

Analysis of Accident-Prone Areas in North Jakarta (Case: Cakung – Cilincing Road)

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Abstract

Transportation is an important part of human life, which has the benefit of facilitating the movement of people and the transportation of goods. This study aims to determine and analyze the locations where accidents often occur along the Cakung - Cilincing road, North Jakarta and determine what factors cause accidents along this road. The research on the analysis of accident-prone areas used the observation method with the quantity data provided by the North Jakarta Police Traffic Unit through IRSMS data, and the survey method was carried out on roads with the recording of passing vehicles, followed by calculations according to MKJI 1997. The results of the study were the location coordinates of the locations that had the highest value Accident-prone, namely segment 3 at the coordinate point - 6.140891 to -6.13712 with an AEK value of 80 which causes 6 deaths, 0 serious injuries, 1 minor injury, 5 objects losses, and Rp.13,200,000 material loss. The number of accidents at the coordinate point was 5 incidents. The value of material losses from accidents on Jalan Cakung Cilincing reached Rp. 92,900,000 for the last 4 years from 2016 - 2019. And research on road segment performance obtained LOS A with DS 0.06 in the morning, 0.06 in the afternoon, and 0, 07 in the afternoon.

Keywords

North Jakarta, Road Performance, Roads, Traffic Accidents, Transportation.

1. Introduction

A traffic accident is an event on the road which is unexpected and accidents involving a vehicle with or without other road users resulting in human casualties and/or property loss. (Undang-Undang Republik Indonesia Nomor 22 Tentang Angkutan Jalan Lalu Lintas, 2009). According to Ms Laura Sminkey (2018), from WHO.int reports from 180 countries, showing that worldwide the total number of road traffic fatalities has reached 1.25 million per year, with the highest road traffic death rates in low-income countries. According to Putra (2019) Traffic accidents are events that are difficult to predict when and where they occur. Accidents not only cause trauma, injury, or disability but can also result in death. Accidents are difficult to minimize and tend to increase with the increasing length of roads and the number of movements of the vehicle.

The National Police of the Republic of Indonesia noted that the number of traffic accidents in 2019 increased compared to 2018. Throughout 2019 the number of traffic accidents in Indonesia increased by 3%, but the number of victims who died decreased by 6% compared to 2018 (Ramadhan 2019).

In the North Jakarta area, the number of motor vehicle accidents in 2019 has increased quite drastically. Due to the large roads that usually have heavy vehicles moving along with motorbike and minibus users. Lack of attention from road users, especially motorbikes, to avoid blind spots. A Blind Spot is a condition when we cannot see objects around us. Various possibilities can occur including the danger of traffic accidents.

In an area, sometimes accident data is not recorded completely, due to the limited data they have, therefore a method is needed that can detect which areas are prone to accidents. So the authors researched and made this study to know the number of traffic accidents per kilometer using the UCL (Upper Control Limit) method, on Jalan Cakung Cilincing Raya, North Jakarta City.

2. Methodology

2.1. General Description

In this study, the following will explain and discuss research methods regarding how to survey and how to process the data to be used. The purpose of the survey was to obtain data which was then processed and know the characteristics of which locations were prone to traffic accidents on Cakung-Cilincing Road, North Jakarta. The following research locations are shown in Figure 1. Exactly located on Cakung Cilincing Road, North Jakarta City, DKI Jakarta.

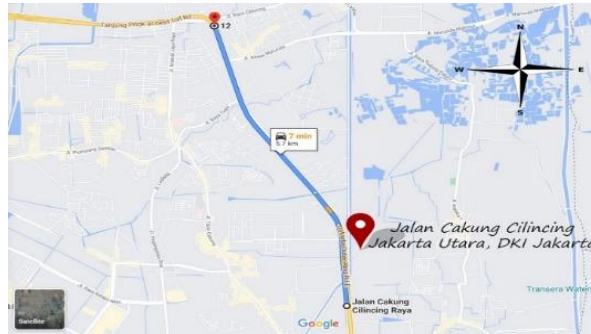


Figure 1. research location map

2.2. Data Retrieval

This accident data is secondary data obtained from the North Jakarta Police Traffic Unit, precisely from the IRSMS data, it is an accident data recording application developed by the POLRI that should be used as the basis for decision making and campaigning for road safety activities. Meanwhile, the data for the analysis of the performance of roads are taken directly by conducting a location survey as primary data followed by calculations according to the Indonesian Highway Capacity Manual (1997). The data required in the analysis of accident-prone areas and road performance analysis includes secondary data and primary data.

