FEASIBILITY STUDY OF PARK AND RIDE IN *ALUN-ALUN* BEKASI CITY

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ABSTRACT

The efforts of the Bekasi City government to reduce congestion and make it easier for the community to mobilize to DKI Jakarta by implementing the Park and Ride concept, in this case the Bekasi City government plans to build a Park and Ride facility in the Bekasi City square. This research was conducted to determine the feasibility level of the Park and Ride development plan in the Bekasi City square and also to obtain an overview of the existing results of the traffic conditions in the Bekasi City square area (PMI Tennis Court). The traffic counting survey and interviews were conducted at Bekasi Station, on Jalan Ir. H Juanda, Jalan Perjuangan, Jalan Pramuka and Jalan Veteran which are then processed using Microsoft Excel to find out the maximum demand from Park and Ride, namely 1527 motorbikes and 308 units of cars, the economic feasibility level of the Park and Ride building shows an IRR of 3.4% , the NPV value > 1 is IDR 102,280,883,874.40 and BCR is 1.37. With a prediction of a building length of 25 years, while for roads that become accessibility for vehicles to and from the Park and Ride building, the lowest level of service occurs on Veteran and Pramuka roads, with service levels F and E. This proves that traffic engineering is necessary and increasing road capacity, to and from Park and Ride, with pedestrian access and bicycle lanes (to improve road performance).

Keywords: feasibility study; park and ride; bekasi city square.

INTRODUCTION

Bekasi City is a partner for the city of DKI Jakarta, which is currently developing quite rapidly as an urban area, relying on the service and trade sectors. With an area of ± 21,049 km2 and a total population of 3.8 million people (Bekasi City Central Bureau of Statistics, 2020), some residents of Bekasi City are commuters to DKI Jakarta for work, school or shopping, while others are users of private vehicles. in their daily activities. There are still many Bekasi City residents who use private vehicles in their activities, making traffic jams unavoidable. One of the government's efforts to reduce congestion and make it easier for the community to mobilize to DKI Jakarta is by implementing the Park and Ride concept (parking and driving), in this case the Bekasi City government plans to make Park and Ride facilities in the Bekasi station area. Due to the double track work in the Bekasi station, there was no parking space inside the station and it was replaced by a double track for the land inside, while the Park and Ride facilities to be made were moved outside the station to be precise in the Bekasi City square (PMI Tennis Court). Bekasi City Square has a land area of 4,333 m2 which has a distance of about 850 m from the Bekasi station which passes Ir H Juanda street, Perjuangan street, Pramuka street and Veteran street. The provision of Park and Ride facilities in the Bekasi City square is expected to be able to encourage private vehicle users, especially road users who travel to DKI Jakarta, to switch modes using public transportation by parking their private vehicles at the Park and Ride facilities.

In handling parking, good cooperation between parking managers and field conditions is needed. Motor vehicle speed is directly related to road conditions (Akbardien.et.al, 202; Syaiful.S, 2017; Syaiful.S, 2020; Syaiful.S, Akbardin.J, 2020). The condition of the road matters. Parking of vehicles on the side of the road affects the speed so that the accumulation of vehicles at one point will be very pronounced. So that a good parking is to carry out parking activities and passenger up and down activities in the places that have been provided (Syaiful.S, 2020; Syaiful.S, 2021; Syaiful.S, Andana.R, 2021; Syaiful.S, Elvira.Y, 2017; Syaiful.S, Fadly.A, 2020; Syaiful.S, Hariyadi.D, 2019). The parking space that has been provided will become a comfortable parking

area if the road surface conditions in the area support it. So whether or not the surface of the parking lot depends on the basic material. Parking areas with pavement and parking areas with reinforced concrete reinforcement will produce different levels of comfort. This comfort will be felt when the passenger of the motorized vehicle is in the vehicle (Syaiful.S, Hariyadi.D 2020; Syaiful.S, Mudjanarko.S.W, 2019; Syaiful.S,et.al, 2020; Syaiful.S, Sutarsa.S,2020; Syaiful.S, Pratama.Y, 20219; Syaiful.S, Yuliantino.M, 2017; Syaiful.S, Wahid.N, 2020).

Park and Ride

Park and ride or in Indonesian, parking and riding is the activity of parking in a private vehicle and then continuing the journey using mass public transportation such as trains or buses, Park and ride is a term used for a place to change modes from private vehicles to public transportation, where ample parking is available (Vuchic, VR, 1976,).

