Trip Assignment Modelling for Transportation at Cikoko LRT Station Using PTV Visum Software

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Abstract

The increasing transportation demand in DKI Jakarta area has led to congestion problems, particularly around the Cikoko LRT Station in South Jakarta. This research aims to analyze trip assignment modeling to evaluate the performance of road networks connected to the station using PTV Visum software. The study employs both primary and secondary data. Primary data was obtained through origin-destination survey projections filled out by respondents at Cikoko LRT Station, while the secondary data includes administrative maps, road networks, population, and land use data from various government sources. Traffic flow data was converted into Passenger Car Equivalent (PCE) values and used to analyze service levels using Volume-Capacity Ratio (VCR). Also Wardrop's User Equilibrium method is used for modeling in PTV Visum software . The study encompasses 11 zones in Jabodetabek and evaluates 48 road segments. Results show that only 24 of the 48 roads experienced loading based on the model. Several road segments, especially in South Jakarta and Bekasi, were found to be over capacity, while others, particularly in Central and North Jakarta, still operate within acceptable service levels. This research provides essential insights for future transportation planning and infrastructure improvements in congested urban areas.

Keywords: Trip assignment, PTV Visum software, Road service level, Cikoko LRT Station

1. INTRODUCTION

Along with advances in road infrastructure, transportation systems have also evolved to facilitate inter-regional movement. Based on Badan Pusat Statistik Indonesia, the increasing demand for transportation today has the potential to increase traffic congestion. The Cikoko LRT Station area in South Jakarta is one of the roads with congestion points in the capital. To understand the traffic congestion in this area, modeling transportation services is necessary for the movement occurring in the Cikoko LRT Station area.

Demand for transportation services can be expressed in various ways, for example, as the number of drivers wishing to travel between specific city zones within a unit of time (1). Road network assignment is a process of requesting transportation services, where trips are assigned to the road network (2). The trip assignment process requires a complete description of the transportation system and requires an inter-zone trip movement matrix (3). The purpose of this assignment is to obtain the flow on the road segment and/or total trips within the network under review.

1.1. Trip Assignment

Traffic assignment or route selection is part of the process that allocates a specific set of travel exchanges to a specific transportation network or system. Traffic assignment is performed to develop construction priorities by assigning future trips estimated for intermediate years to the transportation system proposed for those years (3). In the traffic assignment stage, an origin-destination matrix derived from volume is modeled. The analysis model and the determinants factors of the traffic assignment are described below.

1.1.1 Analysis Model

Several principles are used to impose an origin-destination matrix on the road network, which ultimately produces traffic flow information on each road segment. The model used in this study is the Wardrop Equilibrium model (4). This principle takes into account the impact of traffic congestion and assumes that drivers cannot change their routes to reduce travel costs during periods of congestion. Wardrop's Law states that road users will be affected by the traffic volume density variable (V/C ratio-congestion level), namely, if a road segment is congested, travel route

users will choose the road segment with the lowest congestion level and consider the variables of short distance and shortest time (5).

1.1.2 Determinant Factor

Route selection is influenced by several alternatives, such as the shortest, fastest, and cheapest, and it is also assumed that road users have sufficient information (about road congestion) to determine the best route (5). The determining factors used in the analysis are the shortest and fastest routes.

1.2. Volume Lalu Lintas

Traffic volume is a crucial variable in traffic engineering and its essentially a calculation process related to the number of movements per unit time at a specific location (6). To obtain the origin-destination matrix, traffic volume data is required for each road network from/to Cikoko LRT Station to its origin/destination zone. Traffic volume data is obtained from surveys conducted on each road section or from relevant agencies. Traffic volume can be calculated using the following equation.

$$Q = \frac{N}{T} \quad \text{.....(1)}$$

Where:

Q: Traffic flow (veh/hr)
N: Vehichle amount (veh)
T: Observation time (hour)

The vehicle count data is then calculated in PCE/hour for each vehicle, with the equivalent value for each vehicle in the table below.

Table 1. Passanger Car Equivalent

Type of Vehicle	PCE for Road Type	
	Undivided	Divided
LV	1,00	1,00
MC	1,30	1,30
HV	0,15	0,3

Source: PKJI 2023

1.3. Road Capacity

Capacity is a mathematical value which means the most extreme number of vehicles that can pass on a traffic lane or toll road in one lane (two directions for two-lane/direction two-flow roads) during a certain period of time under existing road and traffic conditions (7). According to PKJI 2023, capacity is the maximum flow that can pass a point on the road under certain conditions and is maintained per unit hour. The road section capacity calculation, according to PKJI 2023, is based on the following equation.

