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The Impact of School Activities on Road Segment Performance Using PTV Vissim Simulation Software (Case Study : Anang Hasyim Street, Samarinda)

Iqbal Arif Arfian[1], Ulwiyah Wahdah Mufassirin Liana[1*]
[1*]Program Studi Teknik Sipil, Fakultas Sains dan Teknologi, Universitas Muhammadiyah Kalimantan Timur
[*]Corresponding Email: uwm216@umkt.ac.id

Abstract – Movement increases along with population growth and economic improvement each year. However, this is not supported by adequate transportation infrastructure, which can lead to congestion and traffic flow. The congestion of Samarinda during peak hours. One such location is Anang Hasyim Street, which has several schools along the road, including Cordova Elementary and Junior High School, SMPN 1, and SMAN 1 Samarinda. Traffic is evident during school hours, both morning and afternoon, along with an increase the number of vehicles and pedestrians. This situation leads to decline in the performance of the road segment. Road performance is a quantitative measurement that describes the conditions occurring on a road segment and serves as a parameter for road performance. This primary data such as road geometric data, traffic volume, and vehicle delays over a specific segment length. Traffic surveys were conducted over three days Monday, February 26, 2024, and Friday and Saturday, March 1-2, 2024. The survey were from 06:30-07:30 WITA,12:00-13:00 WITA, and 15:30-16:30 WITA. The analysis is based on PKJI 2023 and traffic flow simulation using PTV Vissim. The traffic results for 2024 shows the capacity of Anang Hasyim Street is 2968.154 pcu/hour, with the highest vehicle on Monday being 3079.75 pcu/hour and a degree of saturation 0.501 (LoS type A), and side friction of 500.8 incidents per hour. Meanwhile, the forecast for 2034 indicates the capacity remains 2968.154 pcu/hour, vehicle volume of 2202.83 pcu/hour, a degree of saturation 0.74 (LoS type B), and side friction of 563.33 incidents per hour.

Keywords : vehicle volume, side friction, and PTV Vissim software

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1. Introduction

Highways are a vital part of land transportation infrastructure that plays a crucial role in connecting one place to another. Alongside the rapid development with a national perspective, both the infrastructure and facilities of land transportation serve as the backbone for other supporting sectors [1]. Roads are a critical component of land transportation infrastructure, playing a significant role in the field of land transportation. With rapid economic growth, there is a corresponding increase in road traffic users [2]. Traffic refers to a correlation of various components and actions that create a traffic flow situation [3]. Traffic management refers to the strategic management and regulation of traffic flow, aiming to optimize the utilization of existing infrastructure to ensure efficient transportation [4]. Good traffic entails facilitatingsmooth movement, adequate speed, safety, and comfort [5].

The demand for human mobility increases in line with population and economic growth [6]. The tendency for greater travel demand, which tends to increase every year, is not supported by adequate transportation infrastructure. This is due to the growth in the number of motorized trips without a corresponding increase in the quality and quantity of infrastructure to meet the demand. This situation can lead to new problems such as traffic congestion and difficulties in achieving efficient traffic flow [7]. Samarinda City often experiences congestion during peak daily hours, typically when there are numerous vehicles traversing routes towards specific destinations. Students, university students, workers, and employees commuting to schools, campuses, workplaces, and government offices dominate the roads, often disregarding traffic regulations [8]. Congestion is a common problem in urban traffic, caused by factors such as inadequate road infrastructure or capacity to accommodate the volume of vehicles traversing a

particular road segment, besides significant side friction issues [9]. The most disruptive type of side friction is vehicles accessing and exiting the road on the right and left sides [10]. Examples of several side friction obstacles found on Anang Hasyim Street include pedestrians, parked vehicles, and vehicles entering or leaving school areas. These incidents ultimately lead to traffic congestion, disrupting the comfort of the surrounding community, especially road users.