Road Section Performance Parameters

In evaluating urban traffic problems, it is necessary to review the functional classification and system of the existing road links. The classification based on the function of urban roads is differentiated between arterial, collector, and local roads, while the classification based on the network system consists of primary and secondary roads (Directorate of City Road Development, Number 10 / BNKT / 1991 concerning 'Classification of Urban Road Networks'). Performance for urban roads can be assessed using the following traffic parameters:

• VCR (Volume Capacity Ratio)

• Average Travel Speed

• Service Level

The Service Level Indicator on a road shows the overall condition of the road segment. Service levels are determined based on quantitative values such as: VCR,

Travel speed, and based on qualitative values such as the driver's freedom to move / choose the speed, degree of traffic resistance, and comfort.

RESEARCH METHODS

The location of this research was conducted in the city square of Bekasi. The research period was carried out for 4 months from November 2020 to February 2021.
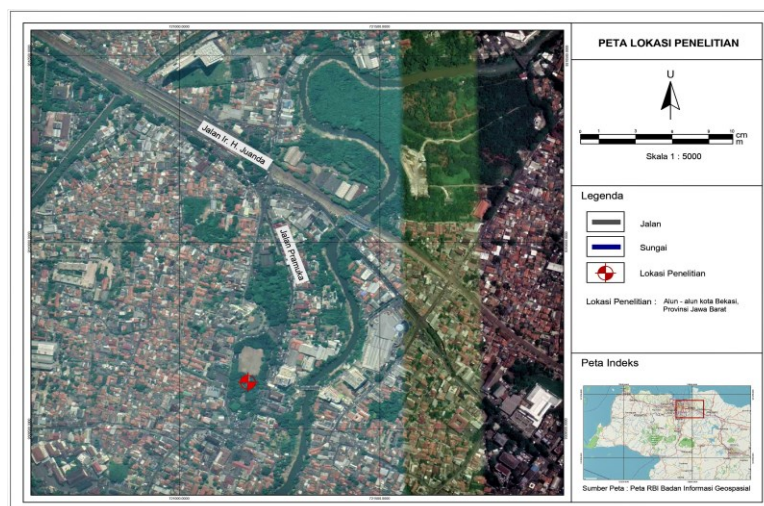
Figure 1. Research location

The stages of this research are shown in the form of a flow chart as follows:
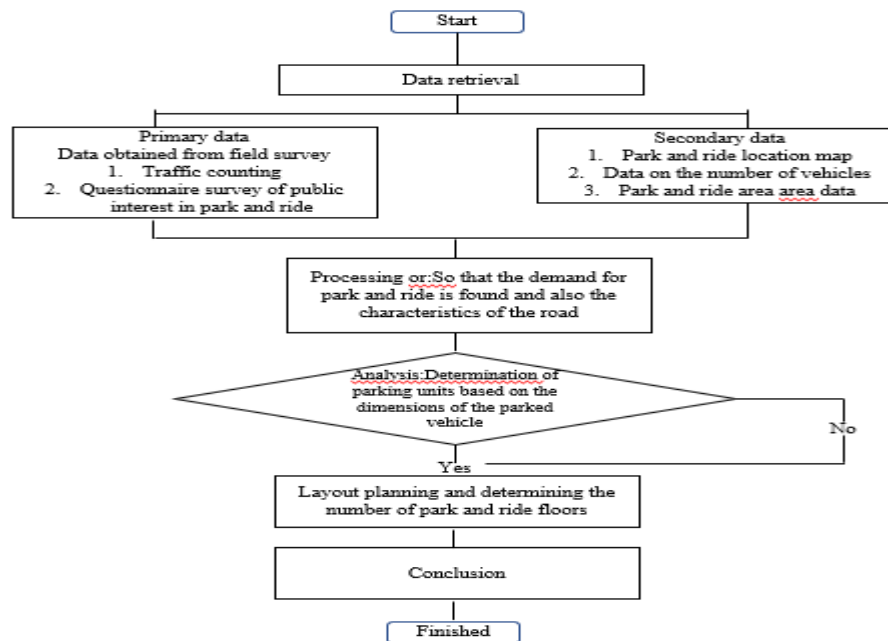
Figure 2. Research location

RESULTS AND DISCUSSION

Survey Results

The results of the accumulated Parking for the two zones at the Bekasi Station are described in the following table:

