Performance Evaluation Study Antasari-Blok M Elevated Freeway

Ferdinand Fassa
Civil Engineering
Universitas Pembangunan Jaya
Tangerang Selatan, Indonesia
Ferdinand_fassa@yahoo.co.id

Fredy Jhon PS & Retno Ambarsari
Civil Engineering
Universitas Pembangunan Jaya
Tangerang Selatan, Indonesia
fredyjhonphilip.sitorus@gmail.com

***Abstract*—Traffic congestion is a common problem that happened on the transportation system especially in Jakarta. One of factor affecting this problem is the growth of road infrastructure is not equal with the growth of vehicles for the last 10 years. It's indicated by the road ratio in Jakarta which is less than ideal about 6%, while the ideal road ratio is 12% from the total area. Basically, Elevated freeway was built as part of road network in Jakarta to reduce the load of arterial road and expected to break the congestion during peak hour. Antasari-Blok M elevated freeway built to provide through traffic accessibility which is came from south and north region. It is in parallel position to Fatmawati-Blok M route where MRT is going to be built. Therefore, Antarsari-Blok M elevated freeway as an alternative route for the trip to south and to the north. The purpose of this study is to find out the effectiveness of Antarsari-Blok M elevated freeway, there are two parameters to be observed. The first is, it need to the compare the traffic load through elevated freeways with the roads surrounding the arterial road based on v/c ratio, and the second is evaluating Elevated freeway performance. Analysis of results indicates that travel speed to the north on the morning (06.00 to 09.00) is 100% faster when used elevated freeway compared with arterial road, while in the evening traffic speed to the south is 20% faster using elevated freeway compared with arterial road and travel time to the north is 5.13 minutes using maximum (on road sign) speed 40 km/hr. While in the evening travel time to the south reached 18.03 minutes.**

Keywords—Elevated freeways, Effectiveness, V/C Ration, Level of Service (LOS)

I. INTRODUCTION (*HEADING 1*)

Traffic congestion is a common problem that happens on any transportation systems especially in Jakarta. One of many factors affecting this problem is that the growth of road infrastructure is not equal with the growth of vehicles for the last 10 years. It's indicated by the road ratio in Jakarta which is less than ideal about 6%, whereas the ideal road ratio is 12% from the total area. Based on World Bank data, the population of middle class in Indonesia was only 37.7% on 2003, but on 2010 this number increased by 56.6% which equals to 134 million people (thepresidentpostindonesia.com, Sept 2014). This leads to an increase of an increase of the number of vehicle ownership from time to time which goes hand in hand with inadequate the public transportation system. For the last five years the growth of motor vehicles is 9.1% per-year but the growth of road is only 0.01% per year.

One of the impacts of traffic congestion most felt by the user is that the travel time is much longer from time to time due to a decrease in road network performance. Consequently, traffic congestion occurs every weekday especially on the peak hour morning and afternoon. In order to reduce traffic congestion and also overcome the accessibility movement from and to the buffer zone, the Central government had planned construction of several new roads in Greater Jakarta. Two of them that has been built are Elevated Freeway Antasari - Blok M and Tanah Abang - Kampung Melayu. Basically, Elevated freeways on Antasari-Blok M & Tanah Abang-Kampung Melayu were built as part of road network in Jakarta to reduce the load of arterial road and expected to break the congestion during peak hour. Antasari-Blok M elevated freeway is built to provide through traffic accessibility which comes from south and north region. It is in parallel position to Fatmawati-Blok M route where MRT is going to be built. Therefore, Antarsari-Blok M elevated freeway serves as an alternative route for the trip to south and to the north. On the other hand, the traffic from east to west is provide with Tanah Abang-Kampung Melayu elevated freeway.

Object of this research is Antasari - Blok M elevated freeway. It is located in South jakarta and it connects southern region which are Pondok Labu, Fatmawati, Cilandak towards to the north region Blok M along 4,75 km. total length of Antasari-Blok M freeway from North to South is is 3.42 km and from South is 4.75km, with 4 lane every lane has a width of 3.5 meters with a height of 10 meters from the existing road. Figure 1 shows map of Antasari-Blok M elevated freeway, figure 2 and 3 show the condition of Antasari-Blok M elevated freeway in the morning.