One example of a congested road on Anang Hasyim Street is exacerbated by the presence of schools along the road, such as Cordova Elementary and Junior High School, SMPN 1, and SMAN 1 Samarinda. The traffic intensity on Anang Hasyim Street, Air Hitam, Samarinda Ulu does not correlate with the road's width. Crawling congestion is often observed during specific hours, such as school hours [11]. During school arrival and dismissal times, there is an increase in the number of vehicles and pedestrians along the road. The high volume of vehicles traversing the road, combined with the presence of several schools, leads to a decline in road segment performance [12]. The use of private vehicles by parents and students for school drop-offs and pick-ups also causes delays at school entrances [13]. Another factor contributing to these obstacles is flooding, which often affects the area due to heavy rainfall intensity and inadequate drainage systems that fail to efficiently handle large volumes of water [14]. Anang Hasyim Street can be classified as a secondary collector road, connecting the first secondary area with residential areas, the second secondary area with residential areas, the third secondary area, and so on, until reaching residential areas [15]. Anang Hasyim Street is a two-lane undivided road with the symbol (2/2 TT) [16].

Road segment performance is a quantitative assessment that describes specific conditions occurring on a road segment [17]. The level of service value of the road is used as a parameter for road segment performance. This study requires primary data, including geometric data by measuring the road shoulder width, traffic volume data by counting the number of vehicles passing through the road segment according to vehicle types, which consist of motorcycles, passenger cars, medium vehicles, large vehicles, free flow speed, which is the speed of vehicles, and vehicle delay over the length of the research segment.

Traffic simulation modeling is an effective approach to analyze traffic operations as it can produce outputs that closely approximate real conditions. Traffic simulation is the mathematical modeling of transportation systems (such as freeway intersections, arterial routes, roundabouts, downtown network systems, and so on) through the application of computer software to better assist in planning, designing, and operating transportation systems. Traffic simulation modeling is an effective approach to analyze traffic operations as it can produce outputs that closely approximate real conditions [18]. Additionally, the complexity of the issues in modeling systems suggests the need for simulation models [19]. Therefore, the researchers have chosen the title with the topic "The Impact of School Activities on Road Performance Using PTV Vissim Software Simulation (Case Study: Anang Hasyim Street, Samarinda)". The PTV Vissim application is software that can visualize road conditions in 3D. In the process of using Vissim to perform traffic simulation, several data inputs are required to create a simulation model that will be analyzed through the Vissim program. Vissim requires data such as traffic volume, road geometry, vehicle speed, and vehicledirection.

2. Research Methodology

2.1 Flowchart of Research

Researchers require a systematic approach from the beginning to the end to accomplish the main objectives of this study. The schematic representation of the research methodology can be seen in Figure 1, Flowchart of Research.

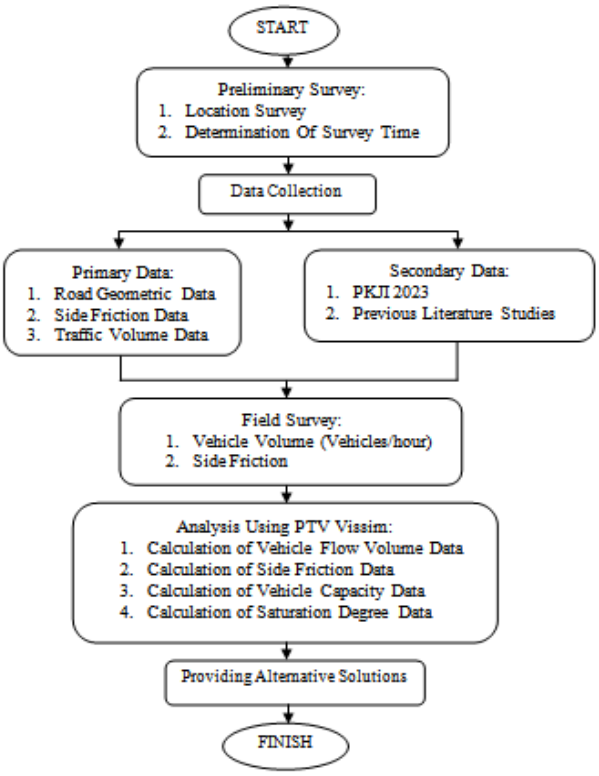

Figure 1 Flowchart Of Research

2.2 Primary Data Collection

Primary data is a source of data or information obtained directly from the field. The following are the primary data used:

1. Road Geometric Data Geometric data is a road segment that plays a crucial role in determining road capacity and performance, including identifying the studied road segment and determining road width and shoulder width [20].