Urban Road

$$C = Co \times FC_L \times FC_{PA} \times FC_{HS} \times FC_{UK} \quad \text{.....(2)}$$

Outer City Road

$$C = Co \times FC_L \times FC_{PA} \times FC_{HS} \quad \text{.....(3)}$$

Freeway

$$C = Co \times FC_L \times FC_{PA} \quad \text{.....(4)}$$

Where:

C : Capacity (PCE/hr)
Co : Base capacity for specified conditions (ideal) (PCE/hr)
FC_L : Road width adjustment factor
FC_{PA} : Directional separation adjustment factor (only for undivided roads)
FC_{HS} : Adjustment factor for side obstacles and curbs
FC_{UK} : Adjusment factor for city size (population)

1.4. PTV Visum

PTV Visum software is used by civil engineers, particularly in the transportation sector. The modeling principle in PTV VISUM follows the developed transportation planning model, which consists of four stages: Trip Generation, Trip Distribution, Modal Split, and Trip Assignment. PTV Visum is software that excels in conducting simulations across various regions. Furthermore, PTV Visum supports road network design based on field conditions using data obtained through primary surveys on specific road sections (8).

1.5. VC Ratio

The results of the PTV Visum network modeling are traffic flows, which are then calculated to determine road density, or the VC Ratio. Based on the 2023 PKJI, the formula is as follows.

$$VCR = \frac{Q}{C} \quad \text{.....(5)}$$

Where:

VCR : Volume Capacity Ratio
Q : Traffic flow (PCE/hr)
C : Capacity (PCE/hr)

If the VCR is less than 0.75, the road section is still considered to be in good condition due to smooth traffic flow. If the VCR is greater than 0.75, the road section is considered poor or even unsuitable due to excessive traffic flow.

2. METHOD

This study analyzes the network loading or trip assignment modeling in the Cikoko LRT Station area. The analysis aims to determine the level of road service on each road segment within the 11 zones studied, based on the traffic flow and capacity parameters. The method used in this loading analysis refers to the Indonesian Road Capacity Guidelines (PKJI) 2023 for traffic flow calculations and the User Equilibrium Method for trip assignment modeling in PTV Visum software.

2.1 Research Object

The location of this research was conducted at the Cikoko LRT Station located at Jl. MT Haryono No. 36, RT.3/RW.2, Cikoko, Pancoran, South Jakarta (Zone 4). The zones studied were 11 zones with a coverage of Jabodetabek, which is the movement limit on each road segment. With 10 internal zones and 1 external zone. This research is a combination of various cities in Jabodetabek (DKI Jakarta, Bogor, Depok, Tangerang, and Bekasi) which are connected by their road segments. From the road segments assigned to each zone, an analysis of the level of service was carried out to determine which roads are suitable and which are not. A map of the zones studied can be seen in Figure 1.

