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PERFORMANCE ANALYSIS OF MT HARYONO ROAD POST CONSTRUCTION OF CAWANG LRT STATION

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Abstract: This research aims to analyze traffic performance on road segments that pass through MT. Haryono Road as an impact of the construction of the Cawang Light Rail Transit (LRT) Station. The performance analysis is conducted using calculations from the Indonesian Road Capacity Manual (IRCM) 1997 and a simulation approach with Vissim software. The performance analysis compares conditions before the construction of the LRT station (2019) and after its completion (2023). Based on the performance analysis, it was found that in 2019, the average speed was 14 km/h, with a service level of F, while in 2023, the average speed improved to 17 km/h, with a service level of D. Referring to the Vissim simulations, traffic management improvement scenarios were implemented. Scenario 1 resulted in an increase in speed difference of 5 km/h, while Scenario 2 showed an increase of 12 km/h.

Keywords: *Traffic Performance, Light Rail Transit, Indonesian Road Capacity Manual (IRCM) 1997, Vissim*

Introduction

Development in an urban area, such as the construction of a supermarket, hospital, or campus, has the potential to cause changes in traffic around it. This occurs because of changes in land use, which result in traffic flowing in or out of that location and can also affect service level patterns. road or road performance in the relevant area. The cause of changes in traffic movements in this area is the existence of a new activity centre, which has the potential to cause or increase traffic generation and affect the traffic around the new activity centre (Pane &

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Nurmaidah, 2020). Public transportation is one aspect of various factors that support traffic movement, which is very important in contributing to the development of a region, for example, the capital city of Jakarta. The public transportation sector in the capital is currently continuing to be developed by the DKI Jakarta Government with the aim of reducing and providing solutions to the many problems that occur related to traffic on the roads, one of which is congestion. Land transportation is one of the modes most popular with the public for carity and daily needs. As time goes by, this will most likely trigger an increase in the number of vehicles on the road, but infrastructure that does not increase will result in an increase in traffic composition that exceeds road capacity, which will cause congestion (Putra et al., 1997).

The DKI Jakarta Provincial Government, realising the public's need for public transportation, provides safe, comfortable, and affordable public transportation modes so that private vehicle users are expected to be interested in switching to the public transportation modes provided. One of the modes of public transportation chosen to meet the comfortable transportation needs of the people of Jakarta is LRT (light rail transit). In 2016, construction of the LRT system began in Indonesia, especially in Jakarta. Currently, work is being carried out on the LRT route construction, starting with the Cibubur-Cawang, East Bekasi-Cawang, and Cawang-Dukuh Atas routes, which connect the cities of Jakarta, Bogor, Depok, and Bekasi. As has been explained, every change in land use in an area will certainly affect the surrounding conditions. The construction of the LRT itself, in the construction process, creates new problems on the roads in the area where it is being built, considering that the LRT route is being built across the road network that is currently operating.

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This research analyses traffic performance on the MT Haryono section using a microscopic simulation approach, only focusing on the Jl. MT. Haryono. The analysis in this research compares performance during construction in 2108 and after construction of the Cawang LRT Station in 2023.Problem Formulation Based on the background is as follows how to identify traffic performance around Jl. M.T. Haryono after the construction of the LRT station (capacity, degree of saturation, traffic speed), what is the level of service on Jalan M.T. Haryono heading from Cawang to Pancoran after the construction of the LRT station, what are the preventive steps to prevent traffic buildup caused by online Motorcyclecycle taxis when operating LRT stations, What forms of management, engineering, or improvements are needed to accommodate changes that occur in traffic conditions (especially in improving street parking).