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2. Side Friction Data This survey is conducted by counting road crossings, stopped vehicles, vehicles entering/exiting the road sides, and non-motorized transportation. The main purpose of data collection is to analyze the frequency of side friction activities observed in the research area [21].
3. Traffic Volume Data Traffic volume units are commonly used in the context of assessing quantity and lane width, including metrics such as average daily traffic, planning hour volume, and road capacity [22]. This survey is conducted by counting vehicles passing through the road segment accordingto vehicle types.

2.3 Secondary Data Collection

from previously researched data or data collected from other parties related to the current issue. The following arethe secondary data obtained:

1. Indonesian Road Capacity Guidelines 2023.
2. Literature Review based on previous research.

2.4 Data Calculation

After completing all the necessary primary and secondary data collections, the next step is to process or calculate all available data using the equations below:

1. Calculation of Traffic Flow Volume Data Traffic flow volume is the number of vehicles passing through a point or section within a certain period of time. Traffic volume units are commonly used in the context of assessing quantity and lane width, which includes metrics such as average daily traffic, planning hour volume, and road capacity [23]. Total Traffic Flow in (pcu/hour):

Qsmp = (MC × emp-MC × LV × emp-LV × MV × emp-MV × HV ×emp-HV)

Keterangan :

MC = Motorctcle
LV = Light vehicle (Passenger car)
MV = Medium vehicle (Small truck, minibus, van))
HV = Heavy vehicle (Large truck and bus)

Table 1
EMP for Undivided Road

Road type	Total two-way traffic volume (kend/jam)	EMP_{KS}	EMP_{SM}	
			LPath ≤6 m	LPath >6 m
2/2-TT	<1800	1,3	0,5	0,40
	≥1800	1,2	0,35	0,25

Source : PKJI 2023

2. Calculation of Capacity Data The capacity of a road depends on the road conditions being better than the established standards. Conversely, if the road conditions are worse than the standard conditions, there will be a decrease in capacity. [24][25].

Below are the capacity equations that will be used:

C = C0 × FCLJ × FCPA × FCHS × FCUK

Keterangan :

C = Capacity of the road segment under observation
C0 = Basic capacity of the segment under ideal road conditions
FCLJ = Capacity correction factor due to lane width differences
FCPA = Capacity correction factor due to Pavement Age
FCHS = Capacity correction factor due to Pavement Condition
FCUK = Capacity correction factor due to urban size

a) CO is the basic capacity per ideal road segment in units of passenger car units per hour (pcu/h). Below is Table 2: Basic Capacity (CO).

Table 2
Basic Capacity

Road type	C_0 (SMP/jam)	Note
4/2-T, 6/2-T, 8/2-T atau One way street	1700	Per lane (one way)
2/2-TT	2800	Two way

Source : PKJI 2023

b) FCLJ is the capacity correction factor due to differences in lane width from ideal conditions. Below is Table 3 showing the capacity correction factors due to lane differences.

Table 3
Capacity Correction Factors Due to Lane Differences

Road type	L_{LE} atau L_{JE} (m)	FC_{LJ}
4/2-T, 6/2-T, 8/2-T one-way street	L_{LE} = 3,00	0,92
	3,25	0,96
	3,50	1,00
	3,75	1,04
	4,00	1,08
2/2-TT	LJE2 direction = 5,00	0,56
	6,00	0,87
	7,00	1,00
	8,00	1,14

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Road type	L_{LE} atau L_{JE} (m)	FC_{LJ}
	9,00	1,25
	10,00	1,29
	11,00	1,34

Source : PKJI 2023

c) FCPA is the capacity correction factor due to parking activity (PA) on undivided road types. Below is Table 4 showing the Capacity Correction Factor due to Parking Activity on Undivided Road Types.