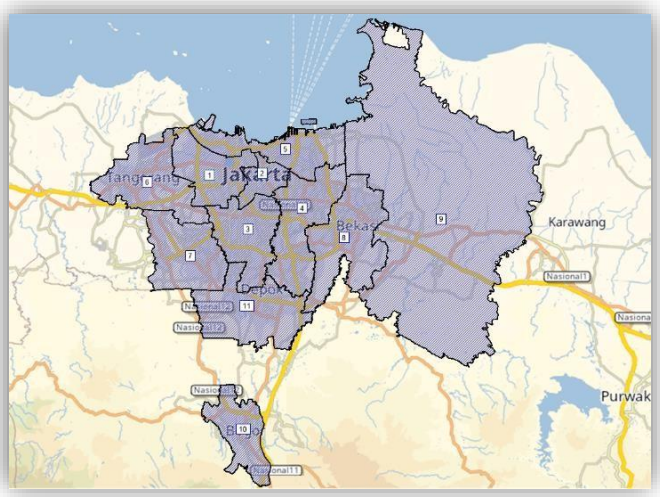

Figure 1. Zone's Map

2.2 Research Data

Theoretically, travel is related to community activities. The initial approach to data collection is to focus on the origin and destination of the trip, rather than the type of activity. However, information on traffic flow on specific road sections within the road network can be used as initial input in this model. This study utilized primary and secondary data. Primary data included traffic flow information obtained from the projections of respondents at Cikoko LRT Station, who filled in the movement patterns between zones, for example from zone 1 to zone 2, zone 1 to zone 3, and so on. Meanwhile, secondary data was collected from various institutions in the Greater Jakarta area through official websites, which included administrative maps, road network data and maps, road section information, population, and land use data. Of the 11 zones studied, 48 road sections were obtained connecting all zones to Cikoko LRT Station.

3. RESULT AND DISCUSSION

3.1 Traffic Flow

The traffic flow obtained from the survey has been converted into PCE/hr units. Vehicle speed data was taken for each vehicle type, namely Motorcycles (MC), Light Vehicles (LV), and Heavy Vehicles (HV). Vehicle free flow speed data in 50-60 km/hr (depends on each road width) is input in the PTV VISUM software.

Table 2. Traffic Flow PCE/hr

Zone	Road Name	Type of Road	LV	MC	HV	Total Flow
			1	0.3	1.3	pce/hr
Jakarta Pusat	Jl. Jendral Sudirman	8/2-T	3998	960	1039	5997
	Jl. Perintis Kemerdekaan	8/2-T	5517	1324	1434	8276
	Jl. Letjen Suprapto	6/2-T	3149	756	819	4723
	Jl. Jenderal Ahmad Yani	6/2-T	2699	648	702	4048
	Jl. Medan Merdeka Selatan	8/2-T	2639	633	686	3958
	Jl. M.H. Thamrin	8/2-T	3498	840	909	5247
Jakarta Barat	Jl. S. Parman	6/2-T	8317	1996	2162	12475
	Jl. Prof. Dr. Latumeten	8/2-T	5683	1364	1478	8525
Jakarta Utara	Jl. Yos Sudarso	6/2-T	1464	351	381	2196
	Jl. Pluit Selatan Raya	6/2-T	452	108	118	678
	Jl. Jembatan tiga	8/2-T	90	22	23	135
	Jl. Jembatan dua	8/2-T	256	61	67	384
	Jl. Cakung - Cilincing	6/2-T	4237	1017	1102	6356
Jakarta Timur	Jl. Halim Perdana Kusuma	4/2-T	667	160	173	1001
	Jl. D.I. Panjaitan	6/2-T	2184	524	568	3275
	Jl. Bekasi Raya	8/2-T	4064	975	1057	6096
	Jl. Mayjen Sutoyo	8/2-T	849	204	221	1274
	Jl. Dewi Sartika	4/2-T	930	223	242	1395
	Jl. Raya Pd. Gede	2/2-TT	1203	289	313	1805
	Jl. Raya Bogor Cililitan	8/2-T	14074	3378	3659	21111
Jakarta Selatan	Jl. M.T. Haryono	8/2-T	2528	607	657	3791
	Jl. Gatot Subroto	6/2-T	11324	2718	2944	16985
	Jl. Kebayoran Lama	4/2-T	5797	1391	1507	8695
	Jl. Metro Pondok Indah	6/2-T	11526	2766	2997	17289
	Jl. Ciputat Raya	4/2-T	6740	1618	1752	10110
	Jl. TB. Simatupang	4/2-T	13885	3332	3610	20828
	Jl. Kapten Tendean	4/2-T	8089	1941	2103	12133
	Jl. H. R. Rasuna Said	8/2-T	11639	2793	3026	17458
Kota Tangerang	Jl. Daan Mogot	6/2-T	6333	1520	1647	9500
	Jl. HOS. Cokroaminoto	4/2-T	2667	640	693	4000
Kota Tangerang Selatan	Jl. Pahlawan	2/2-TT	2342	562	609	3512
	Jl. LLRE. Martadinata	2/2-TT	1539	369	400	2308
	Jl. Ir. H Juanda	4/2-T	5620	1349	1461	8429
Kota Bekasi	Jl. Kalimalang	4/2-T	7497	1799	1949	11245
	Jl. Sultan Agung	4/2-T	2153	517	560	3229
	Jl. I Gusti Ngurah Rai	4/2-T	10159	2438	2641	15239
	Jl. Raya Jatiwaringin	4/2-T	3691	886	960	5536
Kabupaten Bekasi	Jl. Diponegoro	2/2-TT	1223	293	318	1834
	Jl. Sersan Aswan	2/2-TT	712	171	185	1068

