ROAD PERFORMANCE ANALYSIS
(CASE STUDY: JL. KAKIALY AMBON CITY)

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ARTICLE INFO	ABSTRACT
	The number of residents in Ambon City every year has increased, therefore the number of increases in vehicle volume is directly proportional to the number of population growth, and in line with the increasing problem of traffic congestion. One of the traffic jams that occur in Ambon City is on the Kakialy road, which is caused by side obstacles due to unattended vehicle parking on the road, especially during rush hour or peak hours (during school and after school or commuting and returning from work). The existence of community facilities such as shops, fast food areas, hotels, and residential areas is also one of the triggers for road body parking which causes congestion on the Kakialy road section. Therefore, this study was conducted to find out how the performance of the Kakialy road section during peak and normal hours. The method used is a descriptive survey that uses data collection techniques in the form of observation and documentation studies for the calculation of capacity and speed on urban roads using the Indonesian Road Capacity Manual (MKJI) method. The results of data analysis show that the capacity of peak hours at 12.00-13.00 WIT) is 18,721 junior high school/hour and normal hours at 16.00-17.00 WIT is 15,037.8 junior high school/hour, with a vehicle density value (DS) at peak hours of 0.59. The average side resistance data in peak hours has a weighted frequency of 366.6 SMP/hour so it belongs to the medium side resistance class (M), and the average side resistance in normal hours has a weighted frequency of 148.7 SMP/hour, including the low side resistance class (L). So that after going through the calculation analysis process, it is concluded that the vehicle density value (DS) at peak hours (12.00 – 13.00 WIT) is 0.59 and is categorized in Level Of Service (LOS) C which means medium performance. While the vehicle density value (DS) during normal hours (16.00 – 17.00 WIT) is 0.45 and is categorized in Level Of Service (LOS) B which means good performance.

Introduction

Highways are an important factor for the development of human life because the development of roads and the development of human life influence each other. The development of a city is a result of economic growth (Wahl, 2017). This progress is considered very good but compared directly to the increase in the number of vehicles, so there will often be an increase in the use of transportation facilities, both private and public vehicles. If not followed by a balance between road capacity and the number of vehicles, it will cause congestion. This has an impact on the travel time of each vehicle will be even greater.

The number of residents in Ambon City has increased every year, therefore the rate of increase in vehicle volume has increased, resulting in the emergence of traffic congestion problems (Tang, Oanh, Rene, & Binh, 2020). Traffic congestion is caused by an imbalance between increased vehicle ownership and the growth of available road infrastructure, and the effective capacity of existing road sections is less than the planned road capacity due to roadside obstructions (Hidayat, Kristin, & Anggraini, 2019). Several roads in Ambon City often have traffic jams, including the Kakialy Road (Daraba, Cahaya, Guntur, Aslinda, & Akib, 2018). The congestion that occurs on the Kakialy Road section is caused by side obstacles. Side obstacles that often occur on the Kakialy Road section are pedestrians, stopped vehicles, vehicles entering/exiting the side of the road, and slow vehicles. The influence of side obstacles that occur on the Kakialy Road Section of Ambon City during peak hours (during school leaving and leaving hours or commuting and returning from work), as well as the existence of office and school facilities that cause traffic problems such as parking vehicles and stopping on the road body on the Kakialy Road Section. Vehicles that park on this road body cause road capacity to change so that road performance also changes, this causes a decrease in the speed of traffic vehicles and causes congestion problems (Noor, Ashrafi, Fattah, Morshed, & Rahman, 2021).

This study was conducted to obtain differences in the value of traffic capacity and speed during peak hours (peak hours) and normal hours (Wang et al., 2016). The Kakialy Road section is declared to meet the requirements required by the 1997 Indonesian Road Capacity Manual if a saturation degree value of < 0.75 is obtained, but if the saturation degree value is > 0.75, further evaluation needs to be carried out for the sake of improving traffic on the road section (Zanuardi & Suprayitno, 2018). This study was conducted to identify traffic characteristics and the situation of road facilities on the Kakialy Road Section, as well as to find out how much the performance value of the Kakialy Road Section.

Transportation

Transport comes from the Latin word transport, where trans means across or the other side, and portable means to transport or carry.