Secondary data includes:

- a. Victim fatality data
- b. Number of accident victims
- c. Type of accident
- d. Accident coordinates
- e. Street name
- f. The total value of material losses

Meanwhile, primary data includes:

- a. The volume of vehicles passing Cakung Cilincing Road, North Jakarta
- b. The side barriers that were around it
- c. Geometric path

The tools used to retrieve primary data are:

- a. Speed Gun is a tool used to measure the length of the road
- b. Survey form to record the number of vehicles passing and what conflicts have occurred at the site
- c. Counter is used to count the number of vehicles entering the road

2.3. Application of Methods

The data that has been obtained is then recapitulated according to the method used. Here the authors use the AEK method (Accident Equivalent Number) to calculate the analysis of accident-prone areas in North Jakarta. The method used also uses the observation method where the quantity data is taken from the authorized party, namely the North Jakarta Police Traffic Unit, which is then processed according to the Traffic Accident Data Collection Manual. As for the road performance data obtained using a survey method, namely the method of recording the number of vehicles passing Cakung Cilincing Road, North Jakarta, and followed by calculations according to the Indonesian Highway Capacity Manual (1997).

The sequence of data application for the analysis of accident-prone areas:

- a. Know the fatality data for accident victims
- b. Count the number of victims and losses
- c. Categorizes the type of accident
- d. Recapitulation which segments and coordinates of the accident occurred
- e. Classify the accident segments that have been recapitulated
- f. Calculating the segments that have been arranged using the AEK method
- g. Making survey results of the completeness of safety indicators on the highway
- h. Make a diagram of the results of AEK calculations

The sequence of data application for road performance:

- a. Calculating the volume table for Cakung Cilincing Road, North Jakarta
- b. Calculates the side barriers factor table
- c. Calculates the adjustment factor variable table
- d. Calculating the degree of saturation to find out LOS

3. Result and Analysis

3.1. Analysis of Accident-Prone Areas

The data that has been obtained is formed into victim fatality data which can be seen in table 1

Table 1. Victim Fatality Data

The Date of Incident	Accident Rate	Victim			Number Of Victims	Material Loss
		MD	LB	LR		
13/02/2016 08:00:00	1	1	0	0	1	100,000.00
06/06/2016 07:00:00	1	1	0	0	1	100,000.00
21/06/2016 20:00:00	1	1	0	0	1	1,000,000.00
28/06/2016 10:00:00	1	2	0	2	4	200,000.00
23/08/2016 12:00:00	1	1	0	1	2	1,000,000.00
23/08/2016 15:00:00	1	1	0	0	1	-
05/09/2016 07:30:00	1	1	0	1	2	150,000.00
27/09/2016 16:30:00	1	2	0	0	2	2,000,000.00
28/09/2016 15:45:00	1	1	0	0	1	2,000,000.00
07/10/2016 16:40:00	1	1	0	0	1	200,000.00
05/11/2016 11:00:00	1	1	0	0	1	500,000.00
16/11/2016 06:00:00	1	1	0	0	1	50,000.00
28/12/2016 04:00:00	1	1	0	0	1	2,000,000.00
30/12/2016 09:30:00	1	1	0	0	1	2,000,000.00
08/02/2017 21:00:00	1	1	0	1	2	500,000.00
07/04/2017 04:30:00	1	1	0	0	1	-
08/04/2017 12:30:00	1	1	0	1	2	200,000.00
08/04/2017 19:30:00	1	1	0	0	1	3,000,000.00
18/04/2017 21:00:00	1	1	0	0	1	-
28/05/2017 16:45:00	1	1	0	0	1	1,000,000.00
03/09/2017 15:30:00	1	1	0	0	1	200,000.00
15/09/2017 13:30:00	1	1	0	0	1	200,000.00
22/09/2017 14:30:00	1	1	0	0	1	-
22/12/2017 16:45:00	1	1	0	0	1	500,000.00
09/02/2018 0:30:00	1	1	0	0	1	-
05/03/2018 14:30:00	1	1	0	1	2	500,000.00
26/04/2018 15:15:00	1	1	0	0	1	10,000,000.00
30/04/2018 17:30:00	1	1	0	0	1	1,000,000.00
01/06/2018 22:00:00	1	1	0	0	1	1,000,000.00
01/07/2018 22:30:00	1	1	0	0	1	300,000.00
14/07/2018 15:30:00	1	1	0	0	1	200,000.00
26/07/2018 19:00:00	1	1	0	0	1	100,000.00
03/08/2018 06:00:00	1	1	0	0	1	500,000.00
17/12/2018 23:30:00	1	1	0	0	1	-
17/03/2019 18:30:00	1	1	0	0	1	500,000.00
21/03/2019 02:00:00	1	1	0	0	1	500,000.00
23/03/2019 22:30:00	1	1	0	0	1	500,000.00