Table 4
Capacity Correction Factors Due to PA

PA %- %	50-50	55-45	60-40	65-35	70-30
FC_{PA}	1,00	0,97	0,94	0,91	0,88

Source : PKJI 2023

d) FCHS is the capacity correction factor due to shoulder or curb condition (KHS) on roads equipped with shoulders or curbs of non-ideal sizes. Below is Table 5 showing the Capacity Correction Factor due to KHS Conditions.

Table 5
Capacity Correction Factors Due to KHS Conditions

Road type	KHS	FC_{HS} effective shoulder width L_{BE}, m			
		≤0,5	1,0	ł,5	
4/2-T	Very low	0,96	0,98	1,01	1,03
	Low	0,94	0,97	1,00	1,02
	Medium	0,92	0,95	0,98	1,00
	High	0,88	0,92	0,95	0,98
	Very high	0,84	0,88	0,92	0,96
2/2-TT one-way street	Very low	0,94	0,96	0,99	1,01
	Low	0,92	0,94	0,97	1,00
	Medium	0,89	0,92	0,95	0,98
	High	0,82	0,86	0,90	0,95
	Very High	0,73	0,79	0,85	0,91

Source : PKJI 2023

d) FCUK is the capacity correction factor fordifferent city sizes compared to the ideal citysize. Below is Table 6 showing the Capacity Correction Factor for City Size Differences.

Table 6
Capacity Correction Factor for City Size

City size (Million inhabitants)	City classification		City size correction factor, (FCUK)
<0,1	Very Small	Small City	0,86
0,1–0,5	Small	Medium City	0,90
0,5–1,0	Medium	Intermidiate City	0,94
1,0–3,0	Large	Large City	1,00
>3,0	Very Large	Metropolitan City	1,04

Source : PKJI 2023

3. Calculation of Degree of Saturation
The main measure used to determine the performance level of road segments is DS (Degree of Saturation). The DS value indicates the quality of traffic performance and varies between zero and one. The degree of saturation can be determined using thefollowing equation:

$$DJ = Q / C$$

Description :
DJ = Degree of Saturation
Q = Traffic Volume in pcu/hour
C = Road Segment Capacity in pcu/hour

4. Calculation of Side Friction Data
Side friction is the interaction between traffic and activities alongside the road that often leads to conflicts and sometimes significantly affects traffic performance. Types of side friction have been categorized in PKJI 2023. Below are Table 6 Weighting of Side Friction and Tables 7 and 8 Criteria for Side Friction Classes.

Table 7
Weighting of Side Friction

No.	Main types of lateral obstacles	Weight
1	Pedestrians on the roadway and those crossing	0,5
2	Public transportation and other vehicles that stopi	1,0
3	Vehicles entering/exiting from the side or adjacent land	0,7
4	Slow vehicle flow (non-motorized vehicles)	0,4

Source : PKJI 2023

Table 8
Criteria for Side Friction Classes

KHS	Total frequency value (on both sides of the road) multiplied by the weight	Distinctive Characteristics
Very Low (SR)	<100	Residential area, with available local streets (*frontage road*).
Low (R)	100–299	Residential area, with some public transportation (city transit).
Medium (S)	300–499	Industrial area, with some shops along the side of the street.
High (T)	500–899	Commercial area, with high street-side activity.
Very High (ST)	≥900	Commercial area, with street-side market activity.

Source : PKJI 2023

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4. Level of Service (LoS) is a qualitative measure that reflects the perception of drivers and passengers regarding the characteristics of traffic conditions. Six levels of service are symbolized by the letters A to F, where LoS A indicates the best operational condition, and LoS F indicates the worst condition [26]. Characteristics of the level of service can be seen in Table 9.