The definition of transportation according to (Nico Djajasinga, 2020) is moving or transporting from one place to another. (Nico Djajasinga, 2020), the definition of transportation is the movement of goods or passengers from one location to another, with products being moved or moved to the required or desired location. Steenbrink defined it as the movement of people or goods using vehicles or other, geographically separated places (Mulyanto, 2019). According to (Siagian, Adisasmita, & Hustim, 2019), transportation is defined as a system consisting of certain facilities along with flows and control systems that allow people or goods to move from one place to another efficiently at any time to support human activities.

Understanding Traffic Flow

Traffic flow is formed from the movement of individual motorists and motorists who interact with one another on one road section and

Environment. Traffic flow on a road section will vary in characteristics both based on location and time. In addition, driver behavior also affects traffic flow behavior. The driver on a road section designed with a certain speed for example 80 km / h is possible that the driver will have a speed that varies from 30 km/ h to 120 km/ h.

In describing traffic flow quantitatively to understand the diversity of its characteristics and the range of conditions of its behavior. Traffic flow parameters can be distinguished into two main parts, namely macroscopic parameters of traffic flow in general and macroscopic parameters that show the behavior of individual vehicles in a traffic flow related to one another. A macroscopic traffic flow can be described by three main parameters: volume and flow, speed, and density.

Understanding Road Capacity

Capacity in the Indonesian Road Capacity Manual is defined as the maximum current passing through a point on a freeway that can be maintained within hours under prevailing conditions. For undivided freeways, capacity is the two-way maximum current (combination of both directions), for divided freeways capacity is the maximum flow of lanes.

When the flow is low, the speed of free vehicle traffic is no interference from other vehicles, the more vehicles that pass the road section, the speed will decrease until one day the flow/volume of traffic can no longer increase, this is where capacity occurs. After that the current will decrease continuously under the condition of the forced current until one day the condition is completely jammed, the current does not move and the density is high.

The research benefits from the results of the study on traffic analysis of the capacity of the Ambon City Kakialy Road section are:

1. This research is expected to be used as further research in the field of land transportation and add knowledge to readers.
2. This research provides additional knowledge for the author by looking at the circumstances and conditions that occur so that it can broaden the author's horizons in applying the knowledge gained in college.
3. This research is expected to provide input for the Ambon City Public Works Office (PUPR) and the Ambon City Transportation Office.

Method

Types of Research

This research is a descriptive survey that uses data collection techniques in the form of observation and documentation studies.

Time and Location of Research

This research will be carried out on Jln. Kakialy, Sirimau District, Ambon City, Maluku Province. The research was conducted on February 10 – March 7, 2020.

Research Variables

Variables are research objects that are of concern at a point of research objects. Which will later get value from the conclusion of a process (Suharsimi Arikunto).

Primary Data

Primary Data, which is data obtained directly from the field. Here is the primary data obtained from observations on Jln. Kakialy is an analysis of traffic volume, capacity, degree of saturation, and side obstacles, the results of which will be obtained at the time of research.

The primary data obtained from the field include:

1. Road geometrics

Location: Jalan Kakialy located in Sirimau District, Ambon City Source: on-site survey.

Function: is one of the main characteristics of the road that will affect the capacity and performance of the road if it is overloaded with traffic.

2. Traffic volume data

Lokasi: Ruas Jalan. Kakialy yang berada di Kecamatan Sirimau, Kota Ambon Sumber: Survei langsung di lokasi

Fungsi : - Mengetahui volume lalu lintas.

- Mengetahui komposisi lalu lintas.

3. Side obstacles

Location: Road. Kakialy is located in Sirimau District, Ambon City Source: Direct survey at the location

Function: Know activities beside road segments that cause problems along the way

Data Analysis

To achieve the objectives of this study, the analysis conducted on Jalan Kakialy is the road capacity and average speed using the 1997 MKJI method, for urban roads.

Results and Discussion

1. Overview

Jalan Kakialy is one of the roads that is densely traversed by many types of vehicles, it is because on this road there are two directions of traffic flow from Rijali road that enters Kakialy road.

On this section of the road, there are several commercial businesses, settlements, two (2) schools, hotels, and residential areas. These activities greatly affect the smooth running of road transportation, due to vehicles entering and exiting the road body, vehicle parking, and public transportation that unload or raise passengers along the road,

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pedestrians walking or crossing along road segments, and slow-moving vehicles such as bicycles, tricycles, and carts.

2. Segment Identification

The purpose of segment identification is to find out the general data of the analyzed Kakialy road segments such as segment length, and road class.