From the data above, 37 cases of accidents resulted in the death of the victim. Furthermore, accident data contains the types of accidents that occurred on Cakung Cilincing road from 2016 to 2019, which consists of six conflicts which can be seen in table 2.

Table 2. Accident Type Data

No	Accident Type	Year				Total
		2016	2017	2018	2019	
1	Single	0	1	1	2	4
2	Front - Front	1	0	0	0	1
3	Front – Rear	9	5	6	1	21
4	Front - Side	1	0	0	0	1
5	Side - Side	0	1	1	0	2
6	Human Crashes	2	3	2	0	7

Based on the table above, the types of accidents that focus on the victims who died often occur in Cakung Cilincing road, North Jakarta. Namely the front-rear collision in 21 incidents and human crashes in 6 cases. After the accident type data, there is data on the number of victims who died and accident losses which can be seen in table 3.

Table 3. Data On The Number Of Victims And Losses

Year	Victim of MD	Number of Victims	Material Loss (Rp)
2016	16	16	11,300,000.00
2017	10	10	5,600,000.00
2018	10	10	13,600,000.00
2019	3	3	1,500,000.00
Total	39	39	32,000,000.00

In table 3 which focuses on the victims who died had material losses of Rp. 32,000,000.00 and the number of victims who died was 39 people. After that, there is data on the distribution of the coordinate segment. This data contains the coordinate segments on Jalan Cakung Cilincing, North Jakarta, stretching from the coordinate point -6.156.184 to -6.109.051 which is 5.7 km. Furthermore, the calculation of each segment uses the AEK method which has the following formula:

$$AEK = 12MD + 3LB + 3LR + 1K$$

Information:

- a. MD : Pass Away
- b. LB : Serious Injury
- c. LR : Minor injuries
- d. K : loss

After all segments are calculated, a table of the results of the AEK calculation is made which can be seen in table 4.

Table 4. AEK Method Calculation Result Data

No	Segment		Highway Length (KM)	Victim				Material Loss (Rp)	AEK Value
	Early	End		MD	LB	LR	Object		
1	-6.156184	-6.145288	1,7	4	0	0	4	3,600,000.00	52
2	-6.145288	-6.140891	0,5	2	0	1	2	1,000,000.00	29
3	-6.140891	-6.137122	0,5	6	0	1	5	13,200,000.00	80
4	-6.137122	-6.133453	0,5	3	0	0	2	2,000,000.00	38
5	-6.133453	-6.129788	0,5	3	0	1	3	1,500,000.00	42
6	-6.129788	-6.126103	0,5	2	0	0	2	1,000,000.00	26
7	-6.126103	-6.122125	0,5	5	0	1	4	1,700,000.00	67
8	-6.122125	-6.117777	0,5	4	0	0	4	5,300,000.00	52
9	-6.117777	-6.113423	0,5	6	0	0	2	300,000.00	74
10	-6.113423	-6.109051	0,5	3	0	3	3	2,400,000.00	48

Based on table 4 above, there are 10 segments and it is found that accidents on Cakung Cilincing road, North Jakarta often occur at the coordinate points -6.117777 to -6.113423 with a total of 6 accidents and a total of 6 victims died. Followed by the coordinates of -6.140891 to -6.13712 with a total of 6 people who died and at this coordinate point, it becomes the point with the greatest total material loss from other coordinate points, reaching Rp. 13,200,000.00.. The following is a diagram of the results of calculations using the AEK method which can be seen in Figure 2.