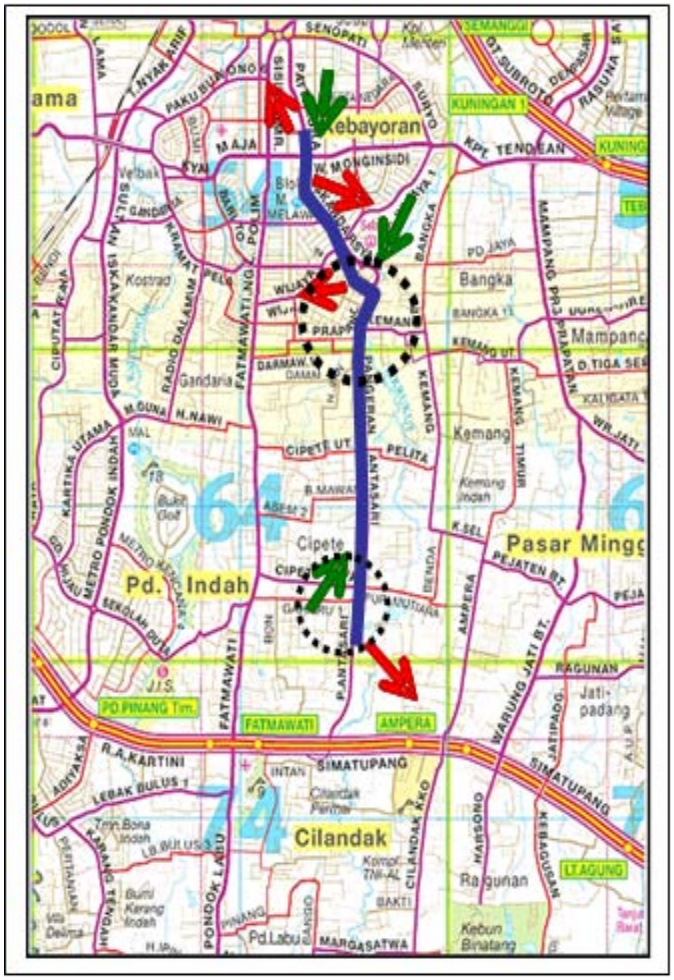

Fig. 1. Antasari-Blok M Elevated Freeway Map

Fig. 2. Antasari-Blok M on ramp to south (Cipete) and off ramp to north

Fig. 3. Antasari-Blok M (Cipete) On Ramp To North (Blok M)

The research question in this case is how the influence of elevated freeway to traffic load distribution compares to arterial roads. The objective of this research is to analyze the service performance of Antasari-Blok M elevated freeway by analyzing the behavior of the traffic flow through analysis v/c ratio, speed and travel time so we can know Level of Service Antasari-Blok M elevated freeway.

This study was conducted using the process below.

- Introduction (Research object, scope, question and aim)
- Theoretical Review
- Data Collection (Geometric, Volume, Travel time)
- Data Analysis (Travel Speed, V/C and LOS)
- Conclusion

II. THEORETICAL REVIEW

A. *Freeway*

According to the Highway Capacity Manual (2000), freeway defined as a divided highway with full control of access and two or more lanes for the exclusive use of traffic in each direction. Freeway has an uninterrupted flow, which is there is no intersection of plot and control traffic signals. Access into and out onto the freeway limited to the site connecting line (ramp).

B. *Capacity*

The Highway Capacity Manual defines the capacity as the maximum hourly rate at which persons or vehicles can be reasonably expected to traverse a point or a uniform segment of a lane or roadway during a given time period, under prevailing roadway, traffic and control conditions.

Capacity expressed in term of passenger car units (pcu) per hour. Capacity factors as given by Equation 1:

$$C = C_o \times FC_W \times FC_{SP} \quad \text{(pcu/hr)} \qquad (1)$$

C. *Travel Speed*

Travel speed is defined as the average space velocity of light vehicles along the freeway segment. The HCM often

uses speed as the service measure for urban street segment and this speed depends on volume to capacity (v/c) ratio (Highway Capacity Manual 2010).

D. Level Of Service (LOS)

LOS is a qualitative measure used to relate the quality of traffic service (HCM). LOS is used to analyze highways by categorizing traffic flow and assigning quality levels of traffic based on performance measure like speed, density, etc. The effectiveness measurement to define the level of service in freeway is the density (density). Thus, LOS is spatially a localized measure and this is used to analyze the operation of specific locations of highway sections (Chen et al. 2003).

