was observed at the Jalan Ahmad Yani–Jalan Ketintang intersection, with 7125.40 pcu/hour, reflecting a substantial traffic load at this critical node. Jalan Ahmad Yani Segment I and Segment II recorded volumes of 5591.95 and 5444.70 pcu/hour, respectively, indicating heavy traffic flow along the corridor. In contrast, Jalan Ketintang experienced a comparatively lower volume of 947.00 pcu/hour.
2. Degree of Saturation
   Ketintang road demonstrated stable traffic conditions with a DS value of 0.32, corresponding to Level of Service (LOS) B. However, both segments of Ahmad Yani road exhibited oversaturated conditions, with DS values of 1.03 (Segment I) and 1.06 (Segment II), indicating LOS F. The intersection of Jalan Ahmad Yani and Jalan Ketintang reached the highest saturation level at 1.19, also classified as LOS F. These findings suggest that the intersection, along with the adjacent segments of Jalan Ahmad Yani, operates under critical conditions and requires immediate traffic management interventions to mitigate congestion.

Suggestions

Future research is recommended to expand the scope of study by including additional variables such as land use along the roads and intersections, traffic conditions during non-peak hours, and the costs incurred due to delays. Furthermore, the study could conduct a more comprehensive analysis of the impact of Royal Plaza's activities on the surrounding traffic conditions, as well as develop more specific and detailed mitigation strategies to improve the efficiency of the road network and intersections. The use of more advanced analytical methods, such as traffic simulation models, could also be employed to obtain more accurate and comprehensive results. In doing so, future research can provide a more significant contribution to the understanding of the impacts of commercial activities on traffic conditions and the development of effective solutions for improving road network and intersection efficiency.

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