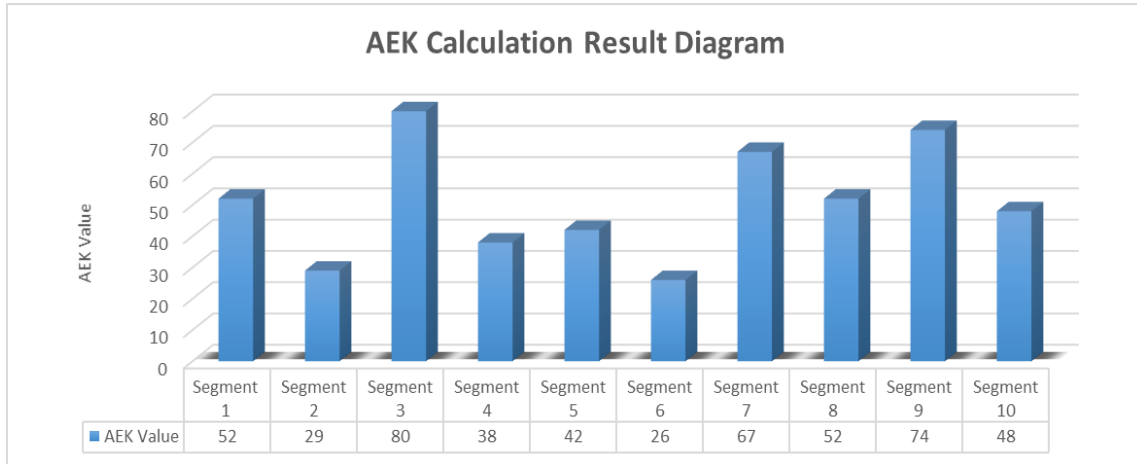


Figure 2. AEK Calculation Result Diagram

From table 4 or Figure 2 it can be concluded that segment 3 is an accident-prone area on Jalan Cakung Cilincing, North Jakarta, which has the highest AEK value among other segments, namely 80 with material losses reaching Rp. 13,200,000. So it is necessary to give special handling to suppress and minimize the occurrence of accidents in the area. After that make a table of safety indicators which can be seen in tables 5 and 6.

Table 5. Survey Data for Cakung Cilincing Road Safety Indicators, North Jakarta
 Coordinates point -6.140891 to -6.13712

No	Safety Indicator	Completeness		information
		Y	N	
1	Road signs		√	There are no road signs in some areas and are blocked by several trees
2	Road markings		√	In this segment, there are no road markings and some markers that have lost their paint
3	Safety Fence / Sidewalk	√		There are sidewalks but not painted and dirty
4	Road Damage		√	There are many roads with holes and cracks
5	Street Lighting	√		Some of the lights were on and some were dim

Table 6. Survey Data for Road Safety Indicators Cakung Cilincing, North Jakarta
 Coordinates point -6.117777 to -6.113423

No	Safety Indicator	Completeness		Information
		Y	N	
1	Road signs		√	The absence of warning signs and road signs
2	Road markings		√	There are no road markings
3	Safety Fence / Sidewalk	√		There are sidewalks but not painted and dirty
4	Road Damage		√	There are some concrete roads that are cracked and bumpy
5	Street Lighting		√	The lights were dim and some were not on

Based on the primary data table above, the coordinate points of -6.117777 to -6.113423 have the lowest weight for adequate facilities and have the potential to have a higher accident rate compared to segments -6.140891 to -6.13712 which relatively have a decent safety weight, although several things need to be fixed. And after conducting an in-person review several factors triggered accidents on Cakung Cilincing road.