Literature Review

Traffic Engineering

Traffic engineering is something that is related to the planning, geometric design, and operation of highway traffic and its network, terminals, land use, and relationship with other modes of transportation. Traffic engineering is the science that studies the measurement of traffic and travel, the study of basic laws related to traffic flow and generation, and the application of practical professional knowledge about the planning, geometric design, and operation of traffic systems to achieve safety and efficient movement of people and goods (Rahman et al., 2018)

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Traffic Volume

Hullaevi et al., (2020) Volume is the number of vehicles passing one observation point during a certain time period. The traffic volume value reflects the composition of traffic by expressing the flow in passenger car units (pcu), which are converted by multiplying the passenger car equivalent value.Various types of volume are discussed in discussing traffic flow, namely: Daily volume, which includes annual average daily volume, annual average weekday traffic volume, average daily traffic, and average weekly traffic volume. Hourly volume, namely the volume of traffic that occurs at a location every hour. Kusuma, (2016) The traffic volume during the hours that occur varies throughout the day, especially in urban road traffic, where the heavy traffic volume (maximum volume) occurs in the morning and evening due to the busyness of people going to and from work, while the heavy traffic volume occurs during peak hours. (peak hour), which is generally used as a basis for traffic management. Volume per sub-hour (flow rate) is a volume that is smaller than the hourly volume. This volume is obtained from surveys over a period of time smaller than one hour, for example, 5 minutes, 10 minutes, or 15 minutes. Sub-hourly volume is generally used as a basis for planning traffic analysis (Farida & Setiawan, 2021)

Composition of Traffic on Highways

Pane & Nurmaidah, (2020) Composition of traffic on highways Traffic moving on highways consists of various types of vehicles, such as passenger cars, buses, trucks, Motorcyclebikes, and non-Motorcycleised vehicles such as bicycles, pedicabs, buggys, etc. Manual Kapasitas Jalan Indonesia (1997) All types of vehicles have different dimensions, weights, and operating characteristics. Traffic composition, as a requirement in planning and calculating traffic on a road, is

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divided into four types of vehicles. Vehicle criteria based on Bina Marga classification are:

- Light vehicles (LV: light vehicle) are two-axle Motorcycleised vehicles with four wheels (including passenger cars, oplets, microbuses, pick-up trucks, and microtrucks).
- Heavy vehicles (HV: Heavy Vehicle) are Motorcycleised vehicles that have more than 4 wheels (including buses, 2-axle trucks, 3-axle trucks, and other truck combinations).
- Motorcyclebike (MC: Motorcycle cycle, namely a Motorcycleised vehicle with 2 or 3 wheels).
- Non-Motorcycleised vehicles (UM: unMotorcycleised), namely all types of vehicles that are not Motorcycleised.

Research Method

In this research, the object of research is the MT Haryono road which was influenced by the construction of the Cawang LRT station. The research method used in this study is quantitative using the Indonesian Highway Capacity Manual and PTV Vissim software. The data source used in this research was taken from the Jabodetabek Traffic Management Unit (SPLL). The type of data in this research is primary data and secondary data.

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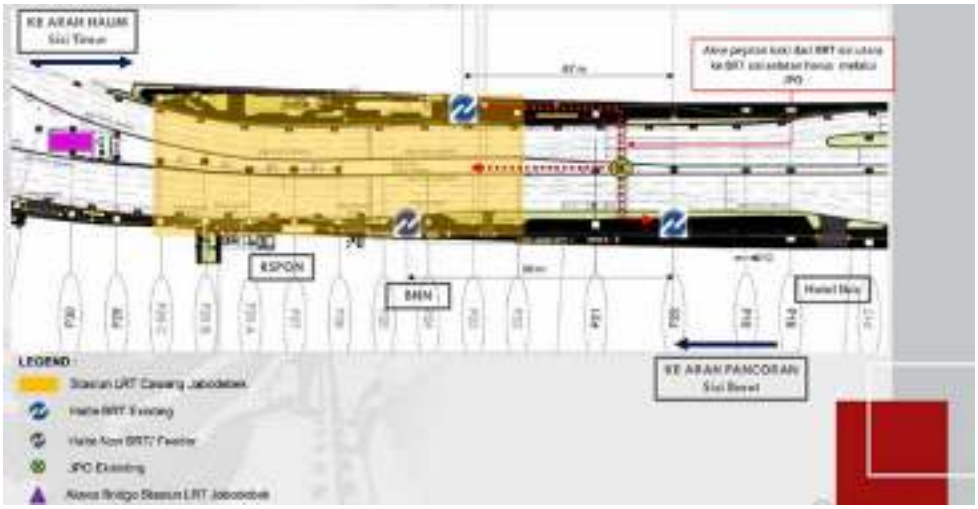
Discusion and Result