Zone	Road Name	Type of Road	LV	MC	HV	Total Flow
			1	0.3	1.3	pce/hr
	Jl. Raya Setu	2/2-TT	3065	736	797	4598
Kota Bogor	Jl. Raya Cilebut	2/2-TT	3109	746	808	4664
	Jl. Raya Jkt - Bogor	4/2-T	10401	2496	2704	15602
	Jl. Raya Bojong Gede	2/2-TT	3990	957	1037	5984
Kota Depok	Jl. Cinere Raya	4/2-T	4869	1168	1266	7303
	Jl. Karang Tengah Raya	4/2-T	2390	574	621	3585
	Jl. Adhiyaksa Raya	4/2-T	1151	276	299	1726
	Jl. Tole Iskandar	2/2-TT	3908	938	1016	5861
	Jl. Raya Citayam	2/2-TT	5683	1364	1478	8525

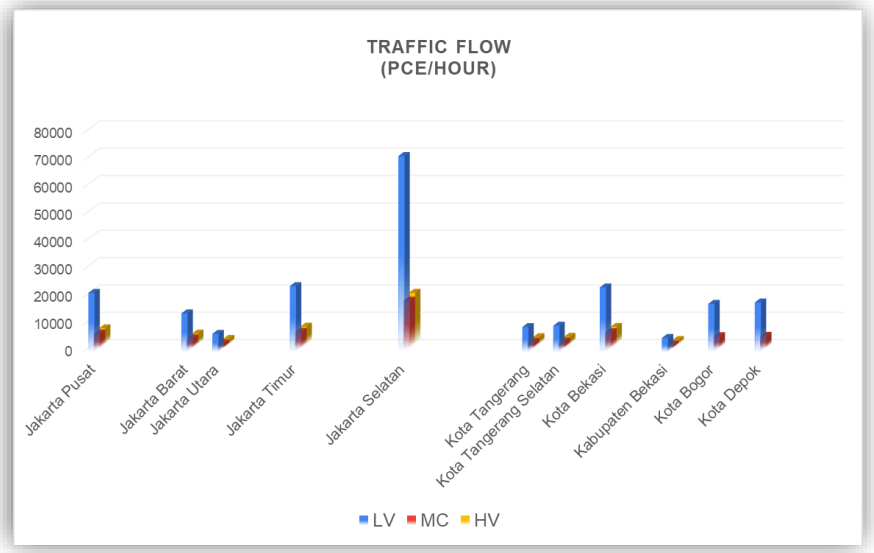

Figure 2. Traffic Flow Graphic

The traffic volume results show the densest traffic flow among the 11 zones and three vehicle types. South Jakarta is the city with the densest traffic flow, with a total of 107,288 people per hour (pce/hr).

3.2 Road Capacity Analysis

Below are the results of the road capacity analysis for roads in the 11 zones studied. The road capacity calculations are based on road characteristic data and the formulas used in the Indonesian Road Capacity Guidelines 2023.

Table 3. Road Capacity

Zone	Road Name	Road Capacity						
		Co (smp/jam)	L le (m)	FC lj	FC pa	FC hs	FC uk	C (smp/jam)
Jakarta Pusat	Jl. Jendral Sudirman	13600	4	1.08	1	0.98	0.94	13531
	Jl. Perintis Kemerdekaan	13600	4	1.08	1	1.03		14221
	Jl. Letjen Suprapto	13600	3.5	1	1	0.98		12528
	Jl. Jenderal Ahmad Yani	10200	4	1.08	1	0.98		10148
	Jl. Medan Merdeka Selatan	13600	4	1.08	1	0.98		13531
	Jl. M.H. Thamrin	13600	4	1.08	1	1.03		14221
Jakarta Barat	Jl. S. Parman	10200	4	1.08	1	1.03	1	11346
	Jl. Prof. Dr. Latumeten	13600	4	1.08	1	0.98		14394
	Jl. Yos Sudarso	10200	4	1.08	1	0.98	1	10796