- 1) Cakung Cilincing road, North Jakarta, is a national road that connects the city of East Jakarta with the city of North Jakarta so that it has an impact and creates a high level of mobility. Most of those passing through this road are heavy and large vehicles heading towards Tanjung Priok and industrial areas in the city of North Jakarta which is one of the cities in Indonesia that has the largest industrial and container areas, due to the presence of a port and container warehouse in the North Jakarta area. Therefore, many heavy vehicles are passing by in this area, around the Cakung Cilincing road there are no sufficient road markings or traffic signs and the lighting is minimal because the number of lights that go out in this area causes an accident rate between motorists and light vehicles. with heavy vehicles getting high on this track. This path is also known as the skull path because motorists or drivers on this route must always meet heavy vehicles who do not know where the actual route is. Here the author can see that the lack of road markings, street lighting, and traffic signs as well as the road conditions that are potholes and bumpy causes the accident rate on this route to be very high and dangerous.
- 2) In this lane, there are also several intersections, although most intersections have signaled there are still intersections that do not have a signal, and there are also factories where the exit or entry of heavy vehicles is not too much attention, such as sign lights for the entry or exit of heavy vehicles. This causes the Cakung Cilincing route to be very prone to accidents. Starting from heavy vehicles that go fast without speed limiting signs to roads with holes and cracks, the North Jakarta city government must pay attention to this route.

The North Jakarta Police Traffic Unit is aware that the Cakung Cilincing route is very prone to accidents. In a meeting between the author and one of the members of the North Jakarta Police Traffic Unit to discuss this route, the government and the police are working together to make a policy for the hours heavy vehicles pass at a certain time but this makes heavy vehicles pile up wishing to cross this route turning around looking for a route alternative. Therefore, the policy of enforcing certain hours is still insufficient to make drivers in this lane feel safe.

3.2. Road Section Performance

Geometric condition and facility data such as the following data :

- 1) Road width = 12 m
- 2) Side lane width = 4 m
- 3) Road type = 3 lanes / 1 direction
- 4) Road shoulder = existing
- 5) Drainage = existing
- 6) Road marking = no there is
- 7) Traffic signs = no there is

The data that has been obtained through the road survey under study is made into a vehicle volume table which can be seen in Table 7 as follows.

Table 7. Vehicle volume
 Cakung Cilincing Road North Jakarta

Time	Hour	Vehicle			Total veh/hour	Emp			Total Pcu/Hour
		LV	HV	MC		LV	HV	MC	
		1	1.2	0.25					
Morning	08.00 - 08.15	25	25	68	118	25	30	17	72
	08.15 - 08.30	32	20	57	109	32	24	14.25	70.25
	08.30 - 08.45	40	34	46	120	40	40.8	11.5	92.3
	08.45 - 09.00	38	15	60	113	38	18	15	71
	Total	135	94	231	460	135	112.8	57.75	305.55
Afternoon	12.00 - 12.15	30	25	52	107	30	30	13	73
	12.15 - 12.30	35	27	42	104	35	32.4	10.5	77.9
	12.30 - 12.45	42	26	47	115	42	31.2	11.75	84.95
	12.45 - 13.00	56	15	48	119	56	18	12	86
	Total	163	93	189	445	163	111.6	47.25	321.85
Evening	17.00 - 17.15	44	22	65	131	44	26.4	11	81.4
	17.15 - 17.30	51	24	57	132	51	28.8	14.25	94.05
	17.30 - 17.45	48	19	59	126	48	22.8	14.75	85.55
	17.45 - 18.00	59	25	45	129	59	30	11.25	100.25
	Total	202	90	226	518	202	108	51.25	361.25

Side friction data is known from direct field surveys by observing the types of side friction events along the 200-meter road segment in the vicinity. Can be seen in table 8.

Table 8. Side Barriers
 Cakung Cilincing Road, North Jakarta

No	Type Side Obstacle	Cakung Cilincing Road, North Jakarta								Side Obstacle Class	
		Pedestrian		Parking Stop Vehicle		Entry Exit Vehicle		Slow Vehicle			Total
		PED	0.5	PSV	1	EEV	0.7	SMV	0.4		Frequenc y
		Frek. Km/ho ur	Frek. Weig ht	Frek. Km/ho ur	Frek. Weig ht	Frek. Km/ho ur	Frek. Weig ht	Frek. Km/ho ur	Frek. Weig ht		Weight
1	Morning	36	18	78	78	190	133	202	80.8	309.8	M
2	Afternoon	19	9.5	116	116	142	99.4	199	79.6	304.5	M
3	Evening	23	11.5	129	129	207	144.9	123	49.2	334.6	M