Table 9
Service Level Characteristics

Level Of Service						
Classification	A	B	C	D	E	F
Speed	>48	40-48	33,6-40	25,6-33,6	22,4-25,6	<22,6
Volume/capacity	0-0,6	0,6-0,7	0,7-0,8	0,8-0,9	0,9-1,0	>1,0

Level Of Service	Average Speed	V/C	Flow Description
A	> 50	< 0,40	free flow (unimpeded traffic flow)
B	> 40	< 0,58	Stable but not free flow (good traffic flow, with the possibility of congestion)
C	> 32	< 0, 80	Stable flow with speed restrictions (traffic flow is still good and stable with acceptable delays)
D	> 27	< 0,90	Flow beginning to deteriorate (disruptions in the flow are starting to be felt, flow is becoming less smooth)
E	> 24	< 1,00	Unstable flow with occasional congestion (service volume is at the unstable flow capacity)
F	< 24	< 1,00	Congestion, long queues (vehicle volume exceeds capacity, flow has experienced congestion)

Source : Introduction to Transportation Engineering and Planning, Edward K. Morlok, p. 213

3. ANALYSIS RESULTS ANDDISCUSSION

3.1 Road Geometric Data

General conditions of Anang Hasyim Street segment, the research location:

1. Road type : 2/2 TT
2. Segment length : 100 m
3. Lane width : 9.40 m
4. Lane widths : Right lane 5.60 m and left lane 3.80 m
5. Shoulder width : Present, only on the right side
6. Shoulder width : 0.35 m
7. Median : Absent
8. Terrain condition : Flat
9. Drainage type : U-ditch
10. Drainage size : 1.5 m
11. Direction separator %: 60 - 40

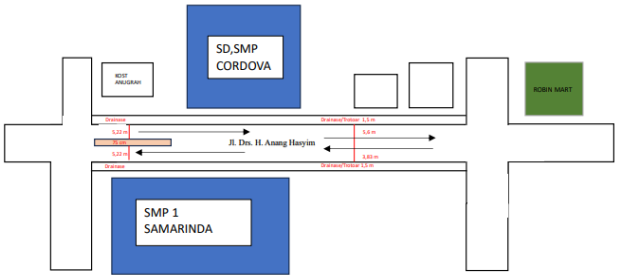

Figure 2 Survey Location Map

3.2 Vehicle Volume

On Anang Hasyim street segment, surveys were conducted during the academic hours of several schools along the street on Monday (February 26, 2024), Friday (March 1, 2024), and Saturday (March 2, 2024) at 06:30-07:30 WITA, 11:30-12:30 WITA, and 15:30-16:30 WITA. Below are the results of the vehicle volume for each type of vehicle during the peak hours of each street segment in pcu/hour, as shown in Table 10 Vehicle Volume per/hour.

Table 10
Vehicle Volume per hour

Day	Time	Number of Vehicles per hour smp/jam				Volume per hour
		MC	LV	MV	HV	
Monday, 26 Feb 24	06:30-06:45	251.3	151	0	0	1488.15
	06:45-07:00	392.7	264	0	0	
	07:00-07:15	169.75	171	0	0	
	07:15-07:30	50.4	38	0	0	
	12:00-12:15	40.25	47	0	0	423.5
	12:15-12:30	41.65	37	0	0	
	12:30-12:45	58.8	73	0	0	
	12:45-13:00	58.8	67	0	0	
	15:30-15:45	88.2	78	0	0	1168.1
	15:45-16:00	116.9	100	0	0	
	16:00-16:15	168	224	0	0	
	16:15-16:30	175	218	0	0	
	Total per day	1611.75	1468	0	0	**3079.75**
Friday, 1 Mar 24	06:30-06:45	221.55	188	0	0	1484.15
	06:45-07:00	372.05	227	0	0	
	07:00-07:15	209.65	160	0	0	
	07:15-07:30	67.9	38	0	0	
	13:00-13:15	149.1	86	1.5	0	962.4
	13:15-13:30	175	101	0.5	0	