Data was used to analyze the consequences of LRT construction on January 23 2023 and January 24 2023. Meanwhile, from the research location Jl. MT Haryono as follows:

1. Road Type: One-way road

2. Lane width: 3.5 meter



Existing conditions in 2023 when construction of the Cawang LRT station is completed. Data was used to analyse the consequences of LRT construction on January 23, 2023, and January 24, 2023. Meanwhile, from the research location, Jl. MT Haryono, as follows:

1. Road Type: One-way road
2. Lane width: 3.5 metres

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Road Data	Description	Number
Road Type : 4 lanes with a median or one-way road	3,00	0,92
Direction Separator	50-50 (%)	1,00
City Size	1,0 - 1,3	1,03
Effective road width : 4 lanes devided (4/2 D) or 2 lanes one way road (2/1)	3m	-4
Side Obstacle Class	High	500-899

Speed Analysis in 2019

Average speed =(total value of data)/(amount of data)

Capacity

Calculating the capacity value (C), namely:

C = CoxFCw x FCsp x FCsf x FCcs

C = 3300 x 0.92 x 1 x 0.95 x 1

C = 2884.2 PCU/hour

Analysis of the Degree of Saturation 2019

Monday 07.00-08.00 Q = 3482.6

C=2884.2 equation

DS = Q/C

DS = 3482.6/2884.2 = 1.2

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Level of Service

Based on the results of calculating the level of service taken from the average value of the degree of saturation (DS), a value of 1.06 was obtained, which indicates that the service level of MT Hayono Road in 2019 is F. The service level F indicates that the flow of vehicles is obstructed, the speed is low, volume is above capacity, and there are lots of stops.

Calculate the free flow speed of light vehicles by:

FV = (FVO + FVw) × FFVSF × FFVCS

FVO = Basic free flow speed of light vehicles = 57

FVw = Adjustment factor for traffic lane width. Effective lane width = 0

FFVSF = Side resistance adjustment factor = 0.95

FFVCS = City size adjustment factor = 1.03

FV = (FVO + FVw) × FFVSF × FFVCS

FV = (57+0) x 0.95 x 1.03

FV = 55.7Km/hour

Capacity

Calculating the capacity value (C), namely:

C = Co x FCw x FCsp x FCsf x FCcs

FCw 4/2D = effective width: 3.50 FCw: 1

Co 4/2D = 1650 pcu/hour * 3 lane = 3300

FCsp = 1 (adjustment factor for direction separation)

FCSF = 1 (high side drag coefficient)

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FCcs = 1 (adjustment factor due to city size) East Jakarta 2,892,783 people (BPS DKI Jakarta Province, 2019)

Capacity

C = Co x FCw x FCsp x FCsf x FCcs

C = 4950 x 1 x 1 x 1 x 1.03

C = 5098 PCU/hour

Calculation of Degree of Saturation data taken January 23 morning 06:30 - 07:30

Q = 4346

C = 5098

DS = Q/C

DS = 4346/5098 = 0.85

Calculation of Degree of Saturation data taken January 23 afternoon at 17:00 – 18:00

Q = 3373

C = 3363.36

DS = 3373/5098 = 0.6

So the calculation of the average degree of saturation is as follows:

Average degree of saturation = (total value of data)/(amount of data)

= (0.8+0.6+0.3+0.7+1.2+0.8+0.5+0.9)/8

= 0.71

From the calculation results, the value of the average degree of saturation (DS) on Jalan M.T Haryono is 0.71.

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Level of Service

Based on the results of calculating the level of service taken from the average value of the degree of saturation (DS), a value of 0.71 is obtained, which means the level of service is D

Comparison of 2019 and 2023 Analysis Results		
Indicator	2019	2023
Average Speed	40,11	54,15
Average Density	1,06	0,71
Capacity	2884,2	5098
Side Obstacle Class	811 (H)	505 (H)
Level Of Service	F	D

The table above contains a comparison of road performance components. It can be seen how the results of the performance analysis of the MT Haryono road section compare between 2019 and 2023. In 2023 (existing conditions) the MT road section Haryono no longer experiences narrowing due to the construction of the Cawang LRT station so that the road capacity has increased from 2019 when the road narrowing was 2884.2 PCU/hour and in 2023 road conditions will return to normal, the capacity will increase to 5098 PCU/hour.