Zone	Road Name	Road Capacity						
		Co (smp/jam)	L le (m)	FC lj	FC pa	FC hs	FC uk	C (smp/jam)
Jakarta Utara	Jl. Pluit Selatan Raya	10200	4	1.08	1	0.98		10796
	Jl. Jembatan tiga	5600	3.5	1	1	0.92		5152
	Jl. Jembatan dua	5600	3.5	1	1	0.92		5152
	Jl. Cakung - Cilincing	10200	4	1.08	1	0.98		10796
Jakarta Timur	Jl. M.T. Haryono	13600	4	1.08	1	0.96		14664
	Jl. Halim Perdana Kusuma	6800	3	0.92	1	0.98		6376
	Jl. D.I. Panjaitan	10200	4	1.08	1	0.98		11228
	Jl. Bekasi Raya	13600	4	1.08	1	0.98	1.04	14970
	Jl. Mayjen Sutoyo	13600	4	1.08	1	0.98		14970
	Jl. Dewi Sartika	6800	4	1.08	1	1		7638
	Jl. Raya Pd. Gede	5600	3.5	1	1	0.97		2825
	Jl. Raya Bogor Cililitan	13600	4	1.08	1	0.98		14970
Jakarta Selatan	Jl. Gatot Subroto	10200	4	1.08	1	0.98		10796
	Jl. Kebayoran Lama	6800	3	0.92	1	0.832		5205
	Jl. Metro Pondok Indah	10200	4	1.08	1	0.84		9253
	Jl. Ciputat Raya	6800	3	0.92	1	0.92	1	5756
	Jl. TB. Simatupang	6800	3	0.92	1	0.92		5756
	Jl. Kapten Tendean	6800	3	0.92	1	0.92		5756
	Jl. H. R. Rasuna Said	13600	4	1.08	1	0.92		13513
Kota Tangerang	Jl. Daan Mogot	10200	4	1.08	1	0.92	1	10135
	Jl. HOS. Cokroaminoto	6800	3.5	1	1	0.856		5821
Kota Tangerang Selatan	Jl. Pahlawan	5600	3	0.92	1	0.84		2164
	Jl. RE. Martadinata	5600	3	0.92	1	0.92	1	2370
	Jl. Ir. H Juanda	6800	3.5	1	1	0.92		6256
Kota Bekasi	Jl. Kalimalang	6800	3	0.92	1	1.03		6444
	Jl. Sultan Agung	6800	3.5	1	1	0.998	1	6786
	Jl. I Gusti Ngurah Rai	6800	3.5	1	1	1.07		7276
	Jl. Raya Jatiwaringin	6800	4	1.08	1	1.07		7858
Kabupaten Bekasi	Jl. Diponegoro	6800	3.5	1	1	0.98		6931
	Jl. Sersan Aswan	6800	3.5	1	1	0.98	1.04	6931
	Jl. Raya Setu	5600	3.5	1	1	0.995		2786
Kota Bogor	Jl. Raya Cilebut	5600	3	0.92	1	0.98		2524
	Jl. Raya Jkt-Bogor	13600	4	1.08	1	0.98	1	7197
	Jl. Raya Bojong Gede	5600	3	0.92	1	1		2576
Kota Depok	Jl. Cinere Raya	6800	3.5	1	1	1.01		6868
	Jl. Karang Tengah Raya	6800	4	1.08	1	1.01		7417
	Jl. Adhiyaksa Raya	6800	3.5	1	1	1.01	1	6868
	Jl. Tole Iskandar	5600	3	0.92	1	1		2576
	Jl. Raya Citayam	5600	3.5	1	1	1		2800

3.3 Road Service Level Analysis

The level of service for a road section is calculated by dividing the traffic flow load by the road section capacity. The traffic flow load is obtained from the results of the PTV Visum modeling. The following are the results of the PTV Visum modeling.