Table 1. Accumulated Parking Results for the two zones at Bekasi Station

Execution time	Total in and out of the vehicle					
	Car			Motorcycle		
	Accumulation	In	Out	Accumulation	In	Out
06:00-07:00	34	37	3	273	287	14
07:00-08:00	57	29	6	489	228	12
08:00-09:00	88	37	6	685	218	22
09:00-10:00	106	27	9	819	155	21
10:00-11:00	131	33	8	952	156	23
11:00-12:00	141	26	16	1039	130	43
12:00-13:00	**141**	**25**	**25**	**1112**	**119**	**46**
13:00-14:00	137	22	26	1102	52	62
14:00-15:00	135	22	24	1061	42	83
15:00-16-00	125	14	24	974	44	131
16:00-17:00	107	15	33	834	36	176
17:00-18:00	76	8	39	622	27	239
18:00-19:00	57	11	30	410	20	232
19:00-20:00	45	6	18	257	12	165
20:00-21:00	32	4	17	181	10	86
Total	**1412**	**316**	**284**	**10810**	**1536**	**1355**

Parking Capacity

The parking capacity calculation is based on the guidelines of the Directorate General of Land Transportation which are stated as the following table:

Table 2. Parking Capacity

Allotment	SRP (Unit for passenger cars)	Parking space requirement
Trading center		
Shops	SRP/100 m² effective floor area	3,5 – 7,5
Supermarkets	SRP/100 m² effective floor area	3,5 – 7,5
Supermarkets	SRP/100 m² effective floor area	3,5 – 7,5
Office center		
Non-public service	SRP/100 m² effective floor area	1,5 – 3,5
Public service	SRP/100 m² effective floor area	1,5 – 3,5
School	SRP /student	
Apartment / Lodging	SRP/ room	
Hospital	SRP/bed	
Cinema	SRP/seat	
No	building type	
1	station parking	
	Station parking space requirements	
No	SRP	number of parking spaces (SRP)
1	public facilities station coefficient 1.5	701,25
Motorbike parking capacity		1608
car parking capacity		244

Table 2 shows the parking capacity as follows:

• Two-wheeled vehicle capacity (motor) = 1608 units

☐ Parking Index: 1.38

☐ Parking Turn Over; 0.95

• Four-wheeled vehicle capacity (car) = 244 Units

☐ Parking Index; 2.24

☐ Parking Turn Over: 1.29

Estimated Income

This income estimate aims to find out the estimated annual income, the income estimate is obtained from a survey of car and motorcycle user preferences, the maximum rate for cars is 16 thousand rupiah with a percentage of 63% and for motorbikes the maximum is 5 thousand rupiah with a percentage of 68%, whereas for the second scenario the parking rate is taken from the lowest rate, the following is a table of annual revenue estimates for scenario 1 and scenario 2:

Table 3. Estimated annual revenue for scenario 1

No	Type	Volume	Unit price (IDR)	Time	Unit	Income
1	Motorcycle parking	1983	5.000	360	day	3.569.400.000
2	Car Parking	308	16.000	360	day	1.774.080.000
3	Retail Land Rental	5	50.000.000	1	year	250.000.000
4	Food Court Area Rental	10	50.000.000	1	year	500.000.000
	Total					**6.093.480.000**

Table 4. Estimated annual revenue for scenario 2

No	Type	Volume	Unit price (IDR)	Time	Unit	Income
1	Motorcycle parking	1983	2.000	360	day	1.427.760.000
2	Car Parking	308	5.000	360	day	554.400.000
3	Retail Land Rental	5	50.000.000	1	year	250.000.000
4	Food Court Area Rental	10	50.000.000	1	year	500.000.000
	Total					**2.732.160.000**

Estimated Costs of Operations

There are several aspects of the estimated cost for operating a parking building, namely the cost of employee salaries, electricity costs, maintenance costs. The following is a table of estimated annual expenses:

Table 5. Annual expenditure

No	Operational Cost	Volume	Unit price (IDR)	Time	Unit	Income
1	Officer Salary	12	3.700.000	12	month	532.800.000
2	Electricity Usage	132	1.645	4320	hour	937.771.085
3	Treatment Allocation	1320	70.000	1	year	92.400.000
	Total					**1.562.971.085**

From table 5. It shows that the number of employees needed is 12 people with a system of dividing the work hours of 6 people at 08: 00-15.00 and the next 6 people at 15: 00-22: 00. It is estimated that electric power uses a lamp with 20 watts and one lamp is installed for each 10 m2 lamp size. In a day it is assumed that it is turned on for 5 hours. Meanwhile, the building maintenance costs are 70,000 per year per 10 m2. The following is a table of estimates of spending on the construction of a park and ride building.