Model validation was carried out using the chi square and GEH methods on Vissim output variables To statistically ascertain whether the difference between the existing model and the existing model has a significant influence on the data or not, it is necessary to carry out a GEH test.

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GEH test results compare traffic volume data from survey results with model calculations as follows:

No.	Road Name	Existing (A)	Model (B)	0,5*(A+B)	(A-B)^2	GEH	Description
1	Jl. MT Haryono arah Timur - Barat	4346	4431	1755570	7225	1,2822	Accepted
2	Jl. MT Haryono arah Barat-Timur	4576	4443,47	9019470	17424	1,9735	Accepted

No.	Road Name	Existing (A)	Model (B)	0,5*(A+B)	(A-B)^2	GEH	Description
1	Jl. MT Haryono arah Timur -Barat	10,96	17	3495	-36	1,6154	Accepted
2	Jl. MT Haryono arah Barat-Timur	10,96	10,6	385	0,1296	0,1096	Accepted

Paying attention to Tables above, it is known that all calculated GEH values produced from the data are smaller than 5 (<5 GEH) meaning that there is no significant difference for this pair of data and the model is declared valid.

Parking Analysis

The large amount of illegal parking on Jalan MT Haryono carried out by online Motorcyclecycle taxis and buyers from street vendors on the sidewalk is the main cause of high side obstacles and affects the level of road service. In this case, a

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parking analysis is carried out to determine the parking space needed and how to deal with Motorcyclebike drivers who park illegally on the road.

Parking Acumulation					
No.	Time	In	Out	Existing vehicles	Acumulation
		(Ei)	(Ex)	(x)	
1.	06:30 - 06:45	43	28	10	25
2.	06:46 - 07:00	36	13	25	48
3.	07:00 - 07:15	46	16	48	78
4.	07:16 - 07:30	21	11	78	88

Vehicle volume				
No.	Time	(Ei)	(x)	Volume (veh)
1.	06:30 - 06:45	43	10	53
2.	06:46 - 07:00	36	25	61
3.	07:00 - 07:15	46	48	94
4.	07:16 - 07:30	21	78	99

The Static Capacity (SC) value is influenced by the length of the road, parking width and parking angle. Static capacity means how many parking spaces can be provided based on the length of the road or a certain area (300m). The following

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is an example of calculating static capacity for on-street parking, namely on Jalan MT Haryono.

SC = L : X
L = Road Length
X = Width of parking space
SC = 300 : 0.75
SC = 400 SRP

Analysis of Existing Parking Needs

For 1 Motorbike plot: 0.75 x 1.95 = 1.46 m2

Motorcyclebike parking requirements = 99 plots

Location area for parking requirements: 1.46 x 99 = 144.54 m2

Road capacity without on street parking is:

C = Co x FCw x FCsp x FCsf x FCcs
C = 4950 x 1 x 1 x 1 x 1.03
C = 5098

Road capacity for on street parking is:

C = Co x FCw x FCsp x FCsf x FCcs
C = 4950 x 0.92 x 1 x 1 x 1.03
C = 4690

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Based on data and calculation analysis, the saturation degree values are obtained as follows:

January 23 2023 v/c ratio value when there is on street parking:

DS = 4346 / 4690

DS = 0.92

On January 23 2023 the v/c ratio value without on street parking will be:

DS = 4346 / 5098

DS = 0.85

The traffic improvement scenario created in this research consists of:

1. As explained in the general description of the research location, along MT Haryono road there are two stops close to each other, so it is better to combine the BNN stop near the DI Panjaitan intersection with the BNN stop under the Cawang LRT station. Apart from being expected to facilitate integration between LRT and Trans Jakarta buses, this can also reduce side obstacles due to the reduced frequency of bus stops.