After calculating the side resistance, the free flow velocity is calculated. Based on Indonesian Highway Capacity Manual (1997), The free-flow speed of a vehicle has the following equation:

$$FV = (FV_0 + FV_W) \times FFV_{SF} \times FFV_{CS}$$

FV_0 is the basic free flow velocity of a light vehicle (Km/Hour). for average speed the results are 57. FV_W is a type of Cakung Cilincing road, North Jakarta, which is 3 lanes 1 way with a lane width of 4 meters, based on Indonesian Highway Capacity Manual (1997), the free flow speed adjustment factor for a traffic lane width of 4 meters is 4 Km/Hour. FFV_{SF} is the free current resistance speed adjustment factor for the side resistance. The value of the side friction adjustment for the 3-lane 1-way road type with the category of kereb width is 1.5 m, then the value is 0,92. FFV_{CS} ber Based on the total population in the city of North Jakarta ± 2,349,351 million people according to the BPS City of North Jakarta in 2020 and the value of the factor based on the Indonesian Highway Capacity Manual (1997) is 1,00. From this data, the following free flow velocity calculations are obtained:

$$FV = (57 + 4) \times 0,92 \times 1,00$$

$$FV = 56,12 \text{ Km/Hour}$$

After calculating the speed of free flow, a capacity table for Jalan Cakung Cilincing is made which can be seen in table 9.

Table 9. Capacity of Cakung Cilincing Road

Variable	Cakung Cilincing Road	
	Adjustment Factor	
C0	Divided Road (3 Lines) / 1 Way	4950
FCw	Wc = 12 m	1.08
FCsp	1 Way Street	1
FCsf	Medium Side Barriers, Width Between Kereb and Barriers on Sidewalks 1.5m	0.91
FCcs	Bekasi City residents = 2.349.351 person	1
C	Pcu/hour	4864.86

Then calculate LOS which can be seen in table 10.

Table 10. Level Of Service

Time	Q	C	Q / C	LOS
	Pcu/Hour	Pcu/Hour	Pcu/Hour	
Morning	305.55	4864.86	0.06281	A
Afternoon	321.85	4864.86	0.06616	A
Evening	361.25	4864.86	0.07426	A

Based on table 10. Level of service on Wednesday 11 November 2020 it is known that in the morning, afternoon and evening it has a service level of A, which means that in high-speed free-flow conditions, the driver can choose the desired speed without a hitch.

4. Conclusion

Based on the results of the survey and analysis of accident data on the Cakung Cilincing road, North Jakarta, it can be concluded as follows:

- 1) In 2016 - 2019 the authors concluded that the 10 greatest value points were at coordinates -6.140891 to -6.13712 with an AEK value of 80. At these coordinates 6 people died, 0 serious injuries, 1 minor injury, loss of objects as much as 5, and material losses reaching Rp. 13,200,000.00
- 2) The types of accidents in the 4 years that caused the death toll were: front-back accidents reached 21 times, human crashes reached 7 times, single crashes reached 7 incidents, side - side crashes reached 2 times and front - crashes - front with front-side crash achieves 1 time.
- 3) The triggering factors for accidents include Lack of traffic signs, absence of road markings, lack of lighting, potholes and damaged roads, lack of appeals such as banners regarding the importance of traffic safety, insecure facilities for road users/pedestrians.
- 4) According to the survey results on Wednesday 11 November 2020, the performance of roads in the morning, afternoon and evening have service level A.

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Biography / Biographies

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Muhammad Isradi., born in Kandangan on 18 August 1972. He is secretary of study program of Civil Engineering of Mercuru Buana University. He earned his Bachelor Degree in Civil Engineer from **Muhammadiyah** Malang University in 1998 with the title of his thesis is One Way Flat Plate Planning at Ratu Plaza Madiun. Then he earned his master degree in Civil Engineer with concentration in Transportation from Brawijaya University in 2001 with the title of thesis is Model Analysis of Family Movement Awakening in Resident Area Sawojajar Malang. He also teaches several courses such as Pavement Planning, Road Geometric Planning, Transportation Planning and Environmental Engineering.

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