Table 6. Estimated Expenditures for Park and Ride Building Construction

1	Land Area	4.333,00	m2
	Building coverage Area	0,80	
2	Building Area		
	Motorcycle Parking	3.928,00	m2
	Car Parking	4.100,00	m2
3	No of Tower	1,00	tower
4	No of Unit/Floor	1,00	unit
5	No of Floor	5,00	floor
6	Tot. GFA	17.330,00	m2
7	Tot No of Unit	5,00	unit
8	Avr Unit Size	2.560,00	m2
9	Motorcycle/Floor	1.075,25	Unit
	Cat/Floor	148,25	
10	Tot No of Vehicle	6.117,50	pax
11	Land Value	12.000,00	/m2
12	Project Dev't Phase	2,00	year
13	Project Age	25,00	year
14	Building Cost	4.000.000	/m2
15	Total Building Cost	69.320.000.000	IDR

NVP, BCR and IRR Scenarios

This economic analysis is based on the assumption that the discount rate or loan interest rate is 10%, and the rate set in the initial year is the preferential rate which is then increased by IDR 500 per year and for the economic life of the building it is assumed to be 25 years, here is the table of results of the IRR, NVP, and BCR scenario 1 and scenario 2.

Table 9. IRR, NPV, and BCR Scenario 1

IRR	3,4%
NPV	IDR 102.280.883.874,40
BCR	1,37

Table 10. IRR, NPV, and BCR Scenario 2

IRR	-1,4%
NPV	IDR 56,511,363,688,51
BCR	0,85

From tables 9 and 10. Shows that the results of NPV ≥ 1, IRR ≥ Loan interest rates at banks, BCR ≥ 1, then the results of the economic analysis for the first scenario meet the above criteria with an IRR of 3.4%, NPV more than 1 and BCR of 1.37.

Road Section Capacity Calculation

The calculation of the capacity of the road sections is obtained from data based on the Indonesian Highway Capacity Manual (MKJI. 2017). The following are the results of capacity calculations for the road network around the Bekasi station:

Table 11. Inventory Data and Calculation of Road Capacity

No	Road	Road body width	Type	Side resistance type	Capacity (smp/hour)
1	Jl. Ir. Juanda 1 (Intersection Juanda - Intersection Sudirman)	12	4/2 UD	High	3692
2	Jl. Perjuangan (Intersection Juanda- Intersection Pintu Air)	9	2/2 UD	Medium	3444
3	Jl. Ir. Juanda 2 (Intersection Juanda - Intersection Mayor Oking)	12	4/2 UD	Medium	3692
4	Jl. Pramuka (Intersection Juanda- Intersection Veteran)	6	½	Low	2680
5	Jl. Veteran (Intersection Juanda- Intersection Mayor Mahmud Hasibuan)	8	½	Medium	3357

From table 11. It shows that the type of side obstacle that is highest is on Jalan Ir. Juanda 1 with a capacity (pcu / hour) of 3692 and an undivided four-lane two-way road.

Table 12. Service Level Categories Before the Park Ride building was built and after the Park and Ride building was built

No	Road	Before built				After built			
		Total	Capacity	VCR	LOS	Ttotal	Capacity	VCR	LOS
1	Jl. Ir. Juanda 1 (Intersection Juanda - Intersection . Sudirman)	2.647	5404	0,49	C	2.727	5.404	0,50	C
2	Jl. Perjuangan (Intersection Juanda- Intersection Pintu Air)	2.172	3190	0,68	C	2.237	3.190	0,70	C
3	Jl. Ir. Juanda 2 (Intersection Juanda - Intersection Mayor Oking)	2.933	5343	0,55	C	3.022	5.343	0,57	C
4	Jl. Pramuka (Intersection Juanda- Intersection Veteran)	1.094	2481	0,44	B	3.087	2.481	1,24	F
5	Jl. Veteran (Intersection Juanda- Intersection Mayor Mahmud Hasibuan)	899	3110	0,29	B	2.886	3.110	0,93	E

From table 12, it shows that if the Park and Ride building is built, the lowest level of service occurs on Veteran and Pramuka roads, with service levels F and E.