2. Reduce on street parking which is dominated by online Motorcyclecycle taxis by creating laybays and asking building owners along Jalan MT Haryono to provide

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drop off - pick up places on building lots along Jalan MT Haryono.
(example: in front of the lobby)

The two scenarios created in this research were then simulated with the PTV Vissim software and proven to increase the speed of traffic flow on Jalan MT Haryono. A speed comparison table with scenarios can be seen in the table

No.	Indicator	Comparison do nothing and do something		
		Eksisting (do nothing)	Scenario (do something) 1	Scenario (do something) 2
1	Speed	17,36	22,1	29
2	Level Of Service	F	C	C

From the table comparing speed and level of service, it can be seen that with scenario 1, namely the combination of the BNN stop near the DI Panjaitan intersection with the BNN stop near the LRT station, the speed increase from 17.36 Km/hour to 22.1 Km/hour and with scenario 2 namely eliminating on street parking with laybay facilities and collaboration between online transportation, especially online Motorcyclecycle taxis, showing an even greater increase in speed with a figure of 29 Km/hour.

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Conclusion

Based on the analysis of the calculations that have been carried out, it can be concluded as follows:

1. To answer the first problem formulation related to identifying traffic performance around Jl. M.T. Haryono, after the construction of the LRT station and calculation analysis, it is known that the existing MT Haryono Road section in 2023 has an average free flow speed of 58 km/h with a vehicle speed value of 17 km/h. The average degree of saturation (DS) value is 0.71 and the capacity is 5098 pcu/hour. Meanwhile, during the construction of the LRT station in 2019, Jalan MT Haryono had a capacity of 2884.2 pcu/hour, the average degree of saturation (DS) value was 1.06, the average free flow speed was 54 km/h, and the vehicle speed value was 14.67 km/h.

2. To answer the second problem formulation related to the level of road service, when there is no road narrowing and the construction of the LRT has been completed, the level of service on the MT Haryono road section is D (Level of Service D). The condition of the MT Haryono road section in 2018 during the period The construction of the Cawang LRT station when the road is narrowing, based on previous research, is known as Level of Service. F

3. To answer the third problem formulation, namely preventing traffic buildup caused by online Motorcyclecycle taxis when operating LRT stations, as in the third problem formulation, the scenario to answer this problem is to use the first scenario (do something), namely by combining BNN stops near intersections with the BNN stop under the LRT station. This is done to facilitate integration between the LRT and Trans Jakarta Bus so that it is

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hoped that the use of online Motorcyclecycle taxis will be reduced. Apart from that, this bus stop merging scenario shows an increase in speed with a value of 22.1 km/hour.

4. To answer the final problem formulation regarding the form of management and engineering or improvements needed to accommodate the changes that happen to traffic conditions, namely improving the area around Jalan MT Haryono, with the second scenario (do something), namely by creating a drop-off or pick-up point in the building area around Jalan MT Haryono. Based on the analysis that has been carried out, the need for parking space for online Motorcyclecycle taxis parked on Jalan MT Haryono is 144.54 m for Motorcyclebikes. If a place for drop-off and pick-up is created in the building area around Jalan MT Haryono, which means there is no on-street parking, it shows an increase in speed with a value of 29 km/hour**.**

Suggestions

1. With the construction of the Cawang LRT Station, the area around Cawang Station will be reorganized. In its existing condition, the Trans Jakarta Cawang BNN bus stop is located on the north and south sides of Jalan MT Haryono. The Cawang BNN stop on the north side and the Cawang BNN stop on the south side are connected by a JPO. With the area restructuring due to the existence of the Cawang LRT Station, it is proposed to combine the Cawang BNN Bus Stop on the north side and the south side, which will be combined into one stop under the Cawang LRT Station. With this move, it is hoped that there will be integration between Trans Jakarta and the Jakarta Bogor Depok Bekasi (Jabodebek) LRT

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2. Arranging the area around the Cawang LRT station also involves controlling illegal parking, which is still a high-side obstacle and interferes with vehicles passing on Jalan MT Haryono. Steps taken to overcome this include the creation of laybays for Motorcyclecycles. By constructing four (four) laybays according to the recommendations of the Andalalin Study for Cawang LRT Station, it is hoped that this can be a solution to the problem of illegal parking. One laybay with a capacity of 3–4 Motorcyclebikes is estimated to be able to reduce the illegal parking population by 10% per hour. Even though there are still side obstacles, they will not be as high as before.

3. Implementation of geofencing technology to reduce gatherings of online Motorcyclecycle taxis This technology was implemented during PSBB (Large-Scale Social Restrictions). The way this technology works is that online Motorcyclecycle taxis that are gathered in groups of more than five will not get orders.

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