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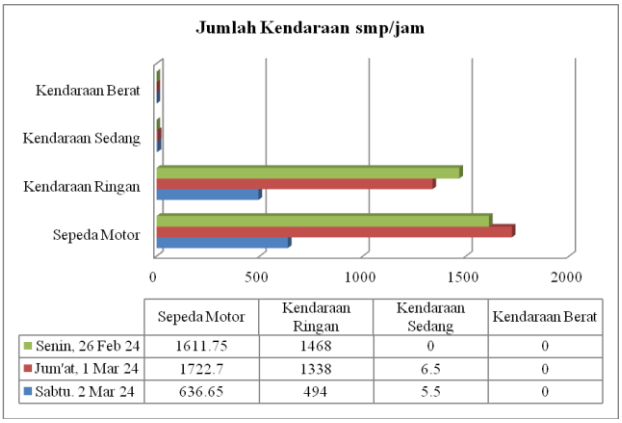
Day	Time	Number of Vehicles per hour (smp/jam)				Volume per hour
		MC	LV	MV	HV	
	13:30-13:45	142.1	112	1.5	0	
	13:45-14:00	116.2	77	0.5	0	
	15:30-15:45	57.75	80	0	0	
	15:45-16:00	67.55	99	0.5	0	620.65
	16:00-16:15	78.4	95	1.5	0	
	16:15-16:30	65.45	75	0.5	0	
	Total per day	1722.7	1338	6.5	0	**3067.2**
	06:30-06:45	11.9	3	0	0	
	06:45-07:00	20.3	18	0	0	133.9
	07:00-07:15	27.65	18	0	0	
	07:15-07:30	25.55	9	0.5	0	
	12:00-12:15	110.95	67	0	0	
Saturday, 2 Mar 24	12:15-12:30	122.15	81	0	0	667.15
	12:30-12:45	85.75	71	0.5	0	
	12:45-13:00	76.3	52	0.5	0	
	15:30-15:45	33.6	52	2	0	
	15:45-16:00	38.15	36	1.5	0	335.1
	16:00-16:15	44.1	35	0.5	0	
	16:15-16:30	40.25	52	0	0	
	Total per day	636.65	494	5.5	0	**1136.15**

Source: Calculation Results, 2024

The results from Table 10 show that the highest volume of vehicles on Anang Hasyim Street occurred during working hours on Monday, with a total of 3079.75 pcu/hour. This high volume is attributed not only to school activities but also to the significant number of public vehicles using the street as an alternative route. On Friday, the volume of vehicles remained relatively constant compared to Monday, with 3067.2 pcu/hour. However, on Saturday, there was a decrease in vehicle volume to 1136.15 pcu/hour due to the absence of school activities.



Source: Calculation Results, 2024

Figure 2 Vehicle Count Diagram

Based on Figure 2, the highest number of vehicles passing through Anang Hasyim Street are motorcycles, followed by light vehicles and medium vehicles. There are no heavy vehicles passing through the street because Anang Hasyim Street is a secondary collector road where the maximum capacity is only 8 tons. The peak hour on Anang Hasyim Street occurs on Friday, where motorcycles outnumber light vehicles and medium vehicles.

3.3 Road Capacity

This classification is done due to the variation in road capacity caused by the population size. According to (BPS, 2023), Samarinda City has a population of 861,878 people, and the economic growth of Samarinda City was 4.27% in 2023. According to the Indonesian Road Capacity Guidelines (PKJI, 2023), Samarinda City has a capacity adjustment factor for city size (FCUK) of 0.94. The road segment calculation is done using PKJI 2023 with the equations provided in Chapter II.

C = CO x FCLJ x FCPA x FCHS x FCUK

Description :

C = Capacity (pcu/hour)

CO = Basic Capacity pcu/hour. Because using a type of road two lanes two directions undivided then used Co = 2800 pcu/hour. Can be seen in Table 2.

FCLJ = Capacity Correction Factor Due to Lane Differences. Because the width of the research lane is 9.4 meters, FCLJ 1.29 is used. Can be seen in Table 3

FCPA = Capacity Correction Factor Due to PA. Because the lane width is not uniform, 5.6 m and 3.8 m, PA 60-40, which is 0.94, is used. Can be seen in Table 4

FCHS = Capacity Correction Factor Due to KHS. Because the lane width is <0.5, FCHS 0.94 is used. Can be seen in Table 5.

FCUK = Capacity Correction Factor for City Size. Because Samarinda is a medium-sized city, FCUK 0.94 is used. Can be seen in Table 6.