CONCLUSION

From the results of the projected increase in Bekasi City vehicles, namely motorbikes by 5% and 3% cars as well as data on potential Park and Ride users obtained from the interview survey, the maximum demand for Park and Ride is 1527 motorbikes and 308 cars. From the calculation of the results of the analysis of the economic feasibility of the park and ride building, the IRR is 3.4%, the NPV value > 1 is IDR 102,280,883,874.40 and the BCR is 1.37. With a prediction of 25 years old building. Based on VCR analysis on roads that become accessibility for vehicles to and from the Park and Ride building, if the Park and Ride building is built, the lowest level of service occurs on Veteran and Pramuka roads, with service levels F and E.

REFERENCES

Ahmad Munawar. (2004), "Manajemen lalu lintas Perkotaan". Yogyakarta: Penerbit Betta Offset. (Indonesian).

Akbardin J., Parikesit D., Riyanto B., Mulyono A. T. & Syaiful S. 2020. Modeling of trips assignment analysis for roads network system based on transportation needs of export commodity. ARPN Journal of Engineering and Applied Science. 15(21): 2463-2470. http://www.arpnjournals.org/jeas/research_papers/rp_2020/jeas_1120_8379.pdf

Badan Pusat Statistik Kota Bekasi. (2020), Statistik Sosial dan Kependudukan 2020. Kota Bekasi: Badan Pusat Statistik. (Indonesian).

Departemen Perhubungan. (1998). "Pedomana dan pengoprasian fasilitas Parkir", Direktorat Bina Sistem Lalu Lintas Angkutan Kota, Direktorat Jendral Perhubungan Darat, Jakarta. (Indonesian).

Departemen Perhubungan. (1996), "Pedomana dan pengoprasian fasilitas Parkir", Direktorat Bina Sistem Lalu Lintas Angkutan Kota, Direktorat Jendral Perhubungan Darat, Jakarta. (Indonesian).

Direktorat Jendral Bina Marga. (1997), "Manual Kapasitas Jalan Indonesia (MKJI) (jalan perkotaan)", Sweroad dan PT. Bina Karya, Jakarta. (Indonesian).

Direktorat Pembinaan Jalan Kota. (1990), "Klasifikasi Jaringan Jalan Perkotaan (No.10/BNKT/1991)". Direktorat Jendral Bina Marga Departemen PU. Jakarta. (Indonesian).

Farhan, B. (2003), "Evaluation, Modeling and Policy Assesment for Park and ride Services as a Component of Public Transportation".Unpublished Disertation . Ohio State University.

Joseph De Chiara dan Lee E. Koppelman. (1975), "Standar Perencanaan Tapak", New Work.

Noel, R. (1998), Park-and-ride: Alive, Well, and Expanding in the United States. Urban Planing an Devel,. ASCE, 114 (1), 2-13.

Syaiful S. 2017. Engineering model of traffic and transportation safety with pattern of cooperation between sustainable region in Bogor, MATEC Web Conf., 138 (2017) 07008 DOI: https://doi.org/10.1051/matecconf/201713807008

Syaiful S. 2020. Analysis of Motorized Vehicle Sound Pollution in front of Mall Yogya Plaza Bogor, International Journal Of Scientific & Technology Research 9 (8), pp 400-405. https://www.ijstr.org/final-print/aug2020/Analysis-Of-Motorized-Vehicle-Sound-Pollutionin-Front-Of-Mall-Yogya-Plaza-Bogor.pdf

Syaiful S. 2020. Analysis on the Addition of Fiber the Strong Bending Mixed Concrete, ARPN Journal of Engineering and Applied Science. 15(6): 724-729. http://www.arpnjournals.org/jeas/research_papers/rp_2020/jeas_0320_8152.pdf

Syaiful S. 2021. Additional Betonmix To Increase The Strength Of Concrete Press. ARPN Journal of Engineering and Applied Science. 16(15): 1583-1589. http://www.arpnjournals.org/jeas/research_papers/rp_2021/jeas_0821_8652.pdf

Syaiful S. & Akbardn J. 2020. Civil Engineering Students' Conceptual Understanding On Centrifugal Force Implementation Through Geometrical Design Of Inter-City Road In Indonesia. International Journal Of Scientific & Technology Research 9 (10), pp 345-349. https://www.ijstr.org/final-print/oct2020/Civil-Engineering-Students-Conceptual-Understanding-On-Centrifugal-Force-Implementation-Through-Geometrical-Design-Of-Inter-city-Road-In-Indonesia.pdf

