Traffic management for MRT construction phase II bundaran HI – kota

Eduardi Prahara¹, Rico Giyar Pionar¹, Andryan Suhendra¹

¹ Civil Engineering Department, Faculty of Engineering, Bina Nusantara University
Jakarta, Indonesia 11480

Email: eduardi@gmail.com, rico.giyar@outlook.com, asuhendra@binus.edu

Abstract. MRT Construction Phase II, which is planned to be carried out in 2020, will cross Sarina, Harmoni, Glodok, Sawah Besar, Mangga Besar, and Kota Stations. The impact of this project during construction makes the road narrowing and causes longer queue length and delay of Harmoni Intersection, and vehicle travel time passes the site of construction. This research aims to determine traffic management and modeling using VISSIM, Indonesian Highway Capacity Manual (MKJI) 1997, and Indonesian Highway Capacity Guidance (PKJI) 2014 on Harmony Central. The value of queue length, delay, and travel time obtained from the existing condition will be used to estimate the traffic performance during construction. The increased queue length, delay, and travel time along the construction site will cause congestion to the previous intersection. The diversion plan needs to be done before the vehicle meets the busway flow that will be diverted caused by the relocation of the terminal to reduce the density of vehicles going into the Signalized Intersection Harmoni.

Keywords: MRT Construction Phase II, Traffic Management, VISSIM, MKJI 1997, PKJI 2014, Road Diversion

1. Introduction

The increasing growth of transportation on urban roads in Indonesia, especially in the capital city of DKI Jakarta is influenced by many factors. These factors include increased motor vehicle ownership due to an increase in population (influenced by birth rates and the level of urbanization), limited resources for road construction and increased industrial and commercial activities in Jakarta [1] [2]. Due to the significant population growth each year, in order to meet the needs, increasing facilities for mass transportation infrastructure in DKI Jakarta continues to develop, this can be seen from the development of new transportation facilities carried out by the government such as MRT development, the addition of Bus Way, inter-city transportation, train lines, addition of road network systems and others [3]. The addition of capacity on a road requires an effective method for design and planning to get maximum results.

MRT is Mass Rapid Transit, which is integrated fast transit which is a rail-based fast transit
transportation system [4]. The establishment of PT Mass Rapid Transit Jakarta (PT. MRT Jakarta) in the form of a Limited Liability Company, is regulated in the Jakarta Provincial Regulation No. 3 of 2008. Established on June 17, 2008 and majority of its shares are owned by the DKI Jakarta Provincial Government [5]. The Jakarta MRT route is planned to stretch approximately ± 110.8 km, which consists of the South-North Corridor (Lebak Bulus - Kampung Bandan Corridor) of ± 23.8 km and East-West Corridor for ± 87 km. The construction of the South-North corridor from Lebak Bulus to Kampung Bandan is carried out in two phases.

Phase 1, which will be built first, connects Lebak Bulus to the 15.7 km Indonesia Hotel Roundabout with 13 stations (7 elevated stations and 6 underground stations) has been start operating in 2019. MRT Construction Phase 2 will continue the South-North route from the Hotel Indonesia Roundabout to 8.1 km of Ancol which will begin construction after phase 1, starting operation and targeted to operate 2022. The pre-feasibility study for this phase has been completed. As for the corridor East - West is currently in the feasibility study. This corridor will operate later than 2024 – 2027 [6].

2. Methodology
This research used several parameters such as vehicle volume, vehicle speed, travel time, road geometry, queue length, and vehicle delay. Several surveys need to be done, such as road geometrics survey, vehicle volume survey, vehicle composition survey, travel route survey, vehicle speed survey, calibration parameters survey, traffic light phase survey, queue length survey, and vehicle travel time. Speed, volume, travel time and vehicle delay are collected using video cameras located on the field. The video camera recorded all traffic flows for a given period. Road geometry and queue length data were collected by roller to measure the length and width of the location. The MRT Construction Plan is obtained from JICA Indonesia and MRT Jakarta. This data is then used as a reference to be compared with the results of VISSIM software simulation modeling to find out the changes that are happening now, as well as during construction. In this study, the result will be compared between the traffic existing condition and estimation during construction (using data from PT. MRT). By using VISSIM, MKJI 1997, and PKJI 2014 as methods for the research, the data results can be compared. The survey location chose for the research is Construction MRT at Harmoni.

3. Results and Discussion
3.1 Analysis of Research Results Data on Existing Conditions
In this research, the area observed was the Phase II MRT Construction site, which would only affect Jalan Hayam Wuruk and Jalan Gajah Mada. For Jalan Hayam Wuruk, the parameters observed were the queue length and the delay caused by the Harmony APILL Intersection. And for Jalan Gajah Mada what is observed is a travel time of 300 m. The following are the results of the queue length on Jl. Hayam Wuruk:
Figure 1. Graph of Queue Length Comparison on Jl. Hayam Wuruk on Existing Conditions

Seen from the graph, the results of the VISSIM analysis have the closest value to the existing value which has a difference of 10 m or about 5%. The difference between the VISSIM simulation results and the results of the MKJI method calculation, it can be concluded that MKJI has a length difference of about 61 meters or about 33% longer. Whereas the comparison between the VISSIM simulation results and the results of the PKJI method calculation, it can be concluded that PKJI has a difference in length of about 36 meters or about 19% shorter. The following are the results of the delay on Jl. Hayam Wuruk:

Figure 2. Graph of Delay Comparison on Jl. Hayam Wuruk on Existing Conditions

Seen from the graph, the results of the VISSIM analysis have the closest value to the existing value which has a difference of 13 seconds or about 15%. The difference between the VISSIM simulation results and the results of the MKJI method calculation, it can be concluded that MKJI has a difference of about 12 seconds or about 14% longer. While the comparison between the VISSIM simulation results and the results of the PKJI method calculation, it can be concluded that PKJI has a difference of about 21
seconds or about 24% faster. The following are the results of the vehicle travel time on Jl. Gajah Mada:

![Graph of Travel Time Comparison on Jl. Gajah Mada on Existing Conditions](image)

**Figure 3.** Graph of Travel Time Comparison on Jl. Gajah Mada on Existing Conditions

Seen from the graph, the results of the VISSIM analysis have the closest value to the existing value which has a difference of 10 m or about 5%. The difference between the VISSIM simulation results and the results of the MKJI method calculation, it can be concluded that MKJI has a difference of around 11.2 seconds or about 37% faster. While the comparison between the VISSIM simulation results and the results of the PKJI method calculation, it can be concluded that PKJI has a difference of around 9.39 or about 32% faster.

### 3.2 Analysis of Research Results Data During Construction

In this study, the conditions of MRT Phase II Construction reviewed were during Step 2 and Step 3 of MRT Construction. Step 2 MRT construction is carried out along Jalan Gajah Mada, while Step 3 Construction of the MRT is carried out along Jalan Hayam Wuruk.

![MRT Construction Step 2 at Harmoni](image)

**Figure 4** MRT Construction Step 2 at Harmoni [7]
The following are the results of the queue length on Jl. Hayam Wuruk:

![Graph of Queue Length Comparison on Jl. Hayam Wuruk During Construction](image)

**Figure 6.** Graph of Queue Length Comparison on Jl. Hayam Wuruk During Construction

The difference between the VISSIM simulation results and the results of the MKJI method calculation, it can be concluded that MKJI has a difference in length of about 12 meters or about 4% longer. While the comparison between the VISSIM simulation results and the results of the PKJI method calculation, it can be concluded that PKJI has a difference in length of about 79 meters or about 32% shorter.

The following are the results of the delay on Jl. Hayam Wuruk:
The difference between the VISSIM simulation results and the results of the MKJI method calculation, it can be concluded that MKJI has a difference of about 118 seconds or around 53% longer. While the comparison between the VISSIM simulation results and the results of the PKJI method calculation, it can be concluded that PKJI has a difference of about 86 seconds or about 61% longer.

The following are the results of the vehicle travel time on Jl. Gajah Mada:

The difference between the VISSIM simulation results and the results of the MKJI method calculation, it can be concluded that MKJI has a difference of about 28 seconds or about 52% faster. While the comparison between the VISSIM simulation results and the results of the PKJI method calculation, it can be concluded that PKJI has a difference of about 22 seconds or about 40% faster.
3.3 Comparison Results of Analysis of Existing Conditions and When Construction of MRT Phase II

The purpose of comparing the results of VISSIM, MKJI 1997, and PKJI 2014 modeling on the existing and when construction occurs is to see how the conditions of Jalan Hayam Wuruk and Jalan Gajah Mada at the time of the Phase II MRT Construction are going on. The following are the comparison results of queue length:

![Graph of Queue Length Comparison on Jl. Hayam Wuruk on Existing Condition and During Construction](image)

It can be seen that in the comparison of the Queue Length on Jl. Hayam Wuruk with existing conditions and time of construction has increased significantly. Queue length using the MKJI method increased by 6%, using the PKJI method increased by 14%, and using the VISSIM method increased by 35%. If average, the estimated increase in Queue Length will increase by 19%.

The following are the comparison results of vehicle delay:

![Graph of Vehicle Delay Comparison on Jl. Hayam Wuruk on Existing Condition and During Construction](image)

It can be seen that in the comparison of Delays on Jl. Hayam Wuruk with existing conditions and...
when construction experienced a significant increase. Delays using the MKJI method increased by 7%, using the PKJI method increased by 32%, and using the VISSIM method increased by 160%. If average, the estimated increase in Vehicle Delays will increase by 66%.

The following are the comparison results of vehicle travel time:

![Graph of Vehicle Travel Time Comparison on Jl. Gajah Mada on Existing Condition and During Construction](image)

It can be seen that in the comparison of Travel Time on Jl. Gajah Mada with existing conditions and when construction experienced a significant increase. The travel time of vehicles using the MKJI method increased by 61%, using the PKJI method increased by 41%, and using the VISSIM method increased by 84%. If averaged, the estimated increase in Vehicle Travel Time will increase by 62%.