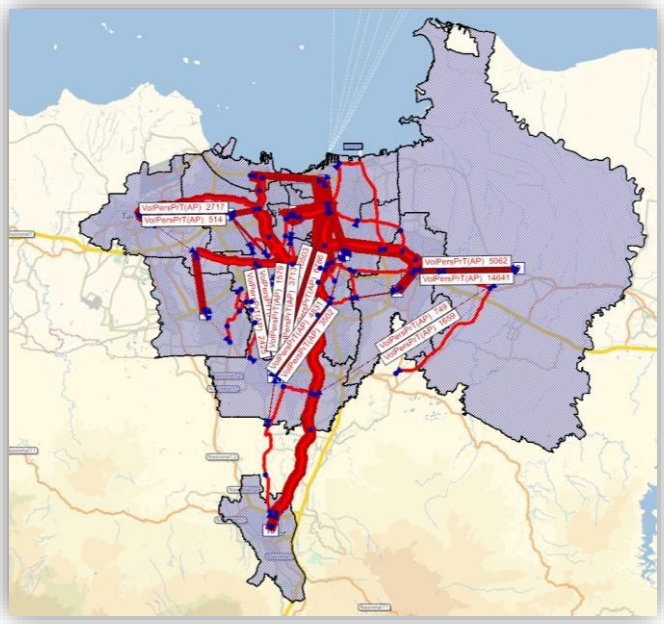

Figure 3. PTV Visum Assignment

Based on the modeling results conducted at PTV Visum, several road sections did not have loading results because the loading on these road sections was too small or even non-existent. Therefore, the level of service of the road sections that can be passed from/to the origin zone to the destination zone was calculated.

Table 4. Road Network Performance

Zone	Road Name	Type of Road	V	C	VCR	LOS
Jakarta Pusat	Jl. Perintis Kemerdekaan	8/2-T	7508	14221	0.53	Very Good
	Jl. Letjen Suprapto	6/2-T	9200	12528	0.73	Good
	Jl. Jenderal Ahmad Yani	6/2-T	5520.028	10147.9	0.54	Very Good
	Jl. Medan Merdeka Selatan	8/2-T	324	13531	0.02	Very Good
Jakarta Barat	Jl. S. Parman	6/2-T	8040	11346	0.71	Good
	Jl. Prof. Dr. Latumeten	8/2-T	7384	14394	0.51	Very Good
Jakarta Utara	Jl. Pluit Selatan Raya	6/2-T	7384	10796	0.68	Good
	Jl. Jembatan tiga	8/2-T	4660	5152	0.90	Bad
	Jl. Jembatan dua	8/2-T	4660	5152	0.90	Bad
Jakarta Timur	Jl. D.I. Panjaitan	6/2-T	7161	11228	0.64	Buruk
	Jl. Bekasi Raya	8/2-T	7508	14970	0.50	Very Good
	Jl. Mayjen Sutoyo	8/2-T	11951	14970	0.80	Not Good
	Jl. Raya Bogor Cililitan	8/2-T	11951	14970	0.80	Not Good
Jakarta Selatan	Jl. M.T. Haryono	8/2-T	11871	14664	0.81	Not Good
	Jl. Gatot Subroto	6/2-T	8040	10796	0.74	Good
	Jl. Kapten Tendean	4/2-T	2546	5756	0.44	Very Good
Kota Tangerang	Jl. Daan Mogot	6/2-T	4195	10135	0.41	Very Good
	Jl. HOS. Cokroaminoto	4/2-T	2546	5821	0.44	Very Good
Kota Tangerang Selatan	Jl. LLRE. Martadinata	2/2-TT	2325	2370	0.98	Bad
Kota Bekasi	Jl. Sersan Aswan	4/2-T	6029	6931	0.87	Not Good
	Jl. I Gusti Ngurah Rai	4/2-T	2891	7276	0.40	Very Good
Kabupaten Bekasi	Jl. Diponegoro	2/2-TT	6058	6931	0.87	Not Good

Zone	Road Name	Type of Road	V	C	VCR	LOS
Kota Bogor	Jl. Raya Jkt - Bogor	4/2-T	6882	7197	0.96	Bad
Kota Depok	Jl. Tole Iskandar	2/2-TT	1169	2576	0.45	Very Good

4. CONCLUSION

Based on the analysis of road network loading in 11 zones conducted in 2025 for each road segment, the following conclusions can be drawn:

1. 1. Not all road segments are loaded in the 11 zones studied. Only 24 of the 48 road segments are loaded as connecting roads between the 11 zones.
2. 2. The level of service on the roads leading to/from the Cikoko LRT Station is already in poor condition. Therefore, modeling for these road segments is required for the planning year.
3. 3. The existing traffic density is inadequate for the expected traffic flow. However, some roads, such as those in Central Jakarta and North Jakarta, are already adequate for their capacity.

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