After all the above factors are known, the capacity value on Jalan Anang Hasyim is as follows :

C = CO x FCLJ x FCPA x FCHS x FCUK
=2800 x 1,29 x 0,94 x 0,94 x 0,94
= 2968,154 smp/jam.

Therefore, the capacity of Anang Hasyim Road is 2968.154 pcu/hour.

3.4 Saturation Degree

3.4.1 Level of Service for the Year 2024

The primary measure used to determine the performance level of road segments is the Saturation

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Degree (DJ). The DJ value indicates the quality of traffic performance and varies between zero and one. The Saturation Degree can be determined using the PKJI 2023 equation as follows.

$$DJ = Q / C$$

Desciption :
Q = Traffic Volume in pcu/hour
C = Road Segment Capacity in pcu/hour

Table 11
Degree of Saturation

Time	Q	C	DJ	LoS
Senin, 26 Februari 2024	1488.15	2968.15	0.501	A
Jum'at, 1 Maret 2024	1484.15	2968.15	0.500	A
Sabtu, 2 Maret 2024	667.15	2968.15	0.225	A

Source: Calculation Results, 2024

With high movement intensity on Mondays due to school activities such as drop-off and pick-up, the number of vehicles on Anang Hasyim Street exceeds its capacity, resulting in congestion and an increase in the saturation degree. Conversely, on Saturdays, the saturation degree decreases due to the absence of school activities, resultingin a decrease in movement intensity.

Based on the analysis results, the highest saturation degree occurs on Monday, February 26, 2024, from 06:30 to 07:30 WITA, with a value of 0.501. The level of service indicates an LoS value of type A, indicating smooth traffic flow on Anang Hasyim Street without any hindrances.

3.4.2 Service Level Forecasting for 10 Years

As technology advances, the number of vehicles is expected to increase. With the projected growth rate of 4% over the next 10 years (based on the Samarinda City Masterplan, 2023), the traffic volume is estimated to reach 2202.83 smp/hour. Based on this figure, the traffic demand will also rise. Below are the DS values if the number of vehicles in Samarinda City increases over the next 10 years, assuming that the road conditions remain unchanged from 2024, where the capacity value is 2968.154 smp/hour, and the number of vehicles passing through will increase as follows.

Table 12
Forecasting 10 Years

Year	Q	C	DJ	LoS
2034	2202.83	2968.15	0.74	C

Source: Calculation Results, 2024

Based on the analysis results for the next 10 years, the congestion degree is 0.74 smp/hour and the service level indicates a grade B, where the road conditions can still be maintained until the forecasting period. Therefore, there is no need for changes in the characteristics of Anang Hasyim Street because the volume of traffic passing through this road during the 10-year forecasting period can still be accommodated by the road.

3.5 Side Barriers

Side barrier traffic surveys are a method of collecting data on various activities or conditions on the side of the road that can affect traffic flow. These side barriers can include pedestrians, stopped vehicles, vehicles entering/exiting, slow vehicles, or other activities along the road. The method of calculating side barriers is to measure how often and how severe the activities or conditions on the side of the road disrupt traffic flow by multiplying them by a weighting factor, as shown in Table 7. From the data obtained, it can be classified according tothe side barrier classes, as shown in Table 8.

Based on Table 13, the highest frequency of side barriers occurred on Monday, February 26, 2024, at 15:30-16:30 WITA, with 500.8 per hour, mainly due to the increased activity of passengers boarding and waiting for pickups in the school area. Meanwhile, the lowest sidebarrier value occurred on Saturday, March 2, 2024, at 12:00-13:00 WITA, with 9.4 per hour. This could be attributed to the absence of school activities on that day.