Table 1
Identify Footwalk Segments

No	Description	Information
1	City	Ambon
2	City size	Small
3	Regional	Office
4	type	216 Metre
5	Segment length	Secondary collector
6	Street class	Peak hours and normal hours
	The period of analysis	

From the table above, it is shown that Ambon City is the capital of Maluku Province which has a land area of 359.45 km2 and an ocean area of 17.55 km2. Jalan Kakialy is a commercial area because around this street there are offices, shops, and settlements.

3. Geometric Data

Road Geometric Data is data about the geometric condition of the segment under study and represents the characteristics of the road segment. Geometric conditions consist of a situation plan (land use, road markings, and intersections), and a cross-section of the road (width of the road and width of shoulders or curb).

Based on the results of measurements and direct visual observations in the field, it was obtained that the width of the Kakialy road was 8 meters, and the width of the road curb ≤ 0.5 meters without a road median. Jalan Kakialy is a secondary collector road.

Table 2
Geometric Conditions of Pedestrian Segments

Location Observation	Building Main	Brand Road	Traffic lane width (m)	Shoulder Width (m)	Median Width (m)
1	School Shopping Office Settlement	Available	8	-	-

Source: Research Results

The traffic volume survey was conducted for 1 month on February 10 – March 7, 2023, for 11 hours, namely 07.00 – 18.00 WIT. The data is then grouped into vulnerable times every 15 minutes for each vehicle. Vehicles are divided into several categories, namely:

1. Motorcycle (Motorcycle - MC): Motorcycle/scooter
2. Light Vehicles (LV): Passenger Cars, Pick Up, Sedans, and Motor Vehicles with a distance between axles 2 - 3 meters.
3. Heavy Vehicles (HV): Micro Buses (L-300 etc.), Buses, 2 Axle Trucks, 3 Axle Trucks, and motor vehicles over 4 wheels.

4. Side Resistance Analysis

The data taken in this side obstacle survey are vehicles that stop and park on the body of the road, pedestrians (who parallel and cross the road), vehicles entering and exiting the road, and slow vehicles. After obtaining data from the next study multiplied by each side obstacle weight factor (parking vehicles = 1 slow vehicle = 0.4, pedestrians = 0.5, and outbound + inbound vehicles = 0.7), the total results of side obstacles can be seen in Table 3.

Table 3
Determination of the frequency of peak hour side resistance events in one month

No	Event Type Bottleneck Side	Weight Factor	Frequency Event	Frequency Weight
1.	Pedestrian	0,5	8632	4316
2.	Vehicle parking and stopping	1	3032	3032
3.	Vehicle in + exit	0,7	1169	818,3
4.	Slow vehicles	0,4	1578	631,2
	Total			8797,5

Source: Research Results

Table 4
Determination of the frequency of normal hour side resistance events in one month

No	Side Obstacle Event Type	Weight Factor	Frequency of Occurrence	Weight Frequency
1.	Pedestrian	0,5	1677	838,5
2.	Vehicle parking and stopping	1	1562	1562
3.	Vehicle in + exit	0,7	983	688,1

4.	Slow vehicles	0,4	1198	479,2
				3567,8
	Total			

After analyzing the side obstacles above, the peak hour side resistance data in one month has a weighted frequency of 366.6 junior high school/hour, including medium side resistance class (M), and normal hour side resistance in one month has a weighted frequency of 148.7 junior high school/hour, including low side resistance class (L).

5. Free Current Speed Analysis

Free Current Speed (FV) is defined as the speed at the zero current level, that is, the speed that the driver chooses if driving a motor vehicle without being affected by other motor vehicles on the road (Mufhidin & Chaniago, 2023).

In the Indonesian Road Capacity Manual (MKJI 1997) the basic free current speed of light vehicles is selected as the basic criterion for the performance of road segments at currents equal to zero.

6. Road Capacity Calculation

$C = C_O \times FC_W \times FC_{SP} \times FC_{SF} \times FC_{CS}$

1. Peak clock time

So that: $C = 1650 \times 1,08 \times 1,00 \times 0,86 \times 0,86 = 1317,967$ SMP/HOUR

Total peak hour capacity of one month = peak hour capacity (junior high school/hour) $\times$ 24 (duration of study). For the calculation is ^{C}Total $= 1317,957 \times 24 = 31631,208$ SMP/HOUR

2. Normal clock time

So that: $C = 1650 \times 1,08 \times 1,00 \times 0,90 \times 0,86 = 1379,268$ SMP/HOUR

Total peak hour capacity of one month = peak hour capacity (junior high / hour) $\times$ 24 (duration of study). The calculation is ^{C}Total $= 1379,268 \times 24 = 33102,432$ SMP/HOUR.