Syaiful S. & Andana R. 2021. Passenger Car Speed Assessment Relationship To The Noise Caused. Astonjadro: Jurnal Rekayasa Sipil 10 (1), pp 41-49. http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO/article/view/3494

Syaiful S. & Elvira Y. 2017. Case Study On Use Area Parking At New Market City Shopping Center Bogor. IJTI (International Journal Of Transportation And Infrastructure), 1(1), 34-40. Retrieved from http://jurnal.narotama.ac.id/index.php/ijti/article/view/330

Syaiful S. & Fadly A. 2020. Analysis Of The Effectiveness Of Bus Services Outside Of Campus IPB Dramaga Bogor. Astonjadro: Jurnal Rekayasa Sipil 9 (2), pp 173-186. http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO/article/view/3597

Syaiful S & Hariyadi D. 2019. Case Study on Sustainable T-Jungtion Cibinong City Mall (CCM) in Bogor Indonesia. ARPN Journal of Engineering and Applied Science. 14(17): 2960-2971. http://www.arpnjournals.org/jeas/research_papers/rp_2019/jeas_0919_7895.pdf

Syaiful S. & Lasmana L. 2020. Study about level of railway road damage railways with sustainable PCI method, ARPN Journal of Engineering and Applied Science. 15(8): 962-968. http://www.arpnjournals.org/jeas/research_papers/rp_2020/jeas_0420_8184.pdf

Syaiful S. & Mudjanarko S. W. 2019. Noise of Motor Vehicles at from of Baiturrahman Great Mosque Semarang City, The Spirit Of Society Journal, 2 (2) March 2019. https://jurnal.narotama.ac.id/index.php/scj/article/view/902

Syaiful S., Prayoga H. & Akbardin J. 2020. Sustainable About The Need Of Parking Systems At The Mall RDS Bogor. ARPN Journal of Engineering and Applied Science. 15(22): 2620-2626. http://www.arpnjournals.org/jeas/research_papers/rp_2020/jeas_1120_8397.pdf

Syaiful S. & Sutarsa S. 2020. Analysis of Sustainable Financial Investment Feasibility Study on Housing Casase Cetrene. Proceeding of the 5th NA International Conference on Industrial Engineering and Operations Management Detroit, Michigan, USA, August 10 - 14, 2020, pp 3631-3639. http://www.ieomsociety.org/detroit2020/papers/716.pdf

Syaiful S & & Pratama Y. 2019. Sustainable Studies about General Public Transport Performance in the City of Bogor. ARPN Journal of Engineering and Applied Science. 14(18): 3241-3247. http://www.arpnjournals.org/jeas/research_papers/rp_2019/jeas_0919_7925.pdf

Syaiful S. & Yuliantino M. 2017. The Study Of Land Parking Mall Bogor Indah Plaza. Proceedings of the Conference on Global Research on Sustainable Transport (GROST 2017) ISSN: 2352-5401, volume: 147 ISBN 978-94-6252-449-1. doi:10.2991/grost-17.2018.25 p. 286-303. https://www.atlantispress.com/proceedings/grost-17/25889389

Syaiful S. & Wahid N. 2020. A Study Of The Density Of Motor Vehicles In Front Of Hospital Bunda Margonda Depok Against Noise Pollution, The Spirit Of Society Journal 3 (2), pp 45-67. https://jurnal.narotama.ac.id/index.php/scj/article/view/1094

Tamin, O.Z, dan Nahdalina. (1998), Analisis Dampak Lalu Lintas (Andall). Jurnal Perencanaan Wilayah dan Kota, Jurusan Perencanaan Wilayah dan Kota ITB, Vol 9, No 3, hal 22–40, September 1998, ISSN: 0853–9847. (Indonesian).

Tamin, O.Z. (2008), "Perencanaan, Pemodelan dan Rekayasa Transportasi: Teori, Contoh Soal, dan aplikasi". Bandung: ITB Bandung. (Indonesian).

Vuchic, V.R. (1976), "Urban Public Transportation Systems and Technology, Prentice-Hall, Englewood Cliffs", New Jersey.

Warpani, P. Suwardjoko. (2002), "Pengelolaan Lalu Lintas dan Angkutan Jalan". Bandung: Penerbit ITB. (Indonesian).

Warpani, Suwardjoko. (1990), "Merencanakan Sistem Perangkutan. Bandung": Penerbit ITB. (Indonesian).