Table 13
Side Friction Data

Day	Time	Frequency of Lateral Obstacles	KHS
Senin, 26 Februari 2024	06:30-07:30	305	Medium
	12:00-13:00	33.2	Medium
	15:30-16:30	500.8	High
Jum'at, 1 Maret 2024	06:30-07:30	229.2	Low
	13:00-14:00	42.6	Very Low
	15:30-16:30	28	Very Low
Sabtu, 2 Maret 2024	06:30-07:30	21.4	Low
	12:00-13:00	9.4	Low
	15:30-16:30	26.7	Low

Source: Calculation Results, 2024

3.5.1 Forecasting Side Barrier Values for the Next 10 Years

Side barriers occurring on Anang Hasyim Street are mainly dominated by school shuttle vehicles, which happen from Monday to Friday. The occurrence of side barriers indicates the capacity level of the street section, and if it exceeds the current side barrier (in 2024) in projections for 5 years and 10 years, then the side barriers will increase as shown in Table 14. In 2029 (5-

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year projection), side barriers increase to 541.67 occurrences per hour.

Meanwhile, in 2034 (10-year projection), side barriers occur at a rate of 563.33 occurrences per hour. Due to the increase in side barriers, the capacity of the street section will decrease, hence actions are needed to minimize the side barriers that will occur. One way is by schools providing a designated area for student pick-ups and drop-offs.

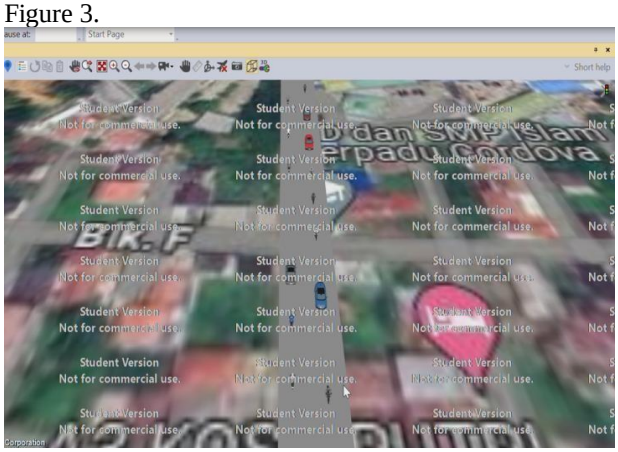
Table 14
Side Friction Forecasting

Year	Side Obstacle Frequency 2024	Traffic Growth Rate Factor (1)	Traffic Growth (I)	Number of Years Considered (n)	Upcoming Side Obstacles
2024	500.8	1	0.04	1	520.83
2029	500.8	1	0.04	5	541.67
2034	500.8	1	0.04	10	563.33

Source: Calculation Results, 2024

3.6 *Visualization using PTV Vissim Software*

Here are the visualization results of Anang Hasyim Street section with a capacity of 2968.154 vehicles Per hour and the highest volume being 1488.15 vehicles per hour using PTV Vissim software. Please refer to Figure 3.



Source : Software PTV Vissim

Figure 3 Visualization of PTV Vissim

4. CLOSING

4.1 Conclusion

1. Based on the analysis using the Indonesian Road Capacity Manual (PKJI 2023), the traffic volume on Jalan Anang Hasyim on Monday, February 26, 2024 was 3079.75 pcu/hour, on Friday, March 1, 2024 was 3067.2 pcu/hour, and on Saturday, March 2, 2024 was 1136.15 pcu/hour. The peak hour occurred on Monday, February 26, 2024 from 06:30-07:30 WITA with 1488.15 pcu/hour, while the capacity of Jalan Anang Hasyim is 2968.154 pcu/hour.
2. The highest saturation degree value in the latest year of 2024 on Jalan Anang Hasyim shows a value of 0.501 with a service level indicating LoS type A. Meanwhile, in the 10-year forecasting, the highest saturation degree in 2034 is 0.74 with a service level indicating LoS type C. From the results of the highest side resistance frequency on Anang Hasyim Road on Monday, February 26, 2024, from 3:30 PM to 4:30 PM WITA, it was 500.8 incidents per hour with a high side resistance class. In the 10-year forecast, side resistance increases by 563.33 incidents per hour.

4.2 Implication

Based on the analysis and data processing results, it can be concluded that the high activity on the roadside is the main cause of congestion and the decline in performance of Jalan Anang Hasyim section, primarily due to school-related activities such as student drop-off and pick-up. Therefore, it is recommended that SD and SMP Cordova provide a dedicated area for student drop-off and pick-up, and install traffic signs prohibiting stopping on that road section.

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