The calculation of road capacity above when tabled can be seen as follows:

Table 5
Calculation of road capacity for one month

Time	C_O	Adjustment Factor				C	C_{TOTAL}
		FC_W	FC_{SF}	FC_{SF}	FC_{CS}		
Peak Hours	1650	1,08	1,0	0,86	0,86	1317,967	31631,208
Regular Hours	1650	1,08	1,0	0,90	0,86	1379,268	33102,432

Source: Research Results

7. Saturation Degree Analysis

Saturation degree is the ratio of traffic flow (junior high school/hour) to capacity (junior high school/hour) on a certain section of road, where DS is used n for parameters

to determine the level of road service. The saturation degree value indicates whether a road section has a capacity problem or not.

8. Average Speed Analysis

Speed in traffic conditions, side obstacles, and actual geometric conditions is obtained using the speed graph as a function of DS for the following multi-lane and one-way roads:

1. the average speed of peak hours and normal hours of light vehicles, heavy vehicles, and motorcycles,
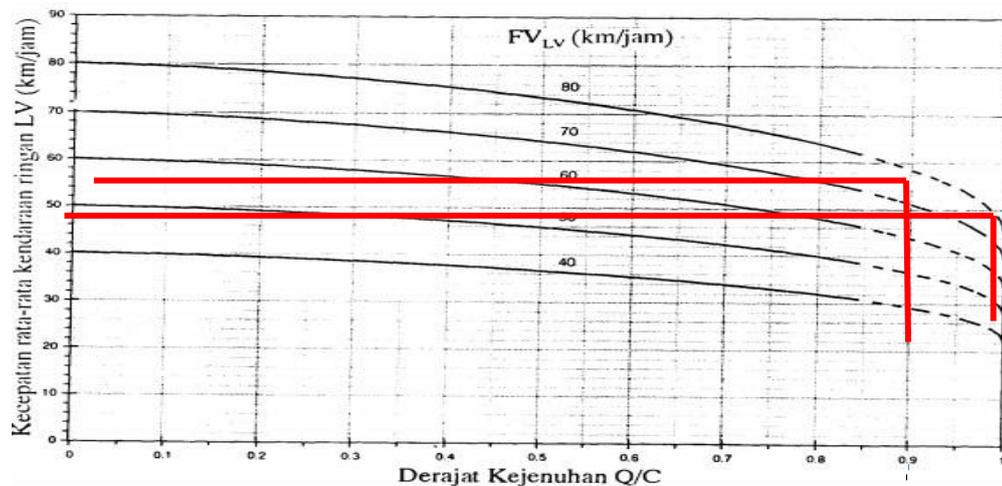

Figure 1

Speed as a Function of DS for Multi-Lane and One-Way Roads in MC, LV, and HV vehicle types

Table 6
Average Speed Calculation of peak hours and normal hours of light vehicles, heavy vehicles, and motorcycles

Vehicle Type	Time	Q (SMP/jam)	DS
Average Volume	Peak Hours	18041,8	0,59
	Regular Hours	15717	0,45

1. Level Of Service (LOS) Walking Sectional

The Simpang service level (LOS) is used as a standard to measure the quality of other traffic conditions, and the volume of service must be less than the capacity of the road itself (Lubis, 2021). Based on the analysis data above, it is known that the DS

value during the Peak Hour is 0.59 which means it is included in the category of density of medium conditions or at level C. While the DS value in Normal Hours is 0.45 which is included in the category of density in good conditions or level B.

For this reason, Jalan Kakialy has a saturation degree value of < 0.75, based on the 1997 Indonesian Road Capacity Manual recommends that if a saturation degree value of > 0.75 is obtained, it is necessary to make improvements to the road section both physically and traffic management. This means that Jalan Kakialy still meets the requirements, and there is no need for repairs and/or traffic improvement (Li, Zhang, & Zhao, 2017).

Conclusion

Based on the results of research and analysis in this final project, it can be concluded as follows:

The performance value on the Jalan Kakialy section of Ambon City measured based on the Level Of Service during peak hours is at level C with a vehicle density value of 0.59. While the Performance Value in normal hours is still at level B with a vehicle density value of 0.45.

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