3.4 Evaluation of Traffic Conditions Due to MRT Phase II Construction

Seeing the increase in traffic performance for each parameter, an alternative traffic diversion needs to be done to reduce the traffic jam that will be caused by Phase II MRT Construction. By comparing the diversion of the busway lane carried out by the MRT, the alternative diversion for other vehicles must not interfere with the flow of the busway so that it must be done before crossing the busway flow. The following is data on busway current transfers carried out by the MRT:

| Corridor ID | Corridor Name                  | Type          | Effect on Busway Lane |
|-------------|--------------------------------|---------------|-----------------------|
| 1           | Blok M - Kota                  | Main Corridor | Unchanged             |
| 1A          | PIK - Balai Kota               | Feeder        | Unchanged             |
| 9B          | Pinang Ranti – Kota            | Main Corridor | Unchanged             |
| 2           | Pulogadung - Harmoni Central   | Main Corridor | Unchanged             |
| 2A          | Pulogadung - Kalideres         | Main Corridor | Detour required (East to South) |
| 2C          | Monas - PRJ JIEXPO             | Main Corridor | Unchanged             |
| 3           | Kalideres – Pasar Baru         | Main Corridor | Detour required       |
According to JICA & MRT Jakarta, the construction that was carried out on Jl. Gajah Mada and Jl. Hayam Wuruk will need a diversion of bus routes for corridors 2A, 3, 5A and 5C. So that the diversion for other vehicles must be carried out without interrupting this route or will increase congestion later. Following is the scheme of diversion the busway route for corridors 2A, 3, 5A, and 5C [7].

|   | Main Corridor               |   |   |
|---|------------------------------|---|---|
| 5A | Kampung Melayu – Grogol 1   |   | Detour required |
| 5C | PGC 1 – Harmoni Central     |   | Detour required |
| 8  | Lebak Bulus – Harmoni Central |   | Unchanged |
| 8A | Grogol 2 – Juanda           |   | Unchanged |
| T12| Poris Plawad – Pasar Baru  | Suburban Service | Unchanged |

According to JICA & MRT Jakarta, the construction that was carried out on Jl. Gajah Mada and Jl. Hayam Wuruk will need a diversion of bus routes for corridors 2A, 3, 5A and 5C. So that the diversion for other vehicles must be carried out without interrupting this route or will increase congestion later. Following is the scheme of diversion the busway route for corridors 2A, 3, 5A, and 5C [7].

The vehicle headed to the construction site is a vehicle that comes from Harmoni APIII Intersection, Kota and also Jl. Sukarjo Wiryopranoto (Pasar Baru). Diversion of traffic flows is done by limiting vehicles entering, prohibiting on-street parking on the side of the road, and prohibiting vehicles headed through certain routes. The following are recommendations for vehicle route schemes to reduce congestion when the MRT construction takes place.
Vehicles coming from the direction of the City going to Pasar Baru need to be diverted before the vehicle enters the construction site. Several locations need to be banned from parking, such as along and before construction sites, as well as Jl. Batu Ceper because it can be used as a diversion route for vehicles. The diversion to Monas can be transferred to Jl. Batu Ceper which then turns towards Jl. Veteran.

4. Conclusion

There are differences in parameters used in the VISSIM, MKJI 1997, and PKJI 2014 simulations. At VISSIM, traffic modeling adds microscopic parameters to each calibration, whereas in MKJI 1997 and PKJI 2014 only uses macroscopic parameters.

After the analysis results are compared using VISSIM, MKJI 1997, and PKJI 2014 simulations. VISSIM simulation results can be said to be closest to existing traffic conditions at Harmony APILL Intersection. On Jl. Hayam Wuruk, Queue Length increased by 35% from existing conditions, Delays increased by 160% from existing conditions, and Travel Time on Jl. Gajah Mada increased by 84% from existing conditions. Significant differences in MKJI 1997 and PKJI 2014 with VISSIM can be due to many factors. One of the factors is vehicle equivalent and vehicle speed. In MKJI and PKJI, the equivalent of vehicles owned by Motorbikes is different and causes the value of vehicle traffic to be different from VISSIM. Vehicle speed which is the parameter of the MKJI 1997 calculation and 2014 PKJI was obtained from the graph provided for the Degree of Traffic Saturation.

Results Analysis estimation when MRT Phase II Construction has an increase for each parameter reviewed. This shows that MRT Phase II Construction will affect the flow of vehicle traffic that will pass on Jalan Hayam Wuruk and Jalan Gajah Mada later.

There needs to be a traffic diversion on Jalan Hayam Wuruk and Jalan Gajah Mada, especially on the busway lane. Given this intersection, there is the Central Harmony Terminal which is one of the largest busway centers in Jakarta. The vehicle needs to be diverted before entering the Harmony APILL Intersection so that the queue length does not increase, it should be diverted first to Jl. Sukarjo Wiryopranoto.
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