Level of service is an indicator that reflects the level of comfort of a road segment, which is ratio between volume of existing traffic capacity and road. The level of service can be expressed with the letter A, B, C, D, E, and F, where A denote the best quality of service and F denote the worst.

files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

III. DATA COLLECTION

A case study of elevated freeway of 4.6 km length on Antasari Road through Blok M in South Jakarta has been considered. This freeway is 4-lane divided having 8.75 m road width in each direction Geometric of Antasari-Blok M elevated freeway consist of 4/2 D as shown of figure below.

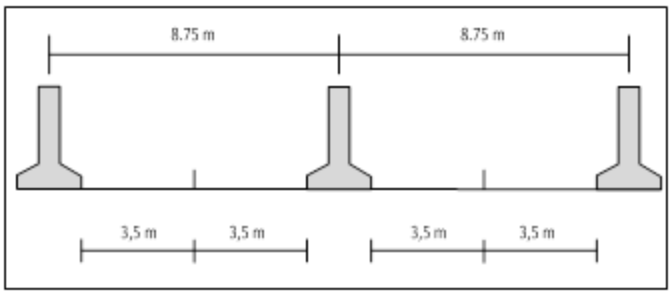

Fig. 4. Antasari-Blok M Elevated Freeway Cross Section

This elevated freeway serve the traffic coming from Cilandak, Fatmawati toward to Blok M. Traffic volume data collection was obtained from Traffic volume survey of weekday start from 06.00 to 22.00. Data collection in this research was mainly focus during morning hour between 06.00 to 09.00 and evening hours of 16.00 to 19.00, Graphic of traffic volume presented in figure 5. In figure 5 show the traffic from south to north during peak hour especially from 07.00 am to 09.00 am is more than 6000 in pcu/hour and in the evening the escalation of vehicle from 16.00-18.00 is more than 5000 in pcu/hour.

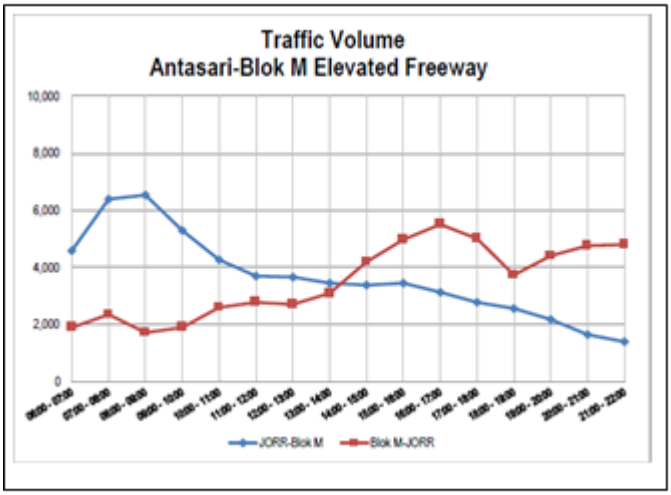

Fig. 5. Antasari-Blok M Elevated Freeway Traffic Volume (pcu), March 2014

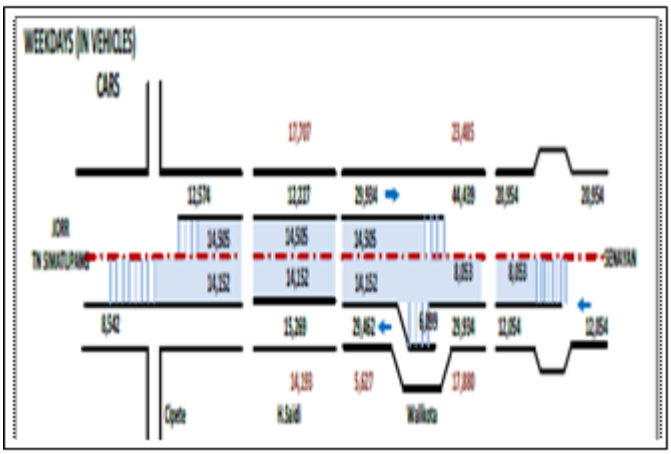

Fig. 6. Antasari-Blok M Elevated Freeway and Arterial road Traffic Volume (in car), March 2014

In figure 6, total traffic volume on arterial road from south to north is 29,934cars on the contrary traffic from north to south is 29,463 cars, on the other hand total traffic volume on elevated freeway from south to north is 14,505cars and traffic from north to south is 14,152 cars.

To obtain travel speed data, this survey carried out by the moving observer method. Floating car strategy used to observe the average vehicles speed on routes that have been determined. With this method, moving observer was instructed to drive at an average speed in traffic flow. This survey was done two days during the weekday.

The travel speed data before the construction of elevated freeway is presented in table 1, based on table below the average vehicle speed on arterial road is 8-12 km/hour in the morning and the evening on both direction.

TABLE I. TRAVEL SPEED ON ARTERIAL ROAD BEFORE CONSTRUTION

Segment	Heading North		Heading South	
	Morning	*Evening*	*Morning*	*Evening*
Pattimura – Iskandarsyah	8-12	8-12	8-12	8-12
Iskandarsyah – Jl. Cipete	8-12	8-12	8-12	8-12

(Source : Kajian DKI Jakarta, 2009)

But after the construction of elevated freeway the travel speed on arterial road is increase become 20-25 km/hour in the morning on and 20-30 in the evening heading north, and to south destination is 10-25 km/hour in the morning and 10-15 in the evening the travel speed on arterial road after construction is presented in table 2.

TABLE II. TRAVEL SPEED ON ARTERIAL ROAD AFTER ELEVATED FREEWAY CONSTRUCTION

Segment	Heading North		Heading South	
	Morning	*Evening*	*Morning*	*Evening*
Pattimura – Iskandarsyah	20-25	20-30	20-25	10-15
Iskandarsyah – Jl. Cipete	22-25	20-40	10-15	10-20

(Source : Survey by moving car method, 2014)

In table 3, travel speed on elevated freeway from north to south in the morning is zero, because base on site observation there are one direction policy start from 06.00 am to 09.00 am. On opposite side travel speed from south to north in the morning is 40-60 km/hour. In the evening, the travel speed from north to south is 16-20 km/hour and from south to north is 40-60 km/hour.

TABLE III. TRAVEL SPEED ON ELEVATED FREEWAY CONSTRUCTION

Segment	*Morning*	*Evening*
North – South	-	16-20
South – North	40-60	40-60

IV. DATA ANALYSIS

Base on the above data can be explained that the existences of elevated freeway can increase travel speed on arterial road between 50% - 100% of the average speed compared before the existences of elevated freeway.

Meanwhile, when compared the travel speed between vehicles passed through elevated freeway against arterial road it can be explained that the travel speed to the north on the morning (06.00 to 09.00) is 100% faster when used elevated freeway compared with arterial road, while in the evening traffic speed to the south is 20% faster using elevated freeway compared with arterial road.

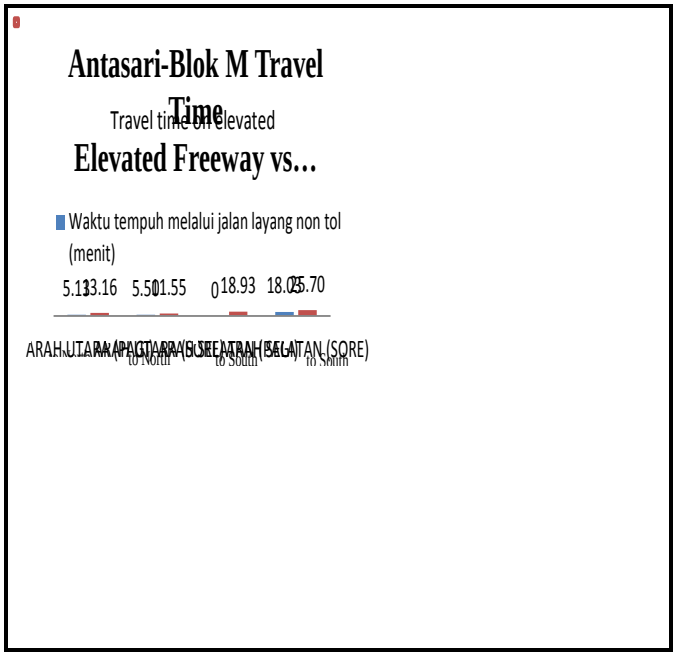

Fig. 7. Antasari-Blok M Travel Time Elevated Freeway vs Arterial Road

TABLE IV. TRAFFIC VOLUME IN THE MORNING (06.00-09.00)

Vehicle	PCU Factor	Traffic Volume (vehicle/hr)		Traffic Volume (pcu/hr)	
		North	*South*	*North*	*South*
LV	1.00	1804	-	1804	-
MHV	1.50	8	-	12	-
LB	1.60	0	0	0	0
LT	2.30	0	2	0	-
Total				1816	0

In table 4 shows the maximum hourly traffic volume totally 1816 pcu. And in table 5 shows the maximum hourly traffic hour totally 742 to north region and 1180 to south region.

TABLE V. TRAFFIC VOLUME IN THE EVENING (16.00-19.00)

Vehicle	PCU Factor	Traffic Volume (vehicle/hr)		Traffic Volume (pcu/hr)	
		North	*South*	*North*	*South*
LV	1.00	727	1163	727	1163
MHV	1.50	2	8	3	12
LB	1.60	0	0	0	0
LT	2.30	5	2	12	5
Total				742	1180

Base on equation 1, the result of actual capacity is 4600 pcu/hr/direction, it presented in table 6.

TABLE VI. CAPACITY ANALYSIS

Base Capacity (Co)	Adjust Factor For Capacity	Actual Capacity (C) (pcu/hr/lane)	Actual Capacity (C) (pcu/hr/direction)
	Car. Width (FCw)	*(a) x (b)*	*(a) x (b)*
(a)	(b)	(c)	(d)
2300	1	2300	4600

Based on MKJI 1997, free flow speed is 88 km/hr it shows in table 7.

TABLE VII. FREE FLOW SPEED ANALYSIS

Base Free Flow Speed (FVo) km/hr	Adjust For Car Width (FVw)	Actual Free Flow Speed (FV)
		(e)+ (f)
(e)	*(f)*	*(g)*
88	0	88

TABLE VIII. V/C RATIO ANALYSIS

Direction	Time	Traffic Flow (Volume)	V/C Ratio	Actual Speed(Vsp) (km/hr)
	Morning	*(h)*	*(i)= (h)/(d)*	*(j)*
North (Antasari-Blok M)	Mornig	1816	0.39	78
	Evening	742	0.16	82
South (Blok M-Antasari)	Mornig	776	0.17	84
	Evening	1180	0.26	78

In theory, if the value of v/c ratio small, then the travel speed will increase. However, the v/c ratio grade cannot be the only indicator to determine the performance of a road, so it must be calculate the average travel. In figure 7 indicate that on peak hours (in the morning), travel time to the north is 5.13 minutes using maximum (on road sign) speed 40 km/hr. While in the evening travel time to the south reached 18.03 minutes.

TABLE IX. LOS ANALYSIS

Direction	Time	Capacity (pc/hr/ln)	Average passanger car speed (km/hr)	LOS
	Morning	*(k)*	*(l)*	*(m)*
North (Antasari-Blok M)	Mornig	2300	40	F
	Evening	2300	38	F
South (Blok M-Antasari)	Mornig	2300	-	-
	Evening	2300	16	F

In table 9 presented the average passenger speed is 16-40 km/hour with capacity 2300 pc/hr/lane. Base on this data the Level of Service for elevated freeway performance the result is F.

V. CONCLUSION

1) The travel speed to the north on the morning (06.00 to 09.00) is 100% faster when used elevated freeway compared with arterial road, while in the evening traffic speed to the south is 20% faster using elevated freeway compared with arterial road.

2) Travel time to the north is 5.13 minutes using maximum (on road sign) speed 40 km/hr. While in the evening travel time to the south reached 18.03 minutes.

3) Level of Service for elevated freeway performance the result is F.

ACKNOWLEDGMENT

The author gratefully acknowledges the following individuals to participate to this study. Students of Civil engineering help counting data during surveying. And Gita widya laksmini soerjoatmodjo for reviewing this paper.

REFERENCES

[1] National Research Council Washington DC, “Highway Capacity Manual” 2000.

[2] Directorate General Bian Marga “Indonesian Highway Capacity Manual” 1997.

[3] Chen, A., Ji,Zhaowangand Recker, W. (2003) Effect of Route Choice Models on Estimation of Travel Time Reliability Under Demand and Supply Variations. The Network Reliability of Transport,*Proc., of the 1st International Symposium on Transportation Network Reliability (INSTR)*, eds., Pergamon